# Nevada Quality Assurance Program Plan for Surface Water Sampling

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NEVADA DIVISION OF ENVIRONMENTAL PROTECTION



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#### **ABBREVIATIONS AND ACRONYMS**

The following abbreviations and acronyms appear throughout this document; abbreviations and acronyms used in tables and figures are defined in the accompanying footnotes.

ASTM	American Society for Testing and Materials
ATV	All-terrain vehicle
BSDW	Bureau of Safe Drinking Water
BWQP	Bureau of Water Quality Planning
CFR	Code of Federal Regulations
СРР	Continuing Planning Process
CWA	Clean Water Act
DO	Dissolved oxygen
DQI	Data quality indicator
DQO	Data quality objective
E. coli	Escherichia coli
EPA	United States Environmental Protection Agency
GPS	Global positioning system
MDL	Method detection limit
mg/L	Milligrams per liter
μg/L	Micrograms per liter
MMI	Multimetric indices
MQO	Measurement quality objective
NAC	Nevada Administrative Code
NDEP	Nevada Division of Environmental Protection
NIST	National Institute of Standards and Technology
NPDES	National Pollutant Discharge Elimination System
NRS	Nevada Revised Statutes
PCBs	Polychlorinated biphenyls
QA	Quality assurance
QA/QC	Quality assurance and quality control
QC	Quality control
RPD	Relative percent difference
SNWA	Southern Nevada Water Authority
SOP	Standard operating procedure
SVOC	Semivolatile organic compound
TDS	Total dissolved solids
TMDL	Total maximum daily load
USGS	United States Geological Survey
VOC	Volatile organic compound

# 1.0 Mission and Policy

The mission of the Nevada Division of Environmental Protection (NDEP) is to protect and enhance the environment of the State of Nevada in order to protect public health, sustain healthy ecosystems, and contribute to a vibrant economy. To accomplish this mission, the Bureau of Water Quality Planning (BWQP) implements programs to meet requirements of the Clean Water Act (CWA) and State water quality laws and regulations contained in the Nevada Revised Statutes (NRS) 445A.300 – 445A.730 and Nevada Administrative Code (NAC) 445A.070 – 445A.2234 and NAC 445A.305 – 445A.340.

BWQP conducts programs to monitor surface-water quality, establish and update water quality standards, calculate and monitor total maximum daily loads (TMDLs), assess waterbody quality, produce the CWA Section 303(d)/305(b) Integrated Report, perform watershed planning, provide strategies to manage pollution derived from nonpoint sources, and conduct environmental education. The overall quality policy of NDEP and BWQP is to ensure activities are conducted according to adequate quality management principles and practices. Adhering to these principles and practices provides reasonable assurance that environmental data generated are of sufficient quality and quantity for the intended use.

The Nevada *Quality Assurance (QA) Program Plan for Surface-Water Sampling* establishes specific quality requirements for the collection and management of data that are used to support BWQP management programs. This QA program plan contains elements of overall management of surface-water quality monitoring programs, and establishes quality requirements for collection and analysis of surface-water samples. Specifically, the QA program plan describes procedures for collecting field data, preparing sample chain-of-custody, conducting laboratory analysis, and reporting analytical results. The policies and procedures contained in the QA program plan ensure that water quality data collected by BWQP will be of known quality. Quality data provide a solid foundation for effective management of Nevada's surface-water resources.

BWQP staff have access to, and must comply with, the requirements described in this QA program plan. The approved QA program plan is available on the BWQP website at the following link: <u>https://ndep.nv.gov/uploads/documents/QAPrP\_Final\_Feb2020.pdf</u>. Contractors who collect waterquality data must follow the procedures described in this document, or otherwise provide sufficient quality assurance and quality control (QA/QC) information to ensure that the data they collect meet the quality requirements described herein. This QA program plan generally follows the guidance for QA program plans from Region 9 of the U.S. Environmental Protection Agency (EPA) (EPA 2012).

This plan provides an overview of the types of projects performed by BWQP staff (and contractors) that involve surface-water sampling. The overarching goal of BWQP's surface water sampling is to assess the water quality condition of Nevada's surface waters, identify waterbodies that are not meeting quality goals, prioritize waterbodies and parameters needing attention, and determine when and where special projects are needed to more deeply study and analyze certain problems or issues. SOPs for different types of monitoring, sampling, and related activities provide details of how the work is conducted in the field (Appendix A).

# 2.0 BWQP Program Descriptions, Organization, and Management

#### 2.1 Program Descriptions

BWQP implements a variety of interrelated programs to assess, protect, and restore the quality of Nevada's waters. The programs form an iterative cycle of monitoring, assessment, planning, restoration, and protection (Figure 1).





## 2.1.1 Water Quality Monitoring

The water-quality monitoring program collects biological, chemical, physical data, and other information to support other BWQP management programs. Monitoring strategies include long-term monitoring, rotational focus-basin monitoring, special projects, bioassessment, and EPA's National Aquatic Resource Surveys. The data collected under these programs are used to determine ambient water quality and water quality trends, establish water quality standards, evaluate whether water quality standards are being met, and develop TMDLs. Monitoring strategies are discussed in more detail in Section 3 of this QA program plan.

All BWQP water quality data are entered in to the BWQP water quality database (i.e., BWQP data warehouse). A web-based application makes all water quality data collected by BWQP programs available to other agencies and the public <u>https://nevadawaterquality.ndep.nv.gov/</u>. BWQP data are also regularly uploaded to the EPA data exchange, and are available for anyone to retrieve, including the public, at <u>https://www.waterqualitydata.us/portal/</u>. EPA notes that the STORET Warehouse was decommissioned on June 29, 2018. For more information, see EPA's website at <u>https://www.epa.gov/waterdata/water-quality-data-wqx</u>.

#### 2.1.2 Water Quality Standards

Water quality standards are the scientific and regulatory foundation of water-quality protection programs under the CWA, and under state statutes and regulations. Water quality standards consist of three components: beneficial uses, water quality criteria to protect those uses, and antidegradation provisions. Appropriate standards are needed to ensure that subsequent actions—such as water quality assessments, TMDLs, watershed plans, projects to reduce pollution from nonpoint sources, and discharge permits—are adequate to protect and restore water quality.

A water quality standard defines the water quality goals for a waterbody by designating beneficial uses of the water and setting narrative or numeric criteria to protect those uses. Criteria are the values or descriptions that are protective of specific beneficial uses, such as watering of livestock, irrigation, protection of aquatic life, etc. Numeric standards are typically based on EPA's national recommended water quality criteria (<u>https://www.epa.gov/wqc/national-recommended-water-quality-criteria</u>); however, site-specific standards may be developed to reflect local or regional conditions. Additional protection is provided for Nevada's high-quality waters through antidegradation provisions.

In addition to narrative standards applicable to all waters, NDEP has established standards for more than 300 individual reaches of rivers, streams, lakes, and reservoirs. Many waterbodies that are not specifically identified in the NAC, are protected by the "Tributary Rule" (NAC 445A.1239). Nevada's water quality standards are contained in NAC 445A.11704 – 445A.2234 (http://leg.state.nv.us/NAC/CHAPTERS.HTML). In addition, EPA has promulgated water quality standards for Nevada for certain parameters and beneficial uses that are contained in the Code of Federal Regulations (CFR) at 40 CFR Part 131.36(d)(11).

During the process of developing water quality standards, data are evaluated to determine if the proposed beneficial uses are appropriate or attainable. These water quality data are also used to derive site-specific standards, where suitable. Specific information and procedures for the development of water quality standards are described in Nevada's Continuing Planning Process (CPP) and the BWQP Long-Range Plan, both of which are currently undergoing revision.

#### Exhibit 1 - What is a Water Quality Standard?

The numeric value that many people may think of as a "water quality standard," is a criterion value that is protective of a specific beneficial use. A water quality standard may be best described as a "three-legged stool" that consists of criteria values, a specified beneficial use, and an antidegradation component. The latter protects existing water quality if that quality is better than the quality needed to support the beneficial use.



Unlike a drinking water standard, Nevada's water quality standards for surface waters across the state are typically not one value for each parameter. For example, the maximum contaminant level (MCL) for arsenic in drinking water is a single value of 10  $\mu$ g/L to protect human health. In contrast, surface waters in Nevada support a variety of beneficial uses, such as watering of livestock, irrigation, protection of aquatic life, and other uses, as well as municipal or domestic supply. Each water quality standard applies to a specific beneficial use. For arsenic, the values for protection of aquatic life are 340  $\mu$ g/L for acute exposure and 150  $\mu$ g/L for chronic exposure. For protecting the beneficial use of irrigation, the value for arsenic is 100  $\mu$ g/L; however, the value for arsenic protective of the beneficial use of watering livestock is 200  $\mu$ g/L. Therefore, there is no single value for "the" water quality standard for arsenic.

Water quality standards for toxic materials apply one or more of four beneficial uses, and are described in NAC 445A.1236; these apply to all waters with one or more of those beneficial uses. Water quality standards for designated waters are contained in NAC 445A.1252 to 445A.2214. These tables may also contain values known as "requirements to maintain existing higher quality" (RMHQs), which represent Nevada's approach to antidegradation. An example of an NAC table is provided below.

	EXHIBIT 1 (	Continued): Exai	mple Ta	ble fro	m NAG	C 445A	- STAND	ARDS O	F WATE	ER QUA	ALITY		
		Wa	lker Riv	ver, Eas	t Fork	at Brid	dge B-14	75					
				1	1		Bene	eficial Uses	a		1		
PARAMETER	REQUIREMENTS TO MAINTAIN EXISTING HIGHER QUALITY	WATER QUALITY CRITERIA TO PROTECT BENEFICIAL USES	Livestock	Irrigation	Aquatic	Contact	Noncontact	Municipal	Industrial	Wildlife	Aesthetic	Enhance	Marsh
Beneficial Uses	I;		Х	Х	х	Х	х	х	Х	х			
Aquatic Life Sp	ecies of Concern		Mountain	whitefish	n, rainbo	w trout a	and brown ti	out.					
Temperature - °C	47.0	S.V. Nov-Apr $\leq 13$ S.V. May-Jun $\leq 17$ S.V. Jul-Oct $\Delta T \leq 23$			*								
дт» - °С pH - SU	Δ1 = 0	S.V. 6.5−9.0			*								
Dissolved Oxygen- mg/L		S.V. Nov-May ≥ 6.0 S.V. Jun-Oct ≥ 5.0			*								
Total Phosphorus (as P) - mg/L		A-Avg. <u>&lt;</u> 0.10			*	*							
Total Nitrogen (as N) - mg/L	A-Avg. ≤ 0.9 S.V. ≤ 1.7				*	*							
Nitrate (as N) - mg/L		S.V. ≤ 10						*					
Nitrite (as N) - mg/L		S.V. <sup>≤</sup> 0.06			*								
Total Ammonia (as N) - mg/L		с			*								
Total Suspended Solids - mg/L		S.V. ≤ 80			*								
Turbidity - NTU		S.V. ≤ 10			*								
Color - PCU		S.V. ≤ 75						*					
Total Dissolved Solids - mg/L	A-Avg. ≤ 320 S.V. ≤ 390	A-Avg. ≤ 500						*					
Chloride-mg/L	A-Avg. ≤ 13 S.V. ≤ 19	S.V. ≤ 250						*					
Sulfate - mg/L		S.V. ≤ 250						*					
Sodium - SAR		A-Avg.≤8		*									
Alkalinity (as CaCO₃) - mg/L		S.V. ≥ 20			*								
E. coli - cfu/100 mL <sup>d</sup>		G.M. ≤ 126 S.V. ≤ 410				*							
Toxic Materials		e											

\* = The most restrictive beneficial use.

X = Beneficial use.

<sup>a</sup> Refer to <u>NAC 445A.122</u> and <u>445A.1882</u> for beneficial use terminology.

<sup>b</sup> Maximum allowable increase in temperature above water temperature at the boundary of an approved mixing zone, but the increase must not cause a violation of the single value standard.

<sup>c</sup> The water quality criteria for ammonia are specified in <u>NAC 445A.118</u>.

<sup>d</sup> The geometric mean must not be exceeded in any 30-day period. The single value must not be exceeded in more than 10 percent of the samples collected within any 30-day period.

<sup>e</sup> The water quality criteria for toxic materials are specified in <u>NAC 445A.1236</u>.

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#### 2.1.3 Waterbody Assessments

Biennially, BWQP prepares the 303(d)/305(b) Water Quality Integrated Report for submittal to EPA. To develop the Integrated Report, water quality data are compared to the water quality standards according to an established methodology, as described in that report. The 305(b) portion of the Integrated Report evaluates the water quality and beneficial attainment of all surface waters of the state, based on five years of recent data (i.e., the reporting cycle). The 303(d) portion of the report contains a list of waters that are not meeting water quality standards and are classified as "impaired" (i.e., listed) waters. EPA recommends that impaired waters be prioritized for restoration, and that TMDLs or a watershed management plan be developed for waters on the 303(d) List. The most current Integrated Report is available on the BWQP website at https://ndep.nv.gov/water/rivers-streams-lakes/water-quality-standards/303d-305b-water-quality-integrated-report.

## 2.1.4 Total Maximum Daily Loads

TMDLs describe the maximum amount (i.e., the load) of pollutants a waterbody can receive on a daily basis and still meet water quality standards. TMDLs provide a means to integrate the management of both point and nonpoint sources of pollution by establishing **waste-load allocations** for point-source discharges and **load allocations** for nonpoint sources. Water quality data are evaluated to define beneficial-use impairment, determine sources of pollution, and establish pollutant load allocations. Specific information and procedures for the development of TMDLs are described in BWQP's CPP and Long-Range Plan documents.

## 2.1.5 Water Quality Protection and Improvement Strategies

Permits issued under the National Pollutant Discharge Elimination System (NPDES) and certifications issued under CWA Section 401 ensure that surface-water discharges meet all applicable water quality standards and TMDLs. The Nevada nonpoint-source program implements TMDLs, watershed-based plans, and other nonpoint-source control projects to restore impaired waters. Grant funding issued through Section 319 of the CWA is provided to other agencies and organizations for projects that address pollution from nonpoint sources, improve water quality, and promote environmental education projects. Water quality data may be used to assess the effectiveness of permits and water quality improvement projects. More information on the Nevada Nonpoint Source Program is available at

https://ndep.nv.gov/water/rivers-streams-lakes/nonpoint-source-pollution-management-program.

## 2.2 BWQP Organization and Management

The organization of BWQP describes three main programs: the water quality standards, monitoring, and assessment program; the nonpoint source program; and the Lake Tahoe watershed program (Figure 2). Under this organizational structure, the Bureau Chief is responsible for overall management, direction, coordination, and guidance for all BWQP programs. The three main programs (Water Quality Standards, Assessment and Monitoring; Nonpoint Source; and Lake Tahoe Watershed) are led by supervisors who, along with their staff, carry out program tasks. The Administrative Assistant and the Special Projects/TMDL Coordinator also report directly to the Bureau Chief.

- The Administrative Assistant and Contract Manager are responsible for budget tracking, day-today office operations, contract preparation, and invoice processing.
- The TMDL and Special Projects Coordinator oversees TMDL development and CWA Section 208 planning, reviews NPDES permits, assists with waterbody monitoring and assessments, assists with development of water quality standards, participates in inter-program and inter-agency coordination, and provides technical assistance.



Figure 2: BWQP Organizational Chart

#### 2.2.1 Water Quality Standards, Assessment, and Monitoring Program

The Standards, Assessment, and Monitoring Branch staff develop water quality standards; conduct chemical, physical, and biological monitoring; conduct waterbody assessments including the 303(d)/305(b) Integrated Report; participate in inter-program and inter-agency coordination; provide technical assistance; maintain water quality and bioassessment databases; and provide data to EPA, other agencies, and the public.

The Branch Supervisor is responsible for overseeing the entire surface-water monitoring program and budget. The supervisor is also responsible for overall development of the sampling design and protocols discussed in this QA program plan, as well as ensuring protocols are followed. On a routine basis, the branch supervisor coordinates with the branch staff and the manager of the certified laboratory to review field and laboratory roles and responsibilities, sampling and field measurement requirements, analytical requirements, sampling schedule, courier logistics (for sample transfer to the laboratory), and requirements for field and laboratory documentation. This coordination minimizes potential problems that could occur as part of the surface-water quality monitoring program. The supervisor is also responsible for ensuring that any amended versions of the QA program plan are provided to the EPA for approval and then distributed to the appropriate individuals and organizations.

The Quality Assurance Officer (QA Officer) is responsible for the QA/QC review of all data generated for the samples collected. The QA Officer receives all data reports from the analytical laboratory and is the main contact regarding data quality issues and concerns. Due to the limited staff resources of the BWQP, the branch supervisor also functions in the role of QA Officer for the BWQP, and may delegate the duties to other staff members. The branch staff collect samples and make field measurements according to policies and procedures established in the QA program plan. The branch staff also communicate with the analytical laboratory regarding sample delivery and schedule.

During the summer field season, technicians are hired to assist with data collection and are trained in QA/QC procedures and supervised by branch staff. The bioassessment program—which operates under the Standards, Assessment, and Monitoring Branch—has successfully used summer-hire technicians to perform work under the EPA's National Aquatic Resource Surveys for nearly a decade. BWQP may also hire contractors to collect environmental data. Contractors must follow this QA program plan or other QA plans approved by the BWQP. Contractors will report and provide data to the branch supervisor.

#### 2.2.2 Nonpoint Source Program

The supervisor and staff of the Nonpoint Source Branch implement the Nonpoint-Source Management Plan to improve water quality in waters affected by pollution derived from nonpoint sources. Projects with stakeholders and partners focus on restoring and maintaining healthy aquatic habitats and watersheds. Staff in this branch oversee contracts with local, state, and federal agencies and environmental organizations on projects to stabilize and restore riparian habitats, enact best management practices, and conduct environmental education projects. These staff also participate in inter-program and inter-agency coordination, provide technical assistance, and issue Section 401 certifications under the CWA.

#### 2.2.3 Lake Tahoe Watershed Program

Staff and the branch supervisor provide direct oversight for implementation of the Lake Tahoe TMDL and other Tahoe-related activities. Branch staff also conduct monitoring, assist with development of water quality standards for waters in the Tahoe Basin, participate in inter-program and inter-agency coordination, and provide technical assistance.

## 2.3 Special Training Requirements and Certifications

Proper training of field personnel represents a critical aspect of QA/QC. All BWQP staff responsible for collecting water quality samples will have sufficient training and hands-on experience. Surface-water sampling is performed by two-person teams, for both safety and logistical reasons; therefore, all newly hired personnel are accompanied by experienced BWQP staff when collecting samples or field measurements. The branch supervisor determines when a staff person is sufficiently trained and qualified to perform sampling and measurements without supervision. Prior to conducting monitoring activities, all BWQP staff must complete health and safety training. All personnel participating in field activities are required to be familiar with the BWQP *Field Staff Safety Guidance and Recommended Protective Measures* (see Appendix B). Health and safety training records are kept on file at the BWQP office and in personnel files or at the Nevada State Archives.

All BWQP personnel are required to complete the defensive driving course for State employees and retain a copy of the training certificate. Refresher training or a repeat of the class is required every four years. All BWQP personnel that use watercraft are required to complete a boater safety course approved by the National Association of State Boating Law Administrators and retain a Nevada boater education card (also known as a Nevada boating safety certificate card). All BWQP personnel that use all-terrain vehicles (ATVs) are required to complete an ATV safety course approved by the State of Nevada Risk Management Division and retain a certificate of completion. Additional field safety trainings, such as a cardiac pulmonary resuscitation course, are encouraged as time and funds allow.

## 2.4 Certified Analytical Laboratory

The Certification Branch of the Bureau of Safe Drinking Water (BSDW) implements a rigorous laboratory certification program to ensure that environmental samples are analyzed according to approved methods and strict QA/QC policies and procedures. To be certified, laboratories must pass an on-site audit at least once every three years, and satisfactorily analyze a set of performance test samples annually. Certified laboratories analyze environmental samples that are collected to meet requirements of the CWA, Safe Drinking Water Act, and Resource Conservation and Recovery Act. Regulations for the Laboratory Certification Program can be found at NAC <u>445A.0552 to 445A.067</u> and <u>NAC 459.96902 to NAC 459.9699</u>. More information on Nevada's laboratory certification program can be found at: <u>https://ndep.nv.gov/environmental-cleanup/certification/certified-environmental-manager/use-of-certified-laboratories</u>

Currently, most of the water quality samples collected by BWQP are analyzed by the Nevada State Public Health Laboratory, which is certified by the State of Nevada. However, other laboratories such as those run by the Desert Research Institute (State-certified for CWA samples), the United States Geological Survey (USGS), private commercial laboratories, and EPA laboratories may also be used. The laboratory is responsible for conducting all sample preparation and analysis, as well as reviewing the analytical data it generates to ensure consistency with its approved QA/QC program. The Laboratory Manager oversees all laboratory-related activities, serves as the main contact for BWQP staff, and has the prime responsibility for the laboratory work. Specific information regarding the Nevada State Public Health Laboratory QA/QC program is contained in the Nevada State Health Laboratory Quality Assurance Management Plan (see <u>Appendix C</u>).

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# 3.0 Objectives and Strategy of the Water Quality Monitoring Program

Data generated through BWQP's water quality monitoring program provide the information needed to effectively manage Nevada's surface-water resources.

#### 3.1 Program Objectives

The main objectives of the monitoring program include the following:

- Provide biological, chemical, and physical data to support waterbody assessments, including the 303(d)/305(b) Integrated Report, and development of water quality standards and TMDLs.
- Increase the geographic coverage of waters monitored to expand water quality standards, update assessments of impairments in assessed waters, assess the status of previously unassessed waters, and collect baseline monitoring data to describe ambient conditions.
- Maintain long-term records for select sites throughout the State to determine trends in pollutant concentrations and loads.
- Measure the effectiveness of TMDLs and projects implemented through the Nevada nonpointsource management program.
- Support national efforts of the EPA to broadly assess waters.
- Provide biological, chemical, and physical data to local, state, and federal agencies, Tribes, and the general public.
- Ensure data quality by following appropriate QA/QC procedures.

#### 3.1.1 Systematic Planning Process

This QA program plan provides an overview of the types of projects performed by BWQP staff (and contractors) that involve surface-water sampling. The overarching goal of BWQP's surface water sampling is to assess the water quality condition of Nevada's surface waters, identify waterbodies that are not meeting quality goals, prioritize waterbodies and parameters needing attention, and determine when and where special projects are needed to more deeply study and analyze certain problems or issues. The main activities that involve surface-water sampling are described below under Section 3.2. SOPs for different types of monitoring, sampling, and related activities provide details of how the work is conducted in the field (Appendix A).

Systematic planning for various sampling activities conducted by BWQP has been implicitly understood, but not described in detail in the previous QA program plan (NDEP 2014). To better align this QA program plan with EPA QA requirements, additional details related to systematic planning have been incorporated into this version of the *QA Program Plan for Surface Water Sampling*. Planning details are structured to generally approximate EPA's data quality objectives (DQO) process for systematic planning. EPA developed the DQO process as a framework for planning, collecting, and evaluating data (EPA 2006). The DQO process begins with a problem statement. Additional steps in the process identify the data needed to answer specific study questions, as well as the quality and quantity of data needed. BWQP collects water-quality and related data to achieve various objectives, as described above in section 3.1.

#### 3.1.2 Planning Framework

Step 1 of the DQO process identifies the requirements or problems be addressed. Background information provides a scientific and historical context for the work to be conducted. Step 2 of the DQO process typically identifies the questions the investigation will attempt to address. Step 3 describes the information to be obtained and the measurements to be taken to resolve the decision statements posed in Step 2, and Step 4 describes the spatial and temporal boundaries for the program or project. DQO steps 5 through 7 involve development of decision rules, defining statistical parameters of interest, specifying tolerable limits on decision errors, and optimizing sampling design as part of an iterative process. Typically, data collected under this QA program plan are not the result of a statistically based study; therefore, decision rules are generalized and tolerable limits on decision errors are not specified. Section 3.2 describes the types of sampling strategies performed.

The quality of laboratory data follows the requirements set by the Laboratory Certification Branch. Nevada has adopted by reference, the NELAC standards (See NAC 445A.0608). Laboratories must pass an onsite assessment every two years. Specific regulations governing certification of laboratories are provided in NAC 445A.0552 to NAC 445A.067. For more information on certification see: <u>https://ndep.nv.gov/water/lab-certification/info-resources</u>

#### 3.2 Monitoring Strategies and Processes

To meet program objectives, BWQP implements a multi-pronged approach for collecting water quality data in accordance with the BWQP's water quality monitoring and assessment strategy and long-range plan. Monitoring activities are generally included in the following categories:

- Long-term monitoring.
- Rotational focus basin.
- Organic compounds, including volatile and semivolatile compounds, pesticides, and herbicides.
- Special projects.
- Bioassessment, including probabilistic sampling.

Table 1 provides a summary of these sampling strategies in the context of the DQO process. Details of each strategy are provided in Sections 3.2.1 through 3.2.5, below.

#### 3.2.1 Long-Term Monitoring

Long-term monitoring is conducted to determine ambient water quality conditions and trends in pollutant concentrations and loads over time. The data may also be used to develop water quality standards and TMDLs or watershed plans. Long-term monitoring sites are maintained on several major rivers and streams, most of which are located at USGS streamflow gaging stations to provide concurrent flow data for statistical analysis. (See Figure 3 and Table 2 for detailed information regarding the long-term sites.) Sites are generally sampled quarterly to characterize seasonality, unless a more frequent schedule is determined to be appropriate. Some monitoring sites are sampled less frequently if weather conditions prevent access or the waterbody is dry or a stream is reduced to a no-flow condition. From year to year, the BWQP attempts to rotate between months of the quarter to capture varying conditions at the monitoring sites. Water quality samples collected at long-term monitoring sites are analyzed for bacteria and routine standard pollutants each time, and metals biannually (See Table 3).

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STEP 1	STEP 2	STEP 3	STEP 4
State the Problem	Identify the Goals or Decisions	Identify Information	Define Study Boundaries
	of the Study	Inputs Needed	
1. Long-term monitoring. This program provides	1. Long-term monitoring. The goal	1. Long-term	1. Long-term monitoring. The
data to address CWA and state regulatory	is to collect data to assess water	monitoring. Data from	biennial Integrated Report provides
requirements to evaluate whether water quality	quality of surface waters across the	field measurements (pH,	assessment results for data collected
standards are being met. This monitoring focuses	state and determine if water quality	DO, temperature).	quarterly over a five-year period for
on sampling of major river systems in Nevada	standards are being met (i.e.,	Narrative observations	routine sites on Nevada's major river
and provides data for water-quality assessments.	determine whether beneficial uses	of field conditions.	systems (Snake, Humboldt, Truckee,
Sites are listed in Table 2.	are supported), or if a waterbody is	Laboratory data for total	Carson, Walker, and Colorado), as
	impaired for any beneficial use.	and dissolved metals,	well as some tributary waters, and
2. Rotational focus basin. This program is similar		routine parameters, and	certain wetlands, lakes and reservoirs.
to long-term monitoring, but provides an	2. Rotational focus basin. The same	bacteria.	
intensive analysis of waterbodies that are not	goals as (1) apply.		2. Rotational focus basin. Similar to
routinely sampled, because of limited resources.		2. Rotational focus	(1), but focused on a particular basin.
	3. Sampling for organic chemicals.	basin. Same as (1).	The Central Region basin was selected
3. Sampling for organic chemicals. This program	The same goals as (1) apply.		as the next focus basin, and recon
was initiated in 2016 to collect data for VOCs,		3. Sampling for organic	work has just begun. Quarterly
SVOCs, herbicides and pesticides on a biannual	4. Special projects These projects	chemicals. Similar to (1)	sampling to be done over a period of
basis from each hydrographic basin. Limited	may require a QA Project Plan to	and (2), but water	2 to 3 years.
resources mean that each basin is sampled for	cover non-routine sampling. The	samples are collected in	
organics for 2 to 3 years before the next basin	goals of each special project are	multiple different	3. Sampling for organic chemicals.
can be sampled. In this sense, (3) is similar to (2).	typically specific to that project.	bottles for specific	Similar to (1) and (2). Biannual
		analyses, such as	sampling of organics has been
4. Special projects. As the name implies, these	5. Bioassessment. Goals of the	analysis of VOCs, SVOCs,	completed for the Truckee and
are problem-focused projects that cover a range	bioassessment program are	pesticides, and	Humboldt basins, and sampling began
of possible topics, from an in-depth study of	provided in the QA program plan	herbicides.	in 2019 for the Walker basin.
nutrients and their relationship to excessive algal	for the Bioassessment Program,		
growth in the Carson River, to a detailed analysis	which includes probabilistic	4. Special projects.	4. Special projects. Described in each
of temperature and dissolved oxygen criteria for	sampling for NRSA. The main	Depends on the project.	QA Project Plan.
the Colorado River.	objective to evaluate the biological		
	condition, water quality, and	5. Bioassessment. Field	5. Bioassessment. See QA Program
5. Bioassessment. This program has its own QA	physical habitat of wadeable	measurements of	Plan for the Bioassessment Program.
program plan, and is included here for	streams and rivers throughout	physical habitat, water	
completeness because surface water samples are	Nevada.	quality data, data for	
collected under this program.		fish and BMI.	

# Table 1. Systematic Planning: Summary Table of DQO Steps 1 - 4

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Figure 3: Nevada's Long-Term Monitoring Sites

	Snake River Basin								
Station ID	Station Name	Waterbody ID	Water Name	UTM_N	UTM_W				
E5	Bruneau River @ Mink Ranch	NV03-BR-16_00	Bruneau River	4640796	609894				
E11	East Fork Jarbidge River Below Murphys	NV03-JR-12_00	Jarbidge River, East Fork	4654530	635143				
E6	Jarbidge River below Jarbidge	NV03-JR-14_00	Jarbidge River	4637497	630244				
E19	Jarbidge River @ gage	NV03-JR-13_00	Jarbidge River						
E4	Owyhee River above Mill Creek	NV-OW-18_00	Owyhee River	4626888.9	587214.64				
E16	Owyhee River below Slaughterhouse Creek	NV03-OW-19_01	Owyhee River	4634730.1	584174.74				
E1A	South Fork Owyhee River @ IL Ranch	NV03-OW-27_00	Owyhee River, South Fork	4603828	551027				
E8	Salmon Falls Creek	NV03-SR-02_00	Salmon Falls Creek	4646085	691688				

Table 2: Long-Term Monitoring Sites

Humboldt River Basin - Upper								
Station ID	Station Name	Waterbody ID	Water Name	UTM_N	UTM_W			
HS4	Humboldt River @ Osino Cutoff	NV04-HR-01_00	Humboldt River	4531990.6	614530.31			
HS5	Humboldt River @ Carlin	NV04-HR-02_00	Humboldt River	4507533.9	585340.61			
HS6	Humboldt River @ Palisade	NV04-HR-02_00	Humboldt River	4495685.7	567668.44			
HS14	Maggie Creek @ SR 221	NV04-HR-59-C_00	Maggie Creek	4508051	576495.82			
HS1	Mary's River	NV04-MR-10-B_00	Mary's River	4568292.9	646093.39			
JACK-1	Jackstone Creek below homeshedder	NV04-HR-63_00	Jackstone Creek					
HS15	North Fork Humboldt River @ North Fork Ranch	NV04-NF-17-B_00	Humboldt River, North Fork	4603058.8	590768.08			
HS39	North Fork Humboldt River @ Bellows Ranch	NV04-NF-56-B_00	Humboldt River, North Fork					
HS3A	South Fork Humboldt River below Dixie Creek	NV04-SF-19-B_02	Humboldt River, South Fork	4511100.9	596283.39			

Humboldt River Basin - Lower								
Station ID	Station Name	Waterbody ID	Water Name	UTM_N	UTM_W			
HS7	Humboldt River @ Battle Mountain	NV04-HR-03_00	Humboldt River	4501885.8	505813.56			
HS8	Humboldt River @ Comus	NV04-HR-04_00	Humboldt River	4535782	466394.45			
HS9	Humboldt River @ Imlay	NV04-HR-05_00	Humboldt River	4505308.8	397034.44			
H6	Humboldt River Below Rye Patch Reservoir	NV04-HR-06_00	Humboldt River	4480541.4	389169.54			
HS43	Humboldt River @ Woolsey	NV04-HR-06_00	Humboldt River	4463228.1	383419.63			
HS12	Humboldt River Above Humboldt Sink	NV04-HR-08-D_01	Humboldt River	4434563.2	374805.1			
RKC-4	Rock Creek @ Gaging Station	NV04-HR-33-C_00	Rock Creek	4519518.8	534883.83			
HS70	Little Humboldt River @ Hot Springs Gage	NV04-LH-47-C_00	Little Humboldt River	4597923.3	464880.17			
HS67	Martin Creek Below Gage	NV04-LH-51-B_00	Martin Creek	4585006.5	468786.13			

	Truckee River Basin – Steamboat Creek								
Station ID	Station Name	Waterbody ID	Water Name	UTM_N	UTM_W				
SB3	Steamboat Creek @ Pleasant Valley	NV06-SC-41-C_00	Steamboat Creek						
SB5	Steamboat Creek @ Rhodes Road	NV06-SC-41-C_00	Steamboat Creek	4362224.1	263662.58				
SB7	Steamboat Creek @ Geiger Grade	NV06-SC-42-D_00	Steamboat Creek						
SB11	Steamboat Creek @ Short Lane	NV06-SC-42-D_00	Steamboat Creek						
SB17	Steamboat Creek @ Pembroke Way	NV06-SC-42-D_00	Steamboat Creek						
SB19	Steamboat Creek @ Cleanwater Way	NV06-SC-42-D_00	Steamboat Creek	4377200	266824				

Table 2 continued: Long-Term Monitoring Sites

Truckee River Basin – Tahoe Tributaries								
Station ID	Station Name	Waterbody ID	Water Name	UTM_N	UTM_W			
3B	3rd Creek @ Lakeshore Drive	NV06-TB-12_00	Third Creek, EF; Third Creek WF; & Third Creek	4347573.3	245753.06			
INCL	Incline Creek @ Lakeshore Drive	NV06-TB-16_00	Incline Creek, EF; Incline Creek, WF; & Incline Ck	4347528.9	245844.75			
TAH21	Glenbrook Creek near Glenbrook	NV06-TB-26_00	Glenbrook Creek	4330591.7	245718.84			
TAH9	Logan House Creek (Lower) above Highway 50 @ USGS Gage	NV06-TB-28_00	Logan House Creek	4328280	245988			
TAH22A	Edgewood Creek @ Palisade Drive	NV06-TB-86_00	Edgewood Creek					

Truckee River Basin – Truckee River						
Station ID	Station Name	Waterbody ID	Water Name	UTM_N	UTM_W	
T1	Truckee River @ Farad	NV06-TR-01_00	Truckee River	4367918	238935.71	
Т2	Truckee River @ Idlewild Park	NV06-TR-02_00	Truckee River	4378451	256743.62	
Т3	Truckee River @ East McCarran	NV06-TR-03_00	Truckee River			
Т20	Truckee River above Lockwood	NV06-TR-04_00	Truckee River	4376605.2	271313.58	
T14	Truckee River @ Derby Dam	NV06-TR-05_00	Truckee River			
Т23	Truckee River @ PLPT boundary	NV06-TR06_00	Truckee River			

Carson River Basin						
Station ID	Station Name	Waterbody ID	Water Name	UTM_N	UTM_W	
C8	West Fork Carson River @ Paynesville	NV08-CR-01_00	Carson River, West Fork	4299221	258851	
C9	East Fork Carson River @ Riverview	NV08-CR-04_00	Carson River, East Fork	4306472	266635	
C15	East Fork Carson River @ Williams Slough	NV08-CR-05_02	Carson River, East Fork	4317263	257499	
C13	Carson River @ Mexican Gage	NV08-CR-08_00	Carson River	4331391	264172	
C1	Carson River @ New Empire Bridge	NV08-CR-09_00	Carson River	4340355	267136	
C10	Carson River @ Weeks Bridge	NV08-CR-11_00	Carson River	4351726	305849	
C18	Carson River Below Lahontan Dam	NV08-CR-13-C_00	Carson River	4370272	323173	
C5	Brockliss Slough @ Muller Lane	NV08-CR-29_00	Brockliss Slough, East and West Branches	4317395	254356	
C6	East Brockliss Slough @ Muller Lane	NV08-CR-29_00	Brockliss Slough, East and West Branches	4317373.9	254663.26	

Walker River Basin						
Station ID	Station Name	Waterbody ID	Water Name	UTM_N	UTM_W	
W5	West Fork Walker River @ Topaz Lane	NV09-WR-01_00	Walker River, West Fork	4276576.6	280802.47	
W2	West Fork Walker River @ Nordyke West	NV09-WR-04_00	Walker River, West Fork	4306749.1	310982.55	
W7	West Fork Walker River @ Hudson Gage	NV09-WR-04_00	Walker River, West Fork	4298008.8	306580.22	
EFS	East Fork Walker River @ Stateline	NV09-WR-06_00	Walker River, East Fork	4250631.4	309086.14	
W3	East Fork Walker River @ Nordyke East	NV09-WR-08_00	Walker River, East Fork	4306672.5	311970.12	
WSG	East Fork Walker River @ Strosnider Gage	NV09-WR-08_00	Walker River, East Fork	4298096.9	322188.54	
W4	Walker River @ Wabuska	NV09-WR-09_00	Walker River	4335718.1	318520.79	

Table 2 continued: Long-Term Monitoring Sites

BWQP staff no longer sample waterbodies in the Colorado River Basin; instead BWQP relies on data collected by other agencies, such as the Southern Nevada Water Authority (SNWA) and some of the municipalities, such as the City of Henderson and the City of North Las Vegas. SNWA has its own laboratories and other entities send samples to commercial laboratories. These laboratories are certified by the Certification Branch of BSDW. The quality of these analytical data is assumed to be adequate, because all certified laboratories must meet quality standards set by the Certification Branch, which has adopted National Environmental Laboratory Accreditation Conference (NELAC) standards (http://www.epa.gov/ttn/nelac) by reference (NAC 445A.0552 through NAC 445A.067; see NAC 445A.0608 for NELAC reference).

## 3.2.2 Rotational Monitoring (Focus Basin)

The State of Nevada contains 14 hydrographic regions for water planning and management (see Figure 4). As part of a rotational design, the BWQP selects one or more of the regions or basins in which to focus water quality monitoring efforts for a two- to three-year period, or until it is determined that sufficient data have been collected to fulfill the purpose of sampling. This focused monitoring is conducted to determine ambient conditions, increase the geographic coverage of assessed waters, and support development of water quality standards and TMDLs (if needed). This program is similar to long-term monitoring program, but provides an intensive analysis of waterbodies that are not routinely sampled, because of limited resources.

#### 1. Objectives of a focus basin review include:

- Review and update of existing water quality standards (this includes updating current water quality standards to new EPA criteria).
- Review and addition of water quality standards to waters lacking some of standards necessary for the protection of existing beneficial uses.

- Addition of new waters and water quality standards for waterbodies that NDEP determines need protection of existing or designated beneficial uses; for example, new waterbodies that need protection for cold-water species.
- Collection of ambient water quality data on waters that have never been sampled.

#### 2. Factors evaluated and considered when selecting a focus basin include the following:

- Time since the previous review of water quality standards within the basin.
- Input from the public, Tribes, and local, state, and federal agencies.
- Public input during BWQP's triennial review process.
- Age or lack of water quality data. (For example, basins that contain waterbodies that have been assigned water quality standards, but have never been sampled or cases where the existing data are limited, out-of-date, or of unknown quality.)
- Potential for natural or anthropogenic degradation of water quality.

# 3. The waterbodies selected for sampling within a focus basin depend on factors, such as the following:

- The number of waterbodies that exist within the basin.
- Waterbodies lacking adequate protection of all beneficial uses; for example, protection for coldwater species.
- Funding.
- Staff resources.
- Travel time to the focus basin.
- Travel time between monitoring sites.
- Potential for changes in water quality due to natural or human causes.
- Best professional judgment.

Selection of sampling sites on a waterbody is based on a targeted approach that considers factors such as size of sub-basins, site access, changes in hydrologic gradients, resource value, land use, fish assemblage, location of any point sources of pollution, and existing data. The Black Rock and Northwest Regions were combined as a focus area over the past several years. The Central Region (NV10) has been selected as the next focus basin, in order to establish baseline conditions in waterbodies across the rural to uninhabited area that constitutes the Central Region. Many of the waters in the Central Region never exit the State; instead, these waters terminate in playas and terminal lakes in the closed basins of the Central Region (see Figure 4).



Waterbodies in the focus basin are generally sampled quarterly; however, sampling frequency depends on waterbody characteristics and may be influenced by changing site-specific conditions. For example, waterbodies may be frozen during the winter and access to monitoring sites may be impeded by snow or mud. Conversely, sample collection may be precluded during the summer and fall because streams and rivers may cease to flow or may dry up completely. From year to year, the BWQP attempts to rotate between months of the quarter to capture varying conditions throughout each season at each monitoring site.

Water quality samples collected from focus basin sites are typically analyzed for bacteria and routine standard pollutants each time and metals biannually. However, the remoteness of many sites within the Central Region and the time needed to get to each site caused BWQP to reconsider the sampling frequency for metals. BWQP decided to collect samples for metals analysis quarterly from the Central Region sites. Specific information on the current focus basin is provided in the CWA Section 106 annual work plan, which is available upon request.

#### 3.2.3 Sampling for Organic Compounds

Sampling and analysis of water samples for organics compounds, including pesticides, was added to the surface-water sampling program in 2015 for one main-stem water. Sampling for organic compounds is performed semi-annually at routine sampling sites on the selected main-stem water. Initially, sampling for organic compounds was conducted on the Truckee River (2015-2017). In 2017, sampling for organic compounds shifted to the Humboldt River (2017-2019). In the fourth quarter of 2019, sampling for organic compounds was moved to the Walker River, which will be sampled semiannually for at least two years. The Carson River will be the next main-stem water to be sampled for organic compounds, likely starting in the fourth quarter of 2021.

Sampling for organic compounds begins with prepacked coolers received from the laboratory. All equipment (but not the bottles) is cleaned prior to arriving at the site and rinsed twice with site water before collecting water in the spigoted churn. Sample bottles are filled from the churn. The recommended amber glass bottles are used, with septum seals for samples to be analyzed for volatile organic compounds (VOCs). Samples to be analyzed for semivolatile organic compounds (SVOCs), herbicides, pesticides, and polychlorinated biphenyls (PCBs) are also collected. (Note: PCBs were banned in 1979, due to their toxicity, persistence, and bioaccumulation in the environment, where they are still found widespread, due to their use from 1929 through 1979.)

Instructions from the lab accompany the cooler of amber glass bottles and vials used to collect samples for organic compounds. The cooler package includes trip blanks for VOCs; these vials are not opened in the field. Most bottles contain preservative; however, acid is added to some of the samples. Tiny ampules of acid are taped to the bottles to which the acid is added. All sampling is performed while wearing nitrile gloves. Samples are carefully repacked into coolers with bubble wrap and ice is placed in ziplock bags in each cooler. Sampling sheets and chain-of-custody sheets are maintained by the sampling crew until the samples and sheets are turned in at the laboratory. All sampling equipment is decontaminated with bleach solution and rinsed with tap water prior to the next sampling site. EPA method 505 analyzes for organohalide pesticides and PCBs, method 515.4 analyzes for chlorinated acids by GC/ECD, 551.1 analyzes for disinfection byproducts from water treatment and chlorination, method, and method 542.2 analyzes for purgeable VOCs in water. Additional descriptions of other analytical methods are provided in Table 3.

Table 5. Organie compounds sampled and Analyzed Semianidany at Routine Sampling Sites.					
Parameter Group	Analytical Method	Description of Analytical Method			
Organochlorine Pesticides/PCBs	EPA 505	Microextraction and GC			
Chlorophenoxy Pesticides	EPA 515.4	Liquid-liquid microextraction and GC/ECD			
EDB/DBCP	EPA 551.1	Liquid-liquid extraction GC/ECD			
SVOCs by GC/MS	EPA 525.2	Liquid-solid extraction, capillary GC/MS			
Endothall	EPA 548.1	Liquid-solid extraction, GC/ECD			
Glyphosate	EPA 547	HPLC, post-column derivatization and FD			
Aldicarbs	EPA 531.2	HPLC, post-column derivatization and FD			
Diquat and Paraquat	EPA 549.2	Liquid-solid extraction, HPLC, UV detection			
Chlorophenoxy Herbicides	EPA 515.4	Liquid-liquid microextraction and GC/ECD			
VOCs by GC/MS	EPA 542.2	Purgeable organic compounds in water by capillary column GC/MS			

 Table 3: Organic Compounds Sampled and Analyzed Semiannually at Routine Sampling Sites.

Notes:

PCBs = polychlorinated biphenyls, EDB = 1,2-dibromomethane (106-93-4), DBCP = 1,2-dibromo-3-chloropropane (96-12-8), SVOCs = semivolatile organic compounds, VOCs = volatile organic compounds.

GC/MS = gas chromatography and mass spectroscopy, GC/ECD = gas chromatography and electron capture detector, HPLC = high-performance liquid chromatography, FD = fluorescence detection, UV = ultraviolet.

## 3.2.4 Special Projects Monitoring

Special project monitoring is conducted to support waterbody assessments and development of water quality standards or TMDLs. Examples include the following:

- Coordinating with the Nevada Department of Wildlife and the Nevada Division of State Parks for water quality monitoring of lakes and reservoirs throughout the state.
- Installing temporary data logger devices (e.g., HOBOs) to assess temperature conditions and develop more appropriate water quality standards for temperature and DO.
- Conducting nutrient assessments, which range from Level I visual estimates of algal cover to detailed Level II quantitative monitoring of algal and water quality conditions.

Level II monitoring is performed to determine nutrient impairment by integrating observable site conditions with the measurement data. Information regarding procedures for Level I and II assessments is contained in *Nevada's Nutrient Criteria Strategy – Version 2* (February 2009), which is available upon request. Water quality monitoring conducted in conjunction with either Level I or II assessments conforms to procedures contained in this QA program plan.

At the present time, there are no special projects underway or proposed. Resource limitations, including staff vacancies due to retirements, have required staff to focus on long-term monitoring, focus basin monitoring, and bioassessment programs. However, BWQP will develop project-specific QA project plans for any special water-quality monitoring projects in the future, as deemed necessary in consultation with the EPA Project Manager.

If a QA project plan is required, the document will be developed according to EPA guidance and requirements described at: <u>https://www.epa.gov/quality/quality-assurance-planning-region-9</u>, and submitted to the EPA for approval. The format of QA project plans will generally reflect EPA's example of a fully prepared QA project plan for a fictitious stream sampling location - *Quality Assurance Project Plan for Monitoring of Surface Water Eagle Valley Reservation* at <u>https://www.epa.gov/quality/quality-assurance-project-plan-monitoring-surface-water-eagle-valley-reservation-fictitious</u>.

#### 3.2.5 Bioassessment Monitoring

Bioassessment monitoring provides a measure of the condition of resident aquatic biota and physical habitat characteristics of rivers and streams. Samples are collected for water chemistry, benthic macroinvertebrates, periphyton, and fish (at some sites). The information and data are used to determine the ecological integrity of waterbodies and support the development of water quality standards and TMDLs.

In 2000, NDEP initiated a biological assessment program with the overall goal of developing baseline data within each watershed. To date, more than 550 sites have been assessed throughout the state, including more than 100 sites associated with the EPA's National Aquatic Resources Surveys and 129 Nevada-specific probabilistic sites. More than one-hundred sites have been designated as potential reference sites that are as close to natural conditions as possible prior to human influences. Benthic macroinvertebrates, periphyton and water chemistry samples are collected, as well as assessments of the physical habitat at each site.

A reference-condition model of benthic macroinvertebrates designed specifically for Nevada was developed by the Western Center for Monitoring and Assessment of Freshwater Ecosystems (Utah State, Logan, Utah). The model applies a "reference-condition approach," which uses life-history characteristics of benthic invertebrates applied to multimetric indices (MMI). In addition to the reference-condition model, an investigation of a periphyton MMI based on diatom community assemblage is ongoing. Select sites are revisited annually to confirm the accuracy and validity of the reference-condition and periphyton MMI approaches for evaluating the ecological integrity of Nevada's surface waters.

Probabilistic monitoring is conducted to broadly assess the condition of waters through statistically valid surveys. BWQP implements a state-scale statistical monitoring program and also participates in EPA's National Aquatic Resource Surveys for rivers, streams, lakes, reservoirs, and wetlands. Probabilistic sites are randomly selected sites throughout the State that, in aggregate, are a statistical representation of

the ecological status of Nevada's streams and rivers. During the site selection, probabilistic sites are evaluated and selected in a sequential manner from the master list. The master list of probabilistic sites includes sites specifically developed for Nevada by the EPA's Office of Research and Development, Western Ecology Division, and remaining oversample lists from previous National Rivers and Streams Assessment program. It is the intent that a minimum of fifteen probabilistic sites are bioassessed per index period.

Indices of biological integrity, other biological evaluation tools, and a QA program plan for collecting biological samples have been completed, and are contained as a set of documents in the *Bioassessment Program for Wadeable Streams and Rivers* (December 2015). This set of documents is available at: <a href="https://ndep.nv.gov/water/rivers-streams-lakes/water-quality-monitoring/bioassessment-program">https://ndep.nv.gov/water/rivers-streams-lakes/water-quality-monitoring/bioassessment-program</a>. Water quality monitoring conducted in conjunction with bioassessment monitoring conforms to procedures contained in this QA program plan.

# 4.0 Data Generation and Acquisition

Some data are collected in the field (field parameters, such as pH, dissolved oxygen (DO), and temperature). Other analytical data are obtained when the water samples collected are sent or delivered to the laboratory for analysis. This section describes the parameters analyzed and some of the analytical requirements.

#### 4.1 Water Quality Parameters and Analytical Methods

During each sampling event, samples are collected for the analyses of routine parameters such as chloride, fluoride, nitrate, nitrite, phosphorus, sulfate, hardness, total dissolved solids (TDS), alkalinity, total coliform, fecal coliform, and *Escherichia coli* (E. coli). Samples are collected biannually for analysis of total and dissolved metals at most sites. Samples for analysis of chlorophyll-*a* may be collected at sites, as deemed necessary. A list of parameters, applicable analytical methods, method detection limits (MDLs), and quantitation limits are provided in Table 4. MDLs and quantitation limits are in more details in Sections 4.1.1 and 4.1.2, below.

Qualitative information is also collected at all monitoring sites to assess NAC 445A.121, "Standards applicable to all surface waters." At a minimum, BWQP staff note whether or not the water contains substances attributable to domestic or industrial waste or other controllable sources including settleable solids that form bottom or sludge deposits; floating debris, oil, grease, scum, and other floating materials; and odor, color, turbidity, or other conditions. Qualitative information is recorded on BWQP field sheets. Parameters are evaluated on an annual basis to decide if continued analysis is warranted or if new parameters should be added. Factors that may influence such decisions include funding, specific water quality standards or TMDL development, emerging issues, or new EPA recommended criteria.



Figure 5. The Humboldt River in Flood. View from Station HS8 – Humboldt River at Comus.

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Analytical Parameter <sup>1</sup>	Analytical Method Number <sup>2</sup>	Method Detection Limits <sup>3</sup>	Laboratory Quantitation Limits <sup>4</sup>		
BACTERIA					
Fecal Coliform	Membrane Filter 9222 D	NA	10 cfu/100 mL		
Fecal Streptococci	SM 9230 C	NA	10 cfu/100 mL		
Total Coliform	Quanti-Tray 9223 B	NA	10 MPN/100 mL		
E. coli	Quanti-Tray 9223 B	NA	10 MPN/100 mL⁵		
E. coli			cfu/ 100 mL		
	<b>ROUTINE PARAMETERS</b>				
Alkalinity as CaCO <sub>3</sub>	SM 2320 B		20 mg/L		
Ammonia-N	SM 4500 NH <sub>3</sub> D	0.008 mg/L	0.1 mg/L		
Bicarbonate as CaCO₃	SM 2320 B		20.5 mg/L		
Bicarbonate as HCO <sub>3</sub>	SM 2320 B		25 mg/L		
Biochemical Oxygen Demand	SM 5210 B		2 mg/L		
Carbonate as CaCO <sub>3</sub>	SM 2320 B		20 mg/L		
Carbonate as CO₃	SM 2320 B		12 mg/L		
Chloride, Cl <sup>-</sup>	EPA 300.0	0.2 mg/L	5 mg/L		
Chlorophyll- <i>a</i>	SM 10200 H	NA	0.5 μg/L		
Color	SM 2120 B	NA	5 PCU		
DOC	SM 5310C	0.07 mg/L			
Electrical Conductivity	SM 2510	NA	10 µS/cm		
Fluoride, F <sup>-</sup>	EPA 300.0	20 µg/L	100 μg/L		
Hydroxide, OH <sup>-</sup>	SM 2320 B	NA	7 mg/L		
Orthophosphate, PO <sub>4</sub> <sup>3-</sup>	SM 4500 P E	0.003 mg/L	0.01 mg/L		
рН	SM 4500 H B	NA	N/A		
Sulfate, SO <sub>4</sub> <sup>2-</sup>	EPA 300.0	0.2 mg/L	5 mg/L		
Total Coliform	Quanti-Tray 9223 B	NA	10 cfu/100 mL		
Total Dissolved Solids	SM 2540 C	4 mg/L	25 mg/L		
Total Kjeldahl Nitrogen (TKN)	SM 4500 N B, 4500 NH <sub>3</sub> D	0.02 mg/L	0.1 mg/L		
Nitrate+Nitrite, $NO_3^-+NO_2^-$	EPA 300.0	0.01 mg/L	0.1 mg/L		
Nitrite, NO <sub>2</sub>	EPA 300.0	0.02 mg/L			
Total Phosphorus	SM 4500 P E	0.002 mg/L	0.01 mg/L		
Total Suspended Solids	EPA 160.2	NA	10 mg/L		
Turbidity	EPA 180.1	NA	0.4 NTU		

 Table 4: Parameters Commonly Analyzed for Monitoring Purposes
Analytical Parameter <sup>1</sup>	Analytical Method Number <sup>2</sup>	Method Detection	Laboratory Reporting Limits <sup>4</sup>
		Limits <sup>3</sup>	-
	METALS		
Aluminum, Al	EPA 200.8	1.7 μg/L	
Antimony, Sb	EPA 200.8	0.02 μg/L	5 μg/L
Arsenic, As	EPA 200.8	0.08 μg/L	3 μg/L
Barium, Ba	EPA 200.7	10 μg/L	20 µg/L
Beryllium, Be	EPA 200.8	0.05 μg/L	2 μg/L
Boron, B	EPA 200.7	20 µg/L	100 μg/L
Cadmium, Cd	EPA 200.8	0.03 μg/L	1 μg/L
Calcium, Ca	EPA 200.7	0.7 mg/L	5 mg/L
Chromium (total), Cr	EPA 200.8	0.06 μg/L	2 μg/L
Copper, Cu	EPA 200.8	0.13 μg/L	2 μg/L
Iron, Fe	EPA 200.7	10 μg/L	50 μg/L
Lead, Pb	EPA 200.8	0.13 μg/L	1 μg/L
Magnesium, Mg	EPA 200.7	0.5 mg/L	5 mg/L
Manganese, Mn	EPA 200.7	10 μg/L	20 μg/L
Mercury, Hg	EPA 245.2	0.03 μg/L	0.2 μg/L
Molybdenum, Mo	EPA 200.8	0.05 μg/L	10 μg/L
Nickel, Ni	EPA 200.8	0.04 μg/L	5 μg/L
Potassium, K	EPA 200.7	0.55 mg/L	
Selenium, Se	EPA 200.8	0.3 µg/l	2 μg/L
Silica, Si	EPA 200.7	0.13 mg/L	
Silver, Ag	EPA 200.8	0.08 µg/L	2 μg/L
Sodium, Na	EPA 200.7	0.7 mg/L	5 mg/L
Thallium, Tl	EPA 200.8	0.03 µg/L	1 μg/L
Zinc, Zn	EPA 200.8	0.83 μg/L	10 μg/L

Table 4 (continued): Parameters Commonly Analyzed for Monitoring Purposes

Footnotes:

<sup>1</sup> In addition to the analyzed parameters, the following parameters are calculated from laboratory analysis data: Total nitrogen, hardness, and sodium adsorption ratio (SAR).

<sup>2</sup> Analytical methods may change. Tables will be updated accordingly.

<sup>3</sup> Method detection limits are recalculated annually, current values may be different than those shown here. MDLs shown here were provided by the Nevada State Public Health Laboratory for 2017.

<sup>4</sup> Laboratory reporting limits may differ depending on the laboratory and water chemistry. Reporting limits and quantitation limits in Table 4 were provided by the Nevada State Public Health Laboratory.

<sup>5</sup> E coli may also be measured and reported as colony forming units, cfu/100 mL

mL = milliliters, MPN = most probable number, NTU = nephelometric turbidity units, PCU = platinum cobalt units, μS/cm = microSiemens per centimeter, DOC = dissolved organic carbon

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## 4.1.1 Method Detection Limits (MDLs)

Typically, analytical data are censored at the reporting limit; however, "reporting limit" is a generic term that may be defined at a detection limit or a quantitation limit. The data user must inform the laboratory as to how the analytical data are to be reported. Ideally, laboratories should report both the MDL and a quantitation limit for each analytical result. The data user can then decide which censoring level is a better fit to project goals. Regulations at NAC 445A.1236 (also known as the "toxics table") require that parameters be censored at the MDL. See regulation at: <u>https://www.leg.state.nv.us/nac/nac-445a.html</u>.

EPA (2016) defines the MDL as "...the minimum measured concentration of a substance that can be reported with 99% confidence that the measured concentration is distinguishable from method blank results." Or more simply, the MDL can be considered to represent 99% confidence that the analyte is present in the sample. In 2016, the U.S. EPA revised slightly how MDLs are to be calculated, but the method still hinges on a "false positive" error (i.e., detecting the analyte when it is not present) of 1%. Laboratories are required to calculate MDLs on a periodic basis, following methodology provided by EPA. (See: <a href="https://www.epa.gov/sites/production/files/2016-12/documents/mdl-procedure">https://www.epa.gov/sites/production/files/2016-12/documents/mdl-procedure</a> rev2 12-13-2016.pdf.)

In Nevada's regulations, NAC 445A.1236(1)(c) states "If a criterion is less than the detection limit of a method that is acceptable to the Division, laboratory results which show that the substance was not detected shall be deemed to show compliance with the standard unless other information indicates that the substance may be present." This means that analytical data for parameters listed in the table provided under NAC 445A.1236 must be censored at MDLs, not at quantitation limits.

To help guide the eventual user of these data, results reported between the MDL and the quantitation limit are typically flagged with a "qualifier." The BWQP follows EPA terminology and uses a qualifier code of "J" for these lower-precision results. Use of a data qualifier for "estimated" results alerts the data user to the greater analytical uncertainty associated with those results. Results less than the MDL are qualified "U" (i.e., not detected). Results above the quantitation limit are not routinely qualified. The relationship between detection and quantitation limits is described in Figure 6.

## 4.1.2 Quantitation Limits

Quantitation limits are levels at which the data are associated with a known confidence (i.e., a specified degree of precision and accuracy). EPA defines the minimum level of quantitation as "the lowest concentration of a substance in a sample that can be measured with a known level of confidence, and generally represents the lowest calibration point." EPA further defines this minimum level of quantitation as "3.18 times the MDL." The upper and lower calibration standards define the limits of quantitation. Responses that exceed the upper limit of this range (i.e., are outside the linear working range of the instrument) may necessitate dilution and re-analysis of the sample. Quantitation limits such as "contract-required quantitation limits" represent concentrations that a laboratory should be able to reliably detect and quantitate. For more information on quantitation and detection limits, see: <a href="https://www.epa.gov/cwa-methods/procedures-detection-and-quantitation">https://www.epa.gov/cwa-methods/procedures-detection-and-quantitation</a>.



Figure 6. General Relationship between Detection and Quantitation Limits.

Results between the MDL and lower limit of quantitation are qualified as "estimated" (i.e., Jqualified); results less than the MDL are "not detected" (i.e., U-qualified).

## 4.2 Sampling Methods for Surface Water

Field measurements are taken at each location simultaneously with sample collection for laboratory analysis. At each sampling location, the water is field tested for temperature, pH, and DO. Calibration of field instruments and equipment is performed according to the manufacturer's instruction manual for each instrument. The criteria for field instrument calibration (frequency, acceptance criteria, and corrective actions associated with exceeding the acceptance criteria) are provided in BWQP's standard operating procedures (SOPs) (see <u>Appendix A-1</u>). Calibration information and sample measurement data is recorded on standardized BWQP field sheets. Stream discharge measurements may be conducted at selected sampling locations.

Methods of sample collection, preservation, and handling conducted under this QA program plan are in accordance with methods described in the following references or otherwise approved by the EPA:

- "Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act," 40 CFR Part 136 or any test procedure approved or accepted by the EPA using procedures provided in 40 CFR Parts 136.3(d), 136.4 and 136.5.
- "Standard Methods for the Examination of Water and Wastewater," latest edition, American Public Health Association.
- "Methods for Chemical Analysis of Water and Waste," and other methods published by the EPA Office of Research and Development or Office of Water.
- "Techniques of Water-Resource Investigations of the USGS."
- Annual Book of American Society for Testing and Materials (ASTM) Standards. Volumes 11.01 and 11.02, Water (I) and (II), latest edition, ASTM International.
- Federal Register, latest methods published for monitoring pursuant to Resource Conservation and Recovery Act regulations.
- "National Handbook of Recommended Methods for Water-Data Acquisition," latest edition, prepared cooperatively by agencies of the U.S. Government under the sponsorship of the USGS.
- Federal Register, latest methods published for monitoring pursuant to the Safe Drinking Water Act regulations.

Detailed procedures for collecting environmental data are provided in the most current BWQP SOPs (see <u>Appendix A</u>). All field activities are conducted in accordance with the SOPs; however, site conditions or project-specific data collection objectives may necessitate the use of alternative field procedures not included in the SOPs. The use of field methods other than those presented in the SOPs must be approved by the supervisor of BWQP's sampling, assessment, and monitoring branch, and documented properly.

## 4.3 Field Documentation and Records

Information and data are documented in the field in several ways, including photographs, standardized BWQP field sheets, and pre-printed forms (e.g., chain-of-custody forms). Field activities are conducted according to the applicable SOPs (see <u>Appendix A</u>). It is the responsibility of the BWQP QA officer to maintain updated SOPs at all times and to distribute updated SOPs to the BWQP staff, as needed. All documentation generated by the sampling program is kept on file in the BWQP office or at the Nevada State Archives. Data or records are transferred to the State Archives according to the State of Nevada, NDEP, and BWQP records management and retention policies, which are available upon request.

Field records are made in indelible ink or fine-point permanent marker. There will be no omissions in the field documentation. Errors are kept to a minimum by exercising caution when recording and transcribing data. Erasing, "white-outs," removal of pages, and multiple crossovers are not used to correct errors. When errors do occur, they will be corrected according to the following procedures:

- 1. A single line is drawn through the incorrect entry; the correct entry is inserted into the closest space available; the correction is initialed and dated.
- 2. Groups of related errors on a single page will have one line through the entries and initialed and dated with a short comment supplied explaining the reason of data deletion.

## 4.3.1 Field Sheets

Standardized BWQP field sheets are used to record field observations, sampling site conditions, information on calibration of field instruments, and on-site field measurements. These sheets are scanned and stored digitally, and hardcopy sheets are maintained in a permanent file in the BWQP office or at the Nevada State Archives.

## 4.3.2 Instrument and Equipment Logbooks

Instrument and equipment logbooks are maintained for each instrument or piece of equipment. Each logbook includes the name, manufacturer, and serial number of the instrument or piece of equipment, as well as dates and details of all maintenance activities.

## 4.3.3 Photographs

Digital photographs may be taken at a sampling location and at other areas of interest near the sampling area. The photographs serve to verify information entered onto the field sheet. Digital photographs are archived in a permanent digital file and maintained on the NDEP server.

## 4.3.4 Labeling

All samples are labeled in a clear and consistent manner for proper identification in the field and for tracking in the laboratory. The samples have identifiable and unique numbers. Each sampling site has a unique sample identification number. Field QC samples (equipment blanks and field replicates) are labeled as such on the field sheets (see <u>Section 7.2</u>).

Nevada-certified laboratories must adhere to routine QC procedures, so BWQP replicate samples are designated by simply adding "\_00" to the sample identification number. BWQP's previous practice of creating fictitious sample IDs to be "blind" to the laboratory led to confusion when handling the data and entering it into the BWQP database. Although not as "blind" to the laboratory as fictitious ID numbers, the precision of the sample results does not affect the laboratory's certification (i.e., there is little incentive for the laboratory to manipulate the results of these replicate samples), and there is no longer any confusion when entering data into the database. QC samples are entered into the BWQP database as equipment blanks or field replicates, as appropriate.

## 4.3.5 Sample Chain-of-Custody Forms and Custody Seals

All sample deliveries and shipments are accompanied by a chain-of-custody form. The original form is included with the samples and delivered to the laboratory. Copies are provided to the BWQP QA officer and maintained in BWQP files.

Typically, BWQP staff deliver samples to the laboratories in Reno, Nevada, in person. If the samples must be shipped, custody seals are affixed across the openings of the cooler both front and back to ensure that samples are not tampered with during transport. The sample packer's initials and the date are included on the custody seals.

## 4.3.6 Sample Handling and Custody

BWQP staff ensure that each sample collected retains its original physical form and chemical composition, from time of collection through analysis by the laboratory. Details of sample handling are found in the BWQP's most current SOPs (see <u>Appendix A</u>).

#### 4.3.6.1 Sample Containers and Preservatives

The BWQP branch supervisor or designated BWQP staff works directly with the laboratory manager to determine the number of sample containers needed for each type of analysis, the proper size and material of containers for each type of analysis, and associated materials (e.g., acid or other sample preservatives) needed for this monitoring program. The containers for bacteria and metals are provided pre-cleaned and pre-preserved from the laboratory and require no washing or rinsing by the field samplers prior to sample collection. The containers for routine parameters are purchased from an outside vendor and are rinsed twice with water from the sampling location by the field samplers prior to sample collection. In addition, the preservative for the routine parameters sample is added to the sample container by the field team immediately following sample collection.

All samples taken, except for bacteria, are immediately stored in ice chests filled with ice until delivered to the laboratory. Bacteria samples are immediately stored in a thermoelectric refrigerator until delivered to the laboratory. Upon delivery of the samples to the laboratory, laboratory staff check that the samples arrived on ice. The laboratory staff note on the chain-of-custody form whether or not the samples arrived on ice. Information regarding sample containers and preservatives is provided in Table 5.

Table 5: Analytical Methods, Containers, Preservation, & Holding Time Requirements

Analytical Parameter	Analytical Method Number <sup>1</sup>	Container	Preservation Requirements	Maximum Holding Times <sup>2</sup>
BACTERIA:				
E. Coli	Quanti-Tray 9223 B	120 mL	Bottle is	6 hours (collection to
Fecal Coliform	Membrane Filter 9222 D	sterilized polystyrene	refrigerated to 4° C. Bottle contains	lab receipt); 2 hours (lab
Total Coliform	Quanti-Tray 9223 B	bottle	sodium thiosulfate.	receipt to analysis)
CHLOROPHYLL-a				
Chlorophyll- <i>a</i>	SM 10200 H	500 mL opaque HDPE bottle	Protect from exposure to light. Filtered as soon as practicable. Filter is frozen immediately.	Water sample must be filtered within 24 hours. 28 days after filter is frozen.
PRESERVED ROUTINE PARAMETERS				
Ammonia-N	SM 4500 NH <sub>3</sub> D		Bottle is chilled to	28 days
Nitrate+Nitrite	EPA 300.0		4° C.	28 days
Total Kjeldahl Nitrogen	SM 4500 N B	0.5 gallon	Bottle is preserved	28 days
Total Phosphorus	SM 4500 P E	HDPE bottle	with 5.0 mL of 96% H <sub>2</sub> SO <sub>4</sub> . Preserve immediately after collection.	28 days

<sup>1</sup> SOPs are based on information presented in the analytical methods listed that are referenced from: EPA (various)

- 160.1 Methods for Chemical Analysis of Water & Wastes, EPA/600/4-79-020, Revised March 1983.
- 200 Series Methods for the Determination of Metals in Environmental Samples Supplement I, EPA/600/R-94/111, May 1994.
- 300.0 Methods for the Determination of Inorganic Substances in Environmental Samples, EPA/600/R- 93/100, October 1993.
- Standard Methods for the Examination of Water & Wastewater, 20th Edition, 1998
- (NOTE: Information regarding containers, preservation, and holding time requirements for the various analytical methods are referenced from: 40 CFR Part 136.3, Table II on page 34.)

<sup>2</sup> All holding times are based on time from sample collection to analysis.

SM

Table 5 (continued):	Analytical Methods,	Containers, Preservation,	, & Holding Tim	e Requirements
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Analytical Parameter	Analytical Method Number	Container	Preservation Requirements	Maximum Holding Times
UNPRESERVED ROUTIN	IE PARAMETERS			
Alkalinity	SM 2320B		14 days	
Chloride, Fluoride, Nitrate, Sulfate	EPA 300.0			28 days
Color	SM 2120 B			48 hours
Electrical Conductivity	SM 2510			28 days
Nitrite	SM 4500 NO <sub>2</sub> B		Dettle is shilled	48 hours
Orthophosphate	SM 4500 P E	U.5 gallon	Bottle is chilled	48 hours
рН	SM 4500 H B	HDPE DOLLIE	104 C.	24 hours
pH Temperature	SM 4500 H B			None
Sulfate	EPA 300.0			28 days
Total Dissolved Solids	SM 2540 C			7 days
Total Suspended Solids	EPA 160.2			7 days
Turbidity	EPA 180.1			48 hours
TOTAL METALS				
Al, Ba, B, Fe, Mn, and K	EPA 200.7		Bottle contains	6 months
Sb, As, Be, Cd, Cr, Cu, Mo, Ni, Pb, Se, Tl, and Zn	EPA 200.8		15% HNO₃ before addition of the	6 months
Hardness	EPA 200.7 <sup>3</sup>		water sample,	6 months
Mercury	EPA 245.2	500 mL HDPE bottle	0.15% HNO₃ after. Chill within 15 minutes of collection.	28 days
DISSOLVED METALS				
Ca, K, Mg, and Na	EPA 200.7		Bottle contains	6 months
Ag, As, Cd, Cr, Cu, Pb, Ni, Se, and Zn	EPA 200.8	15% HNO₃ before addition of the	15% HNO₃ before addition of the	6 months
Mercury	EPA 245.2	500 mL HDPE bottle	water sample, 0.15% HNO₃ after. Filter and chill sample within 15 minutes of collection.	28 days

<sup>&</sup>lt;sup>3</sup> No separate sample is collected to determine hardness. Hardness is calculated from results of calcium and magnesium analyses determined from EPA 200.7. SM2340B provides the calculation.

## 4.3.6.2 Sample Custody

BWQP staff are responsible for custody of the samples until they are delivered to the laboratory or picked up for shipping. As few people as possible will handle the samples to ensure sample custody. Chain-of-custody forms are completed in the field. Each time one person relinquishes control of the samples to another person, both individuals complete the appropriate portions of the chain-of-custody form by filling in their signature as well as the appropriate date of the custody transfer.

During transport by a commercial carrier, the air-bill serves as the associated chain-of-custody. Once at the laboratory, the sample receipt coordinator opens the ice chests and signs and dates the chain-of-custody form. The laboratory personnel are then responsible for the care and custody of samples. The laboratory tracks sample custody through their facility using a separate sample tracking form.

A sample is considered to be in one's custody if any of the following apply:

- The sample is in the sampler's physical possession.
- The sample has been in the sampler's physical possession and is within sight of the sampler.
- The sample is in a designated, secure area.
- The sample has been in the sampler's physical possession and is locked up.

## 4.3.6.3 Sample Packaging and Delivery

BWQP staff deliver the samples as soon as possible to the chosen Nevada-certified laboratory.

## 4.3.7 Analytical Methods

Analyses are performed following either EPA-approved methods or methods from Standard Methods for the Examination of Water and Wastewater, 20th Edition (see <u>Table 3</u>). Laboratories are certified by the Laboratory Certification Branch in the Bureau of Safe Drinking Water (see NAC 445A.0552 to 445A.067). The certified laboratory summarizes the data and associated QC results in a data report, and provides this report to the BWQP branch supervisor/QA officer or designated staff. The branch supervisor/QA officer reviews the data report and associated QC results to make decisions on data quality and usability in addressing the program objectives. Historically, the State Health Laboratory has provided data without narratives because these data are not used in a compliance program. BWQP is in the process of selecting a new laboratory to better meet the data reporting needs of the program.

Data collected for Nevada's water quality program are available to the public at: <u>https://nevadawaterquality.ndep.nv.gov/</u>. Laboratory data sheets are reviewed by the branch supervisor, QA officer, or designated staff to ensure that digital data agree with the paper copy, and to make sure that the MDL and quantitation limits are included on the laboratory reports. Paper copies of all laboratory reports are kept on file in the office of the BWQP in Carson City, Nevada. Reporting and censoring limits may affect data usability, and these are discussed in more detail in Section 4.1 of this QA program plan, along with the typical analytical methods used for different parameters.

## 5.0 Instrument and Equipment Testing, Inspection, and Maintenance

## 5.1 Field Measurement Instruments and Equipment

All field equipment is inspected and maintained as necessary prior to each sampling trip. Any deficiency in the equipment is noted in the instrument or equipment logbook and reported immediately to the appropriate person who will recheck the equipment and arrange for replacement or repair by the manufacturer. BWQP staff do not use equipment if the working condition of the equipment is in doubt. Complete procedures for operating and maintaining equipment used for collecting environmental measurements are contained in the manufacturer's instruction manual for each instrument.

## 5.2 Laboratory Analysis Instruments and Equipment (Off-Site)

Inspection and maintenance of laboratory equipment is the responsibility of the certified laboratory and is described in the laboratory's QA Management Plan (see <u>Appendix C</u>).

## 5.3 Calibration of Instruments and Equipment

BWQP staff use a variety of field instruments and equipment. Calibration of meters and probes is performed first thing in the morning prior to using the equipment in the field that day. Calibration is checked at the end of every field day to assess instrumental drift.

## 5.3.1 Field Instruments and Equipment

Calibration of field instruments and equipment is performed according to the manufacturer's instruction manual for each instrument. Calibration information is recorded on standardized BWQP field sheets. The criteria for calibration (frequency, acceptance criteria, and corrective actions associated with exceeding the acceptance criteria) are provided in BWQP's SOPs (see <u>Appendix A-1</u>).

## 5.3.2 Laboratory Instruments and Equipment

Laboratory instruments are calibrated according to the appropriate analytical methods. Acceptance criteria for calibrations are found in the calibration procedures that are contained in the laboratory's QA Management Plan (see <u>Appendix C</u>).

## 6.0 Meeting Program Objectives and Criteria for Measurement Data

BWQP conducts surface-water monitoring to support development of water quality standards and TMDLs, assess the health of waterbodies, determine if water quality standards are being met, and evaluate long-term trends in water quality. Detailed information regarding study objectives and the appropriate types to data needed to meet BWQP's objectives are provided in Sections 3 and 4. The data quality objective (DQO) process is EPA's project planning process (EPA 2006) that considers the questions the study seeks to answer, identifies the data needed to address the study questions, and describes how the data will be evaluated (statistically or otherwise). Formally, DQOs are qualitative and quantitative statements developed through EPA's seven-step DQO process. However, for this QA program plan, rather than a set of project DQOs, the overall objectives of the program are provided (Sections 3 and 4), along with the acceptance criteria for measurement data (see Section 6.1 below).

### 6.1 Measurement Performance Criteria

Part of the planning process is to assure that the data collected are of sufficient quality and quantity to support project decision-making. To do this, the analytical methods used must provide adequate detection levels (i.e., detection levels should be less than the values of the water quality standards), and the data quality should be verified by established field and laboratory QC procedures. The state's Laboratory Certification Program assures that all certified laboratories meet the state's QC requirements and QC acceptance limits. Consequently, all laboratories certified by NDEP have been determined to be adequate to meet the data quality needs of BWQP's water quality management programs.

Historically, most of BWQP's water quality samples have been analyzed by the Nevada State Public Health Laboratory. The laboratory's QA Management Plan (see <u>Appendix C</u>) and analytical SOPs have been reviewed and certified by Nevada's Laboratory Certification Program. Other analytical laboratories that BWQP may use include those at the USGS, the Desert Research Institute, and the Truckee Meadows Water Reclamation Facility, as well as Nevada-certified commercial laboratories. The associated laboratory QC (types and frequencies of QC samples and QC acceptance limits) measures have been determined to be adequate to meet the data quality needs of BWQP's water quality management programs. Independent, third-party validation has not been required.

Tolerable levels of potential errors in analytical results or project decisions must be established, because it is never possible to eliminate all uncertainty. This is the "error you can live with," and should be based on the consequences of making such an error. The larger and more impactful the consequences, the less uncertainty is acceptable. For laboratory analysis, QC procedures define the range of acceptable uncertainty.

## 6.2 Acceptance Criteria

QC procedures are needed to define the tolerable errors in quantitative measurements that estimate the true value or true concentration of a physical or chemical property. Uncertainty in analytical data comes from variability in sample collection, sample handling, and the conditions associated with the specific samples, as well as analytical variability. Appropriate measurement quality objectives (MQOs) for analytical data are established as quantitative measures of performance against selected data quality indicators (DQIs), as described below.

DQIs provide a means to evaluate the quality of data. For environmental samples, DQIs are normally defined in terms of the "PARCCS parameters" (precision, accuracy, representativeness, completeness, comparability, and sensitivity). Precision, accuracy, and sensitivity are usually covered in method-specific criteria; however, the other DQIs (representativeness, completeness, and comparability) should be defined in the plan for the project or program as a whole.

In terms of the latter three DQIs, a **representative** sample is a sample that closely matches the characteristics of its population as a whole. In other words, the sample should reflect the population from which the sample was collected. **Completeness** is simply a measure of how many samples were collected compared to the number of samples that were planned, and **comparability** means that sample collection, handling, and analysis are reasonably consistent from one sample to the next; thereby assuring that the data are comparable.

The analytical methods employed by the laboratory have associated precision, accuracy and sensitivity goals and these should be compared against project or program goals for these parameters. MQOs are the acceptance criteria established for DQIs during the planning process, and define the acceptable levels of uncertainty throughout the analytical process. These measurement performance criteria are described below. Specific procedures used for sampling, chain-of-custody, instrument calibration, reporting, QC, audits, preventive maintenance, and corrective actions are provided in other sections of this QA program plan and in the State Health Laboratory's QA Management Plan (Appendix C).

#### 6.2.1 Precision

**Precision** is a measure of the reproducibility, and measures the agreement among a set of replicate measurements. Field replicate samples are collected and analyzed to assess precision associated with all steps of the program (from sample collection through analysis) (see <u>Section 7.2.1</u>). For routine monitoring, BWQP staff typically collects one replicate sample per sampling trip (generally, a trip lasts from one to three days).

Analytical precision is estimated by replicate analyses, typically on laboratory control samples, spiked samples or field samples. The most commonly used estimate of precision is the relative standard deviation (RSD) calculated from results of replicate analyses. In laboratory analysis, precision is expressed as maximum allowable relative percent difference (RPD) between replicate recovery values. Precision will be assessed quantitatively with replicate samples and expressed as RPD by the following equation:

RPD (%) = 
$$\frac{|X_1 - X_2|}{\frac{X_1 + X_2}{2}} x100$$

where:

RPD (%) = relative percent difference
X<sub>1</sub> = Original sample concentration
X<sub>2</sub> = Replicate sample concentration

 $|X_1 - X_2|$  = Absolute value of  $X_1 - X_2$ 

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### 6.2.2 Accuracy and Bias

Accuracy is the degree by which measurements compare to generally accepted, well-defined standards. Bias is the estimate of a systematic error. In practice, bias is usually determined as the difference between the mean obtained from a large number of replicate measurements and a reference value. Accuracy and bias will be assessed as related to potential sources of contamination, and will be evaluated quantitatively.

Accuracy and bias, as related to contamination, involves both a field sampling and laboratory component. To assess all steps of the program (from sample collection through analysis), BWQP may collect and analyze equipment blanks, as deemed necessary (see <u>Section 7.2.2</u>).

#### 6.2.3 Representativeness

Representativeness is the ability of a sample to characterize the environmental conditions at the time of collection. The procedures identified throughout this QA program plan optimize the potential for obtaining samples that reflect the true state of the environment, within practical limits. Detailed sample collection and data measurement procedures are described in the respective SOPs included in the appendices to this QA program plan.

### 6.2.4 Comparability

Comparability, or the degree to which data from different studies or methodologies agree, is assessed qualitatively. Comparability expresses the confidence with which one data set can be compared to another. It describes the ability and appropriateness of making collective decisions with two or more data sets. Many variables may affect the descriptive value of the data; these include the following:

- Variables of interest in each data set.
- Use of common units.
- Similarity of methods and QA/QC.
- Timeframes.
- Season.
- Weather.
- Equipment.

The analytical methods to be used by the chosen certified laboratory will be EPA Methods or Standard Methods, both well-documented and published methods for surface-water analyses. In addition, the analytical reports will be in consistent units of measure, such as milligrams per liter (mg/L) or micrograms per liter ( $\mu$ g/L). <u>Table 3</u> lists the analytical parameters to be sampled and the methods to be used for the analysis.

### 6.3. Data Checks

BWQP staff perform a series of data checks prior to and during the uploading of electronic data to the BWQP database ("the data warehouse"). Laboratory reports are received electronically and in paper copy. The QA Officer reviews these files to assure that the results are consistent. The chain-of-custody sheet is used to verify that data have been reported for all samples submitted to the laboratory. In addition, a series of macros check the data during upload to the data warehouse. The use of macros is to check data quality is described in Section 11.1 of this QA program plan.

Macros are used to efficiently perform checks on the data for samples collected by BWQP staff, as well as data from other sources. For example, analytical and field data for water quality are downloaded from the USGS database for surface waters throughout Nevada. The USGS National Water Information System (NWIS) is a comprehensive and distributed application that supports the acquisition, processing, and long-term storage of water data.

Because of its large size, BWQP cannot effectively sample every waterbody in the state (Nevada is the seventh largest state (110,567 square miles) out of all 50 states, and is largely rural). Other agencies in southern Nevada routinely sample waterbodies in and around the greater Las Vegas area. These data are compiled into a database hosted by the Southern Nevada Water Authority (SNWA). Rather than duplicate what is already a large-scale program, BWQP retrieves these data from the SNWA database for assessment of waters in the Colorado River Basin.

## 6.4 Water-Quality Assessment and Reporting Tool (WART)

BWQP's new program, the Water-quality Assessment and Reporting Tool (WART) uses data in the data warehouse to assess water quality conditions against water quality standards for waterbodies across the state. Waterbody segments have designated beneficial uses and water quality criteria designed to protect those uses. The capabilities of WART, which went to production at the end of 2018, also allow BWQP staff to efficiently check all data for any waterbody in the state, and to compare those data against existing standards. In addition, the effect of new possible standards can be evaluated by creating a separate test cycle in WART. Viewing data over time for a specific waterbody or sampling site also allows outliers to be easily evaluated, and as such, WART provides as an additional check on the data.

To develop the 2016-2018 Water Quality Integrated Report, the designated beneficial uses for each waterbody segment were evaluated to determine their support status. A given beneficial use was considered to be fully supported if the applicable water quality criteria (i.e., standards) were met. Likewise, a beneficial use was not supported if any one of the applicable water quality criteria for that use was not met. In some instances, there may not have been enough information to make a use-support evaluation; such waters are assigned as Category 3 waters ("insufficient data to assess"). Data from long-term monitoring, rotational focus basin, organic chemical sampling, special projects, and the bioassessment program are all used in the biennial water quality assessment.

Setting up WART to assess water quality required BWQP staff to populate descriptions and data for all waterbodies or waterbody segments, along with all associated water quality standards, and to designate the assessment cycle. There were nearly 500 standards created in WART to assess conditions in nearly 700 waterbodies or waterbody segments throughout Nevada over the 7-year time period evaluated in the *2016-2018 Water Quality Integrated Report*.

#### Exhibit 2 – The Use of Standards and Data in WART

**Standard groups** include the following: Ammonia 118, Fish Tissue Group, Human Health, Less Restrictive Uses, NV01 Northwest, NV02 Black Rock, NV03 Snake, NV04 Humboldt, NV06 Truckee, NV08 Carson, NV09 Walker, NV10 Central, NV11 Great Salt Lake, NV13 Colorado, Sediment Group, and Toxics 1236. The 16 standard groups help organize the nearly 500 standards that apply in Nevada. These groups were further broken down into standard sets, which are based on water quality standards tables found in the NAC.

**Standard sets** represent a set of waterbody-specific or beneficial-use-specific standards that are applied to each waterbody or waterbody segment. Most sets are associated with a specific table in NAC 445A.1258 through NAC 445A.2214, but some sets apply across waterbodies. Broadly applicable standards, such those for ammonia (NAC 445A.118) or toxic materials (NAC 445A.1236), are mainly organized by beneficial use. Each standard set contains all the criteria values (or formulas for calculating criteria values) for each parameter in that set. The broadly applicable standards apply to all designated waters for which there is an aquatic-life beneficial use (in the case of ammonia), and to designated waters for which there is aquatic life or irrigation or municipal and domestic supply or watering of livestock (in the case of toxics).

#### Field versus Laboratory Data

Some of the available datasets include both field and laboratory values. For pH, temperature, TDS and some other parameters (e.g., SAR), "analysis" variables were created in WART, using logic sequences so that the tool could examine the data for the preferred form, or use the second choice for conducting the assessment if there were no data for the preferred choice. "Analysis" variables were also created to select appropriate values from some of the data (e.g., minimum DO values). The use of "if, then, else" logic meant that "analysis" variables could be created to use data for total metals if data for the dissolved fraction were lacking. Setting up such conditional statements in the database (i.e., the data warehouse) allows WART to maximize use of existing data during the assessment process.

## 7.0 Quality Control Requirements

This section identifies the QC checks that are in place for the sample collection, field measurement, and laboratory analysis that are used to assess the quality of the data generated from this program. To properly interpret water quality sampling data, the analyst should understand the sources of variability and possible contamination associated with sample collection, processing, and analysis.

## 7.1 Field Procedures Quality Control

The BWQP controls the quality of collected data by using standardized methods that are documented in BWQP's most current SOPs (see <u>Appendix A</u>). All BWQP staff must be familiar with these protocols and collect data in accordance with the procedures as they are defined in the SOPs and this QA program plan. Newly hired BWQP staff will learn sampling procedures through training and apprenticeship with experienced BWQP personnel.

The quality of field activities is checked via periodic field audits. The field audits are performed periodically as resources allow. BWQP staff to be audited will be randomly selected and the field audits will be performed by the program's QA Officer or designated staff.

## 7.2 Field Sampling Quality Control

The collection of field QC samples is an important part of the continuing effort to improve the quality of the resultant data by assessing and possibly refining the collection, handling, and transportation techniques used by the BWQP. QC samples include field replicate samples and equipment blank samples. QC samples, in the form of replicate samples, are collected at a frequency of approximately 10% of the surface-water samples collected for laboratory analysis.

#### 7.2.1 Field Replicate Samples

Replicate samples consist of two or more samples collected or processed so that the samples are considered to be essentially identical in composition. Replicate samples are prepared by dividing a single volume of water into multiple samples. Replicate samples are preserved, packaged, and sealed in the same manner described for the surface water samples. Previously, a fictitious sample ID was assigned to replicate samples, but this produced confusion when loaded into the database. Because of this confusion, a new labeling strategy was devised. Although not explicitly identified to the laboratory as a field replicate, the replicate sample is labeled with the site ID followed by "\_00" added to the ID.

Field replicate samples provide a measure of the variability introduced during sample collection, processing and analysis. BWQP will collect a minimum of one replicate sample during each sampling event. Field replicate samples will be collected at random from the established sampling sites. If QC criteria are exceeded, field sampling and handling procedures will be evaluated, and problems corrected through greater attention to detail, additional training, revised sampling techniques, or other appropriate means.

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## 7.2.2 Equipment Blanks

The BWQP may collect equipment blanks as needed. In general, however, sampling procedures call for triple rinsing of sampling equipment with site water prior to sampling, and rinsing with bleach solution followed by a clean (tap) water rinse, after sampling at each site. Following this decontamination, sampling equipment is triple-rinsed with stream water from the next sampling site prior to collecting the sample at that site. The decontamination of sampling equipment assures that invasive species are not carried from one site to the next, and the triple rinsing of equipment prior to collecting a sample assures that the sample collected is free from cross-contamination and is representative of water quality at that site.

Equipment blanks are prepared in the field and used to demonstrate that equipment has been adequately cleaned to remove contamination introduced by samples obtained at the previous site, and that sample collection and processing have not introduced contaminants to the sample, nor has sample handling and transport. Equipment blanks are collected by running analyte-free water through the sample collection equipment after decontamination and before sample collection. The equipment blank is then collected in the appropriate sample container with the proper preservative, identical to the regular samples. Equipment blanks are preserved, packaged, and sealed in the same manner described for the surface water samples. A separate sample number and station number are assigned to each equipment blank. Equipment blanks are submitted blind to the laboratory for analysis.

If target analytes are found in equipment blanks, sampling and handling procedures will be reevaluated and corrective actions taken. These may consist of, but are not limited to, obtaining sampling containers from new sources, additional training of personnel, discussions with the laboratory, invalidation of results, greater attention to detail during the next sampling event, or other appropriate procedures.

## 7.3 Laboratory Analyses Quality Control (Off-Site)

QC at offsite laboratories is the responsibility of the personnel and QA/QC staff at laboratories used by the BWQP for water quality analyses. Most water quality samples are analyzed by the Nevada State Public Health Laboratory. The laboratory's QA Management Plan and analytical SOPs have been reviewed and certified by NDEP's Laboratory Certification Program. Accordingly, associated laboratory QC (types and frequencies of QC samples and QC acceptance limits) have been determined to be adequate to meet the data quality needs of BWQP's water quality programs (see <u>Appendix C</u>).

## 8.0 Inspection and Acceptance of Supplies and Consumables

## 8.1 Field Sampling Supplies and Consumables

Containers and preservatives for bacteria and metals samples are provided by the certified laboratory. Containers are inspected for breakage and proper sealing of caps. Containers and preservatives that are not provided by a certified laboratory will be approved by a certified laboratory.<sup>4</sup> All bottles are stored out of direct sunlight. Other equipment such as sample coolers and safety equipment will be acquired by the BWQP. Materials and supplies necessary for equipment decontamination will also be purchased by the BWQP. Any equipment deemed to be in unacceptable condition will be repaired or replaced.

## 8.2 Field Measurement Supplies and Consumables

Field measurement supplies, such as calibration solutions, are acquired from standard sources, such as the instrument manufacturer or reputable suppliers. Chemical supplies will be American Chemical Society reagent grade or higher. The expiration date on standards and reagents is checked prior to use. Expired solutions are properly discarded and replaced.

## 8.3 Laboratory Analyses (Off-Site) Supplies and Consumables

Supplies and consumables required by the chosen certified laboratory are the responsibility of the QA/QC department of the laboratory.

<sup>&</sup>lt;sup>4</sup> The containers and preservatives for routine parameters are purchased from an outside vendor.

## 9.0 Field Assessment and Oversight

This section describes how field activities are checked to ensure that they are completed correctly and according to procedures outlined in this QA program plan. Periodic assessment of the program's activities assures that this QA program plan is being implemented as planned. This helps minimize critical deviations before it is too late to remedy the situation.

## 9.1 Readiness Reviews

Sampling personnel are properly trained by qualified personnel before conducting monitoring activities. BWQP staff complete a checklist and review all field equipment, instruments, containers, and paperwork to ensure that all is in readiness prior to the first day of each sampling event. Any problems that are noted are corrected before the sampling team departs the BWQP's facilities.

## 9.2 Field Audits

The program QA Officer or designated staff accompany each field personnel at least once per year to assess the sample collection methodologies, field measurement procedures, and record-keeping. This helps to ensure that activities are being conducted as planned (and as documented in this QA program plan). Any deviations that are noted will be corrected immediately so that all subsequent samples and field measurements collected are valid. If any of the deviations are associated with technical changes or improvements made to the procedures, the program QA Officer or designated staff will verify that the changes have been documented by the BWQP staff on the field sheets and addressed in an amendment to this QA program plan. The program QA Officer or designated staff may stop any sampling activity that could potentially compromise data quality.

The program QA Officer or designated staff will document any noted issues or concerns and discuss these items informally and openly with the BWQP staff while on site. Once back in the office, the program QA Officer or designated staff will formalize the audit findings in a Field Audit Report which is submitted to the BWQP Bureau Chief and staff.

#### 9.3 Post-Sampling Event Review

Following each sampling event, BWQP staff will complete a review of the field activities. This review of field sampling and field measurement documentation helps ensure that all information is complete and any deviations from planned methodologies are documented. This review is conducted in the office, not in the field. The results of this review, as well as comments associated with potential impacts on field samples and field measurement integrity may be used to prepare a report for the sampling event. This report will be used as a guide to identify areas requiring improvement prior to the next sampling event.

## **10.0 Laboratory Assessment and Oversight**

Programs within BWQP employ only those laboratories certified by the Certification Branch of the BSDW at NDEP. The certified laboratory is responsible for its own internal data review and verification prior to submitting the associated data results package to the program QA Officer or designated staff. Historically, most of BWQP's water quality samples have been analyzed by the Nevada State Public Health Laboratory; however, a different laboratory may be selected during the next contract period. Appendix C, which currently contains the most-recent finalized QA management plan for the State Health Laboratory, will be updated if a new laboratory is contracted. The QA management plan will detail data review procedures (including checking calculations, reviewing for transcription errors, ensuring the data package is complete, etc.), and the associated consequences or remedies.

## 11.0 Data Management

All data collected by the BWQP are maintained both as paper laboratory reports in binders and digitally in the BWQP data warehouse, which is a Microsoft SQL server platform. The hard copy and electronic results are compared to ensure that the data are in agreement. If discrepancies are noted, the laboratory is contacted to resolve the issues. Field measurements are hand-entered into a digital data form and are uploaded to the BWQP's data warehouse. All data uploaded to the warehouse undergoes a series of checks and verifications as part of the upload process.

#### 11.1 Data Review and Upload to BWQP's Data Warehouse

NDEP receives data from five main data sources: (1) Nevada State Health Laboratory, (2) Nevada Department of Agriculture Laboratory (pesticides only), (3) Eurofins (organic compounds only), (4) USGS, and (5) SNWA (Colorado River basin only). Because the data warehouse database accepts data in only one format, all of the data from the different sources need to be tailored to fit the warehouse format. BWQP has developed a series of macro enhanced Microsoft Excel workbooks to cross check the data and transform it into the import format.

Validating the data prior to input into the data warehouse constitutes a large portion of the macros. The macros check for consistency of measurement units, and translate units and values as necessary. The macros also attribute replicate/duplicate samples as needed, check for data values outside of the normal expected range, and attribute data with appropriate qualifiers. In addition, the macros check for and cross-walk station IDs, agency names, parameter names, test methods, units, and other variables. After the data upload has been run through the macros, one last manual check is conducted prior to import. Upon import, the data warehouse has its own data validation routines that will produce a report of all data not accepted for import. Those data are reviewed manually to determine why they were rejected from the upload to the data warehouse. The two separate processes for validating that the data ensures that the data stored and used for water quality assessments does not contain unchecked outliers.

Data collected by BWQP and other entities across Nevada are maintained in BWQP's database. However, only data collected by BWQP is made available to the public via BWQP's webmap application. The web-based application makes all water quality data collected by BWQP available to other agencies and the public <u>https://nevadawaterquality.ndep.nv.gov/</u>. BWQP data are also regularly uploaded to the EPA data exchange, and are available for anyone to retrieve, including the public, at <u>https://www.waterqualitydata.us/portal/</u>.

## 12.0 Data Usability

Water quality data are collected to support numerous BWQP programs, including development of water quality standards and TMDLs and assessment of water quality conditions. Prior to using data to make program decisions, the quality of the data is reviewed and evaluated to determine whether the data satisfy the program's objectives. This process involves technical evaluation of the off-site laboratory data, as well as review of the information collected during the field sampling and measurement activities. The latter is a more-qualitative review and provides a better understanding about the overall usability of the data and potential limitations on usability. Table 6 shows the elements of laboratory results that are included in the laboratory analytical reports.

After all the data from the field and laboratory have been evaluated, the program QA Officer or designated staff makes an overall assessment concerning the final usability of the data (and any limitations on its use) in meeting the program's needs. The initial steps of this assessment include, but are not necessarily limited to:

- Discussions with the BWQP staff.
- Review of deviations from this QA program plan or associated SOPs to determine whether these deviations may have adversely affected data quality (and determining whether any impacts are widespread or single incidents, related to a few random samples or a batch of samples, or affecting a single or multiple analyses).
- Evaluation of the field and laboratory results and QC information, including comparison of chain of custody sheets with data received to be certain all samples are accounted for, along with a comparison of paper and electronic data deliverables.
- Review of any other external information which might influence the results, such as out-of-state activities upstream, meteorological conditions (e.g., storm events proceeding sampling that might contribute to high turbidity readings), and data from other sources.
- Examination of any assumptions made when the program was planned, if those assumptions were met, and, if not, how the program's conclusions are affected.
- Evaluating the data to determine if it is adequate for the objectives of the planned program.

After all this information has been reviewed, the program QA Officer or designated staff will incorporate his or her perspective on the critical nature of any problems noted and, ultimately, identify any data usability limitations in supporting program objectives and decision making. Data used in monitoring and assessment program are not used for compliance purposes and are not subject to independent, third-party validation.

In addition, the program QA Officer or designated staff will assess the effectiveness of the monitoring program and data collection at the end of each calendar year. Sampling locations, frequency, list of analytical parameters, field measurement protocols, choice of the analytical laboratory, etc. will be modified as needed to reflect the changing needs and program objectives of the BWQP. This QA program plan will be revised or amended, accordingly.

## Table 6: Elements of Laboratory Results

Laboratory Field	Explanation
Accession No	Lab ID number
Client	Nevada Division of Environmental Protection
Client Address	901 S. Stewart Street
Client City	Carson City
Client State	Nevada
Client Zip	98701
Date Time Collected	Date and Time Sample Collected
Sampled By	Sampler(s) Name
Date Time Received	Date and Time received by Laboratory
Report Date Time	Time and Date of Report
Analysis Type	Describes which environmental Act this analysis done under: CWA or SDWA or RCRA. BWQP's analyses are always CWA.
General Location	BWQP Control Point name
Source Address	Station ID
Sample City	General Location (City, Basin)
Sample State	Nevada
Sample County	County
Report To Contact	NDEP Contact
Report To	Nevada Division of Environmental Protection
Report Address	901 S. Stewart Street
Report City	Carson City
Report State	Nevada
Report Zip	98701
Comments	Comment on sample, e.g., out of holding time
Test	Parameter
Test Method	Analysis Method
Sign	Qualifier (<, >, etc.)
Result	Value if detected, MDL (toxics) or reporting limit if non-detect, quantitation high limit if exceeds linear working range
Units	Generally mg/L or μg/L
Sample Reporting Limit	Reporting limit
Analysis Date	Date Sample analyzed
Analyst	Chemist Name

## **13.0** Documents and Records

### 13.1 Laboratory Documentation and Records

Most water quality samples are analyzed by the Nevada State Public Health Laboratory. The laboratory's QA Management Plan details documentation and record-keeping requirements (see <u>Appendix C</u>).

### 13.2 Technical Reviews and Evaluations

As part of the QA efforts for the program, on-going technical reviews will be conducted and documented. These reviews are associated with both field activities and the data generated by the off-site laboratory.

## 13.3 Quarterly Reports

Once each quarter, the supervisor of BWQP's Water Quality Standards, Monitoring, and Assessment Branch will prepare and submit a report on that quarter's sampling activities. This report will be submitted to the BWQP Bureau Chief for approval. After approval, the report will be submitted to the EPA Grants Project Officer.

## **14.0 REFERENCES**

- Environmental Protection Agency, 1991. Office of Emergency and Remedial Response (OERR) Directive 9345.302, May 1991.
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- Environmental Protection Agency, 2005. *Quality Assurance Project Plan for Monitoring of Surface Water* –*Eagle Valley Reservation,* September 2005.

<u>https://www.epa.gov/sites/production/files/2015-06/documents/g4-final.pdf</u> Additional information is available at: <u>https://www.epa.gov/quality/epas-elements-systematic-planning-data-quality-assurance</u>.



Figure 7: View of Lake Tahoe, Looking Southward. Truckee River Basin.

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# **APPENDICES**
# APPENDIX A: STANDARD OPERATING PROCEDURES FOR FIELD WORK

- Appendix A-1: Standard Operating Procedures for Field Meter Calibration and Maintenance
- Appendix A-2: Standard Operating Procedures for Collecting Stream Samples and Field Measurements
- Appendix A-3: Standard Operating Procedures for Collecting Lake/Reservoir Samples and Field Measurements
- Appendix A-4: Standard Operating Procedures for Transporting and Operating Boats
- Appendix A-5: Standard Operating Procedures for the Deployment of Temperature Loggers
- Appendix A-6: Standard Operating Procedures for Unattended Deployment of Data Sondes
- Appendix A-7: Standard Operating Procedures for Unattended Deployment of the Onset HOBO Dissolved Oxygen Data Logger
- Appendix A-8: Standard Operating Procedures for Streamflow Measurements of Wadeable Streams
- Appendix A-9: Standard Operating Procedures for Transporting and Operating All-Terrain Vehicles
- Appendix A-10: Standard Operating Procedures for Decontamination of Field Equipment to Limit the Spread of Invasive Species
- Appendix A-11: Standard Operating Procedures for Sampling for Harmful Algal Blooms

Appendix A-1: Standard Operating Procedures for Field Meter Calibration and Maintenance

## Standard Operating Procedures for Field Meter Calibration and Maintenance

## Prepared by: State of Nevada Department of Conservation and Natural Resources Division of Environmental Protection Bureau of Water Quality Planning Carson City, Nevada

February 2020

**APPROVALS:** 

Paul Comba NDEP BWQP Chief Date: 2020 **Dave Simpson** NDEP BWQP Quality Assurance Officer: Date: 3-4-20

#### **Field Meter Calibration and Maintenance**

#### pH and DO Meter

#### MAINTENANCE AND STORAGE:

The dual electrodes (pH and DO) and meter are maintained and stored per manufacturer's instructions.

#### **CALIBRATION PROCEDURES:**

The dual pH and DO meter is calibrated per manufacturer's instructions.

pH Electrode							
<b>Calibration Activity</b>	Frequency	Acceptance Criteria	<b>Corrective Action</b>				
Two-point calibration bracketing expected field sample range (using 7.0 and 10.01 pH buffer). Analysis check of 7.0 pH	Beginning of each day. After initial	Two-point calibration done electronically. Calibration slope must be between 90 and 110%. Within ± 0.1 pH units	Recalibrate. Recalibrate.				
buffer.	calibration	of true value (7.0)					
Analysis check of 7.0 and 10.01 pH buffers.	End of each day.	Within ± 0.2 pH units of true value at both end points (7.0 and 10.01).	Qualify data.				
Side-by-side comparison of the pH meters in a laboratory setting.	Quarterly.	± 0.2 pH units.	Recalibrate. Return inaccurate meter to manufacturer or official repair company for refurbishment.				
	DO Ele	ctrode					

#### HYDROLAB DATA SONDES

### MAINTENANCE AND STORAGE:

The HYDROLAB DS5 DATA SONDES are maintained and stored per manufacturer's instructions.

### CALIBRATION PROCEDURES:

The HYDROLAB DS5 DATA SONDES are calibrated per manufacturer's instructions.

DISSOLVED OXYGEN						
Calibration Activity	Frequency	Acceptance Criteria	<b>Corrective Action</b>			
One-point calibration with	Beginning of	One-point calibration	Recalibrate.			
saturated air.	each day.	done electronically.	Return inaccurate			
			probe to			
			manufacturer or			
			official repair			
			company for			
			refurbishment.			
Side by side comparison of the	Quarterly.	± 0.3 mg/L.	Recalibrate.			
Hydrolab Data Sondes in a			Return inaccurate			
laboratory setting.			probe to			
			manufacturer or			
			official repair			
			company for			
			refurbishment.			
	р	H				
Calibration Activity	Frequency	Acceptance Criteria	Corrective Action			
Two-point calibration	Beginning of	Two-point calibration	Recalibrate.			
bracketing expected field	each day.	done electronically.	Return inaccurate			
sample range (using 7.0 and			probe to			
10.01 pH buffer).			manufacturer or			
			official repair			
			company for			
			refurbishment.			
Analysis check of 7.0 pH	After initial	Within ± 0.1 pH units	Recalibrate.			
buffer.	calibration	of true value (7.0)				
Analysis check of 7.0 and 10.01	End of each	Within ± 0.2 pH units	Qualify data.			
pH buffers.	day.	of true value at end				
		points (7.0 & 10.01).				
Side by side comparison of the	Quarterly.	± 0.2 pH units.	Recalibrate.			
Hydrolab Data Sondes in a			Return inaccurate			
laboratory setting.			probe to			
			manufacturer or			
			official repair			
			company for			
			refurbishment.			

HYDROLAB DATA SONDES continued						
SPECIFIC CONDUCTANCE						
Calibration Activity	Frequency	Acceptance Criteria	<b>Corrective Action</b>			
Two-point calibration.	Beginning of	Two-point calibration	Recalibrate.			
Calibrate the sensor to zero	each day.	done electronically.	Return inaccurate			
and then to the slope buffer.			probe to			
			manufacturer or			
			official repair			
			company for			
			refurbishment.			
Analysis check of zero and	After initial	Within $\pm$ 5 $\mu$ S/cm of	Recalibrate.			
slope buffer.	calibration	true value at zero and				
		slope buffer.				
Analysis check of zero and	End of each	Within $\pm$ 5 $\mu$ S/cm of	Qualify data.			
slope buffer.	day.	true value at zero and				
		slope buffer.				
Side by side comparison of the	Quarterly.	± 5 μS/cm.	Recalibrate.			
Hydrolab Data Sondes in a			Return inaccurate			
laboratory setting.			probe to			
			manufacturer or			
			official repair			
			company for			
			refurbishment.			
	TENADE					
Calibration Activity	I EIVIPEI Eroguopou	Accontance Criteria	Corrective Action			
Check of ondpoints of desired	Quartarly	$\pm 0.2^{\circ}$ C of true	Poturn inaccurato			
	Quarterly.	$\pm 0.5$ C of the	nroho to			
National Institute of Standards		endnoints (i e	manufacturer or			
and Technology (NIST)		manufacturer's listed	official renair			
certified thermometer		accuracy for the	company for			
		sensor).	refurhishment			
			reiuivisiinient.			

#### YSI 550A DISSOLVED OXYGEN METER

#### MAINTENANCE AND STORAGE:

The YSI 550A DO meter is maintained and stored per manufacturer's instructions.

#### **CALIBRATION PROCEDURES:**

The YSI 550A DO meter is calibrated per manufacturer's instructions.

DISSOLVED OXYGEN							
Calibration Activity	Frequency	Acceptance Criteria	<b>Corrective Action</b>				
One-point calibration with	Beginning of	One-point calibration	Recalibrate.				
saturated air.	each day.	done electronically.	Change membrane				
		Record elevation and	then recalibrate.				
		Calibration Value.	Return inaccurate				
			meter to YSI-				
			approved repair				
			company.				
Calibration check.	At each site.	Within ± 2% of	Recalibrate.				
		original Calibration					
		Value (read in Percent					
		Saturation mode).					
Side by side comparison of the	Quarterly.	± 0.3 mg/L.	Recalibrate.				
YSI 550A DO meters in a			Change membrane				
laboratory setting.			then recalibrate.				
			Return inaccurate				
			meter to YSI-				
			approved repair shop.				
	TEMPE	RATURE					
Calibration Activity	Frequency	Acceptance Criteria	Corrective Action				
Check of endpoints of desired	Quarterly.	$\pm 0.3^{\circ}$ C of true	Return inaccurate				
temperature range versus a		value at both	meter to YSI-				
NIST certified thermometer.		endpoints (i.e.,	approved repair shop.				
		manufacturer's listed					
		accuracy for the					
		sensor).					

#### **TEMPERATURE DATA LOGGERS**

#### MAINTENANCE AND STORAGE:

The TEMPERATURE LOGGERS are maintained and stored per manufacturer's instructions.

#### **CALIBRATION PROCEDURES:**

The TEMPERATURE LOGGERS are calibrated per manufacturer's instructions.

TEMPERATURE							
<b>Calibration Activity</b>	Frequency	Acceptance Criteria	<b>Corrective Action</b>				
Check of endpoints of	Pre- and	±0.5° C of a NIST	Return inaccurate				
desired temperature range	post-	certified	temperature loggers				
versus a NIST certified	deployment	thermometer at both	to manufacturer or				
thermometer.		endpoints (i.e.,	official repair				
		manufacturer's listed	company for				
		accuracy for the	refurbishment.				
		sensor).					

#### **DISSOLVED OXYGEN DATA LOGGERS**

#### MAINTENANCE AND STORAGE:

The dissolved oxygen (DO) data loggers are maintained and stored per manufacturer's instructions. <u>https://www.onsetcomp.com/products/data-loggers/u26-001</u>

#### **CALIBRATION PROCEDURES:**

The DO data loggers are calibrated per manufacturer's instructions.

#### DISSOLVED OXYGEN

Calibration Activity	Frequency	Acceptance	Corrective
		Criteria	Action
Check of endpoints of desired DO	Pre-deployment and	±0.5° C of a	Return
saturation range (100% and 0%	check every 2 weeks	NIST certified	inaccurate
saturation) following the manufacturer's	for calibration while	thermometer	temperature
instructions.	deployed. If outside of	at both	loggers to
https://www.onsetcomp.com/files/manu	acceptance range,	endpoints (i.e.,	manufacturer
al pdfs/15603-J%20MAN-U26x.pdf	recalibrate, following	manufacturer'	or official
	manufacturer's	s listed	repair
	instructions.	accuracy for	company for
		the sensor).	refurbishmen
			t.

Appendix A-2: Standard Operating Procedures for Collecting Stream Samples and Field Measurements

# Standard Operating Procedures for Collecting Stream Samples and Field Measurements

Prepared by: State of Nevada Department of Conservation and Natural Resources Division of Environmental Protection Bureau of Water Quality Planning Carson City, Nevada

February 2020

**APPROVALS:** 

Paul Comba NDEP BWQP Chief:

Dave Simpson NDEP BWQP Quality Assurance Officer:

Date: 3/5/2020

Date:

3-4-20

## Standard Operating Procedures for Collecting Stream Samples and Field Measurements

## 1.0 PURPOSE AND APPLICABILITY

This document describes the procedure for (1) collection of water quality samples from rivers and streams and transport to the laboratory, and (2) collection of field measurements from rivers and streams.

## 2.0 FIELD EQUIPMENT PREPARATION

Prior to going to the field, make sure that the electrodes (pH and DO) are working properly and that the meter batteries have sufficient charge. If batteries are needed for these instruments, do not mix depleted and fresh batteries together or serious injury and instrument damage may occur.

## 3.0 DATA AND SAMPLE COLLECTION

If possible, sites should be sampled in the order of least to greatest potential for equipment fouling or contamination. If possible, sites should be sampled in the order of least to greatest potential for infestation of invasive species. If it is not possible to sample in the order of least to greatest potential for infestation of invasive species then follow the instructions in the SOP for Decontamination of Field Equipment to Limit the Spread of Invasive Species (Appendix A-10).

The stream must have sufficient flow to allow collection of a representative sample. If water is ponded and no flow is observed, do not sample and mark sampling sheet accordingly. Best professional judgment is used to determine if conditions are acceptable for sample collection.

#### 3.1 At the Beginning of the Sampling Day

Calibrate the DO electrode and record the date, time, elevation (feet), and calibration value (% slope) on the field sheet. See Appendix A-1 for calibration instructions.

Calibrate the pH electrode and record the date, time, (% slope), and pH value of the buffer analysis check on the field sheet prior to collecting the water sample. See Appendix A-1 for calibration instructions.

## 3.2 Prior to Collecting the Field Measurements and Water Sample

Fill out the date, time, collected by, basin, control point, station ID, weather, and air temperature fields on the field sheet. Be sure to get the air temperature readout before turning off the vehicle. Retrieve and label with the site ID, all the empty sample bottles needed for the site.

#### 3.3 Taking pH/DO/Water Temperature Measurements and Collecting the Water Sample

If possible, pH/DO/water temperature measurements and water samples are to be collected from a representative portion of the stream, typically the centroid of flow. Be sure to remove the buffer-filled cap from the pH electrode before lowering the electrodes in the stream. (If sampling in the winter, keep the probes in the cab of the truck in-between sampling sites.)

Gently lower the DO and pH electrodes into the stream. Make sure that the pH and DO electrodes are not in an area where bottom deposits cover the electrodes. If possible, take the pH/DO/temperature measurements upstream of where the water sample is being collected.

After the pH, DO and water temperature readings have stabilized, the meter will beep and the meter display will show that pH and DO have "locked." Remove the electrodes from the water, taking care that the electrodes do not bang into rocks or bridge structures. Place the protective cap back on the pH electrode. Do not turn meter off, but carefully return to the vehicle or other safe location to record these measurements from the meter onto the field sheet.

If the meter shuts off before the readings can be written down, the data from the most-recent set of measurements can be retrieved by recalling the last reading.

#### 3.3 Filling the Sample Bottles

Put on clean nitrile gloves while filling all sample bottles.

Sample bottles should remain closed until bottle is ready to be filled. Remove lid from the sample bottle just prior to filling.

While filling the sample bottles keep pumping the churn splitter at an even rhythm, approximately one stroke every three seconds.

#### <u>Bacteria</u>

Do not rinse bottle. Fill the 120 mL bacteria bottle to the shoulder/neck of the bottle. *Make sure not to overfill* because the bottle is prepared with sodium thiosulfate preservative. Cap the bottle immediately after filling it. Upend the bottle several times to mix the sodium thiosulfate into the water sample. Immediately place the bacteria sample in the thermoelectric cooler. *Do not pre-rinse the bacteria bottle because it contains sodium thiosulfate prepared in the laboratory.* 

#### **Dissolved Metals**

If taking a sample for analysis of dissolved metals, begin by rinsing the filter transfer bottle with 10 to 15 mL of sample water from the churn splitter. Screw the cap onto the filter transfer bottle and shake to rinse, then discard the rinse water. Repeat. Then fill the filter transfer bottle with enough water to fill the 500 mL dissolved metals bottle. DO NOT RINSE THE METALS BOTTLE. Attach the pump and the filter cartridge, *making sure not to touch the inlet and the outlet of the filter cartridge*. Slowly pump the water from the filter transfer vessel through the filter into the 500 mL dissolved metals bottle to the shoulder/neck of the bottle. Make sure not to overfill because the bottle is already prepared with nitric acid. Cap the bottle immediately after filling it. Upend the bottle several times to mix the nitric acid in the water sample. Immediately place the dissolved metals sample in an ice chest and cover with wet ice. *Do not field rinse the dissolved metals bottle because it is pre-acidified* (i.e., it contains nitric acid).

#### <u>Total Metals</u>

If taking a sample for analysis of total metals, fill the 500 mL total metals bottle from the churn splitter to the shoulder/neck of the bottle. DO NOT RINSE THE METALS BOTTLE. Make sure not to

overfill the bottle because it is already prepared with nitric acid for sample preservation. Cap the bottle immediately after filling it. Upend the bottle several times to mix the nitric acid in the water sample. Immediately place the total metals sample in an ice chest and cover with wet ice. **Do not field rinse the total metals bottle because it is pre-acidified with nitric acid.** 

#### **Routine Parameters**

**Blue cap**. The half-gallon bottles from Model Dairy are used as sample bottles for routine parameters. These bottles do not contain any preservative and should be rinsed twice in the field before collecting the sample. Drain a small amount (10-15 mL) of water from the churn splitter into routine parameters bottle with the blue cap. Place the cap on the bottle, but do not seal it. Rinse the bottle and blue cap and discard the rinse water. Repeat. Then fill the bottle from the churn splitter to the shoulder/neck of the bottle. Seal the blue cap onto the bottle. Immediately place the blue cap bottle into an ice chest and cover with wet ice.

**Red cap.** The half-gallon bottles from Model Dairy are used as sample bottles for routine parameters. These bottles do not contain any preservative and should be rinsed twice in the field before collecting the sample. Drain a small amount (10-15 mL) of water from the churn splitter into routine parameters bottle with the red cap. Place the cap on the bottle, but do not seal it. Rinse the bottle and red cap and discard the rinse water. Repeat. Then fill the bottle from the churn splitter to the shoulder/neck of the bottle. After filling the bottle, add 5.0 mL of 96% sulfuric acid and seal the red cap on the bottle. Upend the bottle with the red cap several times to mix the sulfuric acid in the water sample. Immediately place the red cap bottle into an ice chest and cover with wet ice. Discard the empty acid ampoule in the acid-waste ampoule container.

#### 3.6 Field Sheet Completion and Review

Prior to leaving the sampling site, write any comments on the field sheet and fill out the narratives section (settleable solids that form bottom or sludge deposits; floating debris; oil, grease, scum, and other floating materials; odor; and color, turbidity, or other conditions).

Review the field sheet to ensure completeness, and have the second field person (i.e., a person other than the one who filled out the form) check over the form before leaving the site.

## 3.7 Decontamination of Field Equipment to Limit the Spread of Invasive Species

After sampling all streams—especially those that are suspected or known to contain invasive species clean and decontaminate all sampling equipment prior to the leaving the sampling site. For further information read the SOP for *Decontamination of Field Equipment to Limit the Spread of Invasive Species* (see Appendix A-9).

## 3.8 Completing the Bacteria Forms and the Chain-of-Custody Sheet Prior to Sample Delivery

Samples must remain under the samplers' control until the samples are delivered to the laboratory, as indicated on the chain-of-custody sheet. Fill out the bacteria forms and the chain-of-custody sheet before arriving at the laboratory. As a courtesy, when delivering samples to the Nevada State Health Laboratory for analysis, be sure to call the lab after collecting the last sample, or about 30 to 60 minutes prior to arriving at the laboratory.

Attachments

## **Stream Sampling Equipment Checklist**

### Number of Expected Samples: \_\_\_\_\_

Paper	work
<ul> <li>Clipboard</li> <li>Water Chemistry Chain of Custody</li> <li>Field Sheets</li> </ul>	<ul> <li>Pens/Sharpies</li> <li>Bacteria Chain of Custody (1 per sample)</li> <li></li></ul>
Bott	les
Routine Parameters         Blue Lid Bottles (1 per sample)         Red Lid Bottles (1 per sample)         Sml Ampules of H2SO4 (1 per sample)²         Acid Waste Container         120ml Bacteria Bottles (1 per sample)²	<ul> <li>Metals</li> <li>500ml Preserved Metals Bottles (2 per sample)<sup>3</sup></li> <li>Filters (1 per sample)</li> <li>Filter Transfer Vessel</li> <li>Vacuum/Pressure Pump</li> <li>250ml Glass DOC bottle(s)(1 per sample)<sup>4</sup></li> </ul>
Equip	ment
<ul> <li>pH Meter</li> <li>DO Meter</li> <li>pH Buffers (7.00 and 10.01)</li> <li>2-250ml pH Cups</li> <li>Deionized Water Squirt Bottle</li> <li>Nitrile Gloves</li> <li>Extra Batteries</li> </ul>	<ul> <li>Thermoelectric Cooler</li> <li>Ice Chest(s) With Ice</li> <li>Churn Splitter</li> <li>Dipper</li> <li>50ft Rope</li> <li>Waders</li> <li>Paper Towels</li> </ul>
Decontaminatio	on Equipment
<ul> <li>Pump Sprayer Containing 5% Bleach Solution</li> <li>Pump Sprayer Containing Clean Rinse Water</li> </ul>	<ul> <li>Eye Protection</li> <li>Portable Eyewash Bottle</li> <li>Stiff-bristled Brush</li> </ul>

<sup>1</sup> 120 ml Bacteria bottle contains sodium thiosulfate. Place bacteria bottles in thermoelectric cooler. Do not rinse.

 $^2$  The 5.0 ml of  $H_2SO_4$  is added to the bottle after it is filled from the churn with the water sample.

<sup>3</sup> Bottles contain 15% HNO<sub>3</sub> before addition of the water sample, 0.15% HNO<sub>3</sub> after. 1 sample is filtered. Do not rinse.

<sup>4</sup> Bottles contain 0.1% o-Phosphoric Acid after the addition of the water sample. Filter sample into bottle. Do not rinse.

FOR COMPLIANCE

#### **NEVADA STATE HEALTH LABORATORY** CHAIN OF CUSTODY FORM FOR WATER CHEMISTRY ANALYSIS NEVADA DIVISION OF ENVIRONMENTAL PROTECTION

University of Nevada School of Medicine 1660 North Virginia Street, Reno, NV 89503-1738 Phone: (775) 688-1335 Fax: (775) 688-1460

XXXX NOT FOR COMPLIANCE

OWNER INFO	ORMATION		REPORT TO INFORM	IATION	DELIVERED ON I	ICE BILL TO I	NFORMATION			
Owner: Address: City, St, Zip: Phone:	Bureau of Water Qu 901 S. Stewart St. Carson City 687-9444	uality Planning NV 89701 FAX: 687-5856	Owner: BWQI ATTN: John I Address: 901 S City, St, Zip: Carso Phone: 687-9	D Heggeness . Stewart St. n City, NV. 89701 444 Fax: 687-5856	Initals (Lab) Shipped Samples: Temp Blank	No Owner: Address: City, St, Z Phone: °C	BWQP 901 S. Stewart St. ip: Carson City, NV. 889701 687-9444 Fax: 687-5856 USE OF WATER		ble Metals Is	
다 고 고	SOURCE OF WA Spring Surface Well	TER Filter Depth (ft)	SAMPLE TYPE SDWA CWA Other	REASON FC         □       Public Wate         □       Private Resi         ☑       Other       State	DR ANALYSIS er Supply idence Surface Water	<ul> <li>Domestia</li> <li>Geothern</li> <li>Industrial</li> <li>Other:</li> </ul>	c Drinking Water nal 🗖 Irrigation or Mining <u>Various Uses</u>	e Pollution Trace Metals	Total Recovera	
Line Line	Date Tim Collected	e Station ID	Control Point		State	County	Remarks	Routine NDEP 7	NDEP 1	COD BOD Other
$     \begin{array}{r}       1 \\       2 \\       3 \\       4 \\       5 \\       6 \\       7 \\       8 \\       9 \\       10 \\       11 \\       12 \\       13 \\       14 \\       15 \\       16 \\       17 \\       18 \\       19 \\       20 \\     \end{array} $										
Collected B FOR LAB USI How sample w	By: E ONLY: vas delivered	C	Drop Off	Fed	Sample	ups	U.S. Postal		Ca	mpus Mail
Delivered By Sample is test NOTE: This d	ted as received. Ana locument will be dest	lytical results asso royed at NSHL afte	ciated with this requisition and er 12 years, unless Client reque	Date generated by NSHL are repr ests otherwise	Received By resentative only of	f the sample submit	ted to this laboratory.	Page	Date	

### NDEP STREAM SAMPLING FIELD SHEET

HACH ID #:						Sampling Event Post-Check
Calibration: Date: Time: pH Calibra			ation Slope: %		Date: Time:	
pH Buffers 0 4.01 0 7.00 0 10.01 Ca			libration post-	check	7.00= 10.01=	
DO Calibration Accepted? O Yes O No 7.00= 10.01=		DO saturation= %				
Control Point:						Station ID:
Date:	Time:	(	Collect	ed By:		Basin:
Water Temp:	DO: m	g/L p	pH:			Air Temp:
Weather:						Collection Method:
Comments:						
Waters Contain Su	bstances Attribut	table to	) Dome	stic or Industria	al Waste or Oth	er Controllable Sources Including:
Settleable solids that form	n bottom or sludj	ge depo	osits:	O YES O NO	Comments:	
	Floa	iting de	ebris:	O YES O NO		
Oil, grease, scum,	and other floating	g mate	rials:	O YES O NO		
		C	Odor:	O YES O NO		
Color, ti	urbidity, or other	condit	tions:	O YES O NO		
Control Point:						Station ID:
Date:	Time:		Collect	ed By:		Basin:
Water Temp:	DO: m	g/L p	pH:			Air Temp:
Weather:						Collection Method:
Comments:						
Waters Contain Substances Attributable to Domestic or Industrial Waste or Other Controllable Sources Including:						
Settleable solids that form bottom or sludge deposits: OYES ONO Comments:						
Floating debris:			ebris:	O YES O NO		
Oil, grease, scum, and other floating materials:			rials:	O YES O NO		
Odor			Odor:	O YES O NO		
Color, turbidity, or other conditions:				O YES O NO		
Control Point:						Station ID:
Date:	Time:	(	Collect	ed By:		Basin:
Water Temp:	DO: m	g/L p	pH:			Air Temp:
Weather:						Collection Method:
Comments:						
Waters Contain Su	bstances Attribut	table to	) Dome	stic or Industria	al Waste or Oth	er Controllable Sources Including:
Settleable solids that form	n bottom or sludj	ge depo	osits:	O YES O NO	Comments:	
Floating debris:			ebris:	O YES O NO		
Oil, grease, scum, and other floating materials:			rials:	O YES O NO		
Odor:			Odor:	O YES O NO		
Color, ti	urbidity, or other	condit	ions:	O YES O NO		
Collection Methods		BNDM	I - Bank	k - Direct Metho	od	WDM - Wading Direct Method
BNDC - Bank Dipper/Chur	rn	wc-v	Vading	Churn		BRC - Bridge Rope Churn
BNC - Bank Churn DRC - Dam Rope Churn				UNK - Unknown		

Appendix A-3: Standard Operating Procedures for Collecting Lake and Reservoir Samples and Field Measurements

# Standard Operating Procedures for Collecting Lake/Reservoir Samples and Field Measurements

Prepared by: State of Nevada Department of Conservation and Natural Resources Division of Environmental Protection Bureau of Water Quality Planning Carson City, Nevada

February 2020

**APPROVALS:** 

Paul Comba NDER BWQP Chief:

D

Dave Simpson NDEP BWOP Quality Assurance Officer:

3/5/2020

Date:

Date:

3-4-20

## Standard Operating Procedures for Collecting Lake and Reservoir Samples and Field Measurements

## 1.0 PURPOSE AND APPLICABILITY

This document describes the procedure for: (1) calibration and operation of the Hydrolab DS5 data sonde for the collection of depth, dissolved oxygen (DO), temperature, pH, and specific conductance (SpC) data in lakes and reservoirs, (2) operation of the Secchi disc to measure water clarity, (3) collection and transportation of water samples, and (4) preparation of Chlorophyll-*a* samples.

## 2.0 HYDROLAB DS5 DATA SONDE PREPARATION

The following equipment is used for calibration of the Hydrolab DS5 data sonde (Hydrolab):

- Hydrolab
- Surveyor handheld datalogger (Surveyor) or laptop computer loaded with Hydras 3 LT software.
- Interface cable
- Interface cable to USB adapter (if using laptop computer)
- Calibration standards (pH and conductivity)
- Deionized water squirt bottle

Prior to going to the field, make sure that the Hydrolab and Surveyor (or laptop computer) are working properly and the batteries have sufficient charge. To check the Hydrolab and Surveyor battery levels, connect the two instruments and turn on the Surveyor. The display has been initially set up to display the following:

Surveyor Data

D/T	Date/Time
IBV	Internal battery voltage
BP	Barometric pressure

#### <u>Hydrolab Data</u>

Temp	Temperature in Celsius
рН	рН
LDO	DO in milligrams per liter (mg/L)
LDO%	DO in percent saturation
IBa	Internal battery voltage
SpC	Specific conductance
D/T	Date/Time

If the Surveyor battery voltage (IBV) is less than 6.5 volts, it is recommended that the battery pack be recharged. If batteries are needed for the Hydrolab, do not mix depleted and fresh batteries together or serious injury and instrument damage may occur.

If you wish to change the parameters on the Surveyor display, do the following

Select Setup/Cal Select Setup Select Display: Tabular Remove or add any new parameters as desired

Before heading out into the field, calibrate the DO, pH, and SpC probes per manufacturer's recommendations. Calibration can be performed with either the Surveyor or a laptop computer loaded with Hydras 3 LT software attached to the Hydrolab DS5 Data Sonde. Fill out the Instrument, Calibration Date, and Calibration Time fields on the attached Lake Profile field sheet (Profile Sheet).

## 3.0 BOAT LAUNCH AND OPERATION

For further information read the SOP for Transporting and Operating Boats (see Appendix A-4).

## 4.0 DATA AND SAMPLE COLLECTION

If possible, sites should be sampled in the order of least to greatest potential for equipment fouling or contamination. Also, if possible, sites should be sampled in the order of least to greatest potential for infestation of invasive species. If it is not possible to sample in the order of least to greatest potential for infestation of invasive species then follow the instructions in the SOP for *Decontamination of Field Equipment to Limit the Spread of Invasive Species* (Appendix A-9).

## 4.1 Sample Location Setup

Navigate with a GPS to the identified sample location. Properly anchor pursuant to the SOP for *Transporting and Operating Boats* (see Appendix A-4). Establish working zones on the boat and set-up equipment for data collection.

One staff member will collect profile data, measure the secchi depth, and fill out the Profile Sheet while the other collects the water sample.

Fill out the date; time; collected by; lake; station ID; air temperature (°C); weather; surface conditions; floating debris; oil, grease, scum, etc.; odor; and color, turbidity, or other conditions fields on the profile sheet.

## 4.2 Collect Profile Data and Secchi Depth

Lower the Secchi disc down the shady side of boat to the point where it is no longer visible, counting the 1.0-meter marks on the rope while you lower it. Record the number of meters, measuring between the 1.0-meter marks, on the profile sheet.

Remove the Hydrolab cup and install the weighted probe guard. Lower the Hydrolab sensors to the water surface and calibrate the depth to zero. Record water temperature ( $^{\circ}C$ ), pH, specific conductance ( $\mu$ S/cm), and DO (mg/L) data from the surface to the lake bottom at one meter increments on the profile sheet. Record the bottom depth (m) on the profile sheet. Prior to removing the Hydrolab sensors from the water, record water temperature ( $^{\circ}C$ ), pH, specific conductance ( $\mu$ S/cm), and DO (mg/L) data at the surface again for QA/QC purposes.

## 4.3 Collect Water Samples

Prior to collecting the water sample properly label all the sample containers.

Sample collection depends on the sampling scheme established for the waterbody. In general, three samples are collected along the lake profile: (1) epilimnion (surface), (2) metalimnion, and (3) hypolimnion (bottom). The depth of the metalimnion sample is determined by examining the lake profile data for large changes in either one or all of the recorded parameters. For example, a metalimnion exists where water temperature changes at least 1° C per meter. If large changes in recorded parameters do not exist, then the middle of the lake profile can be substituted. Hypolimnion samples are only collected on lakes that are greater than or equal to 5 meters deep, unless determined otherwise. Metalimnion (or middle) samples are only collected on lakes that are greater than or equal to 8 meters deep, unless determined otherwise.

Collect the epilimnion sample by dipping the churn splitter directly in the lake from the front side of boat. Rinse splitter by closing the lid to the churn splitter and moving the agitator up and down to rinse all inside parts of the splitter. Open the nozzle and let water run through the spigot. Repeat. Collect sample. Fill out the time field on the profile sheet.

Collect the hypolimnion sample using the discrete-depth sampler (i.e., the Kemmerer sampler). Lower the discrete-depth sampler down to one meter above the bottom to limit contamination from the disturbance of bottom sediments. Send the messenger down to close the discrete-depth sampler and collect the water sample. Raise the discrete-depth sampler and empty into the churn splitter to rinse. Repeat. On the second rinse cycle, rinse the appropriate sample bottles from the churn splitter as described below. Collect sample and empty the discrete depth sampler into the churn splitter. Close the churn splitter to prepare for filling bottles. Fill out the depth and time fields on the profile sheet.

Collect the metalimnion (or middle) sample in the same way as the hypolimnion sample. Sample at the determined depth. Fill out the depth and time fields on the profile sheet.

## 4.4 Filling the Sample Bottles

Don clean nitrile gloves. Before filling the bottles, gently pump the handle of the churn splitter ten times at an even rhythm making sure the disk hits the bottom of the container and the stroke length should be as long as possible without breaking the water surface. The churning must be continuous during the withdrawals.

Sample bottles should remain closed until bottle is to be filled. While filling bottles, keep pumping the churn splitter at an even rhythm, approximately one stroke every 3 seconds.

#### <u>Bacteria</u>

DO NOT RINSE BOTTLE. Fill the 120 mL bacteria bottle to the shoulder/neck of the bottle. *Make sure not to overfill* because the bottle is prepared with sodium thiosulfate preservative. Cap the bottle immediately after filling it. Upend the bottle several times to mix the sodium thiosulfate into the water sample. Immediately place the bacteria sample in the thermoelectric cooler. *Do not pre-rinse the bacteria bottle because it contains sodium thiosulfate prepared in the laboratory.* 

#### Chlorophyll-a

Drain approximately 10-15 mL of the water sample from the churn splitter into the 500 mL brown chlorophyll-*a* bottle. Screw the cap on the bottle. Rinse the bottle and the cap and discard the rinse water. Repeat. Then fill the bottle to the top from the churn splitter. Place the cap on the bottle and immediately place the bottle into an ice chest and cover with wet ice.

#### **Dissolved Metals**

If taking a sample for analysis of dissolved metals, begin by rinsing the filter transfer bottle with 10 to 15 mL of sample water from the churn splitter. Screw the cap onto the filter transfer bottle and shake to rinse, then discard the rinse water. Repeat. Then fill the filter transfer bottle with enough water to fill the 500 mL dissolved metals bottle. DO NOT RINSE THE METALS BOTTLE. Attach the pump and the filter cartridge, *making sure not to touch the inlet and the outlet of the filter cartridge*. Slowly pump the water from the filter transfer vessel through the filter into the 500 mL dissolved metals bottle to the shoulder/neck of the bottle. Make sure not to overfill because the bottle is already prepared with nitric acid. Cap the bottle immediately after filling it. Upend the bottle several times to mix the nitric acid in the water sample. Immediately place the dissolved metals sample in an ice chest and cover with wet ice. *Do not field rinse the dissolved metals bottle because it is pre-acidified* (i.e., it contains nitric acid).

#### <u>Total Metals</u>

If taking a sample for analysis of total metals, fill the 500 mL total metals bottle from the churn splitter to the shoulder/neck of the bottle. DO NOT RINSE THE METALS BOTTLE. Make sure not to overfill the bottle because it is already prepared with nitric acid for sample preservation. Cap the bottle immediately after filling it. Upend the bottle several times to mix the nitric acid in the water sample. Immediately place the total metals sample in an ice chest and cover with wet ice. **Do not field rinse the total metals bottle because it is pre-acidified with nitric acid.** 

#### **Routine Parameters**

**Blue cap**. The half-gallon bottles from Model Dairy are used as sample bottles for routine parameters. These bottles do not contain any preservative and should be rinsed twice in the field before collecting the sample. Drain a small amount (10-15 mL) of water from the churn splitter into routine parameters bottle with the blue cap. Place the cap on the bottle, but do not seal it. Rinse the bottle and blue cap and discard the rinse water. Repeat. Then fill the bottle from the churn splitter to the shoulder/neck of the bottle. Seal the blue cap onto the bottle. Immediately place the blue cap bottle into an ice chest and cover with wet ice.

**Red cap.** The half-gallon bottles from Model Dairy are used as sample bottles for routine parameters. These bottles do not contain any preservative and should be rinsed twice in the field before collecting the sample. Drain a small amount (10-15 mL) of water from the churn splitter into routine parameters bottle with the red cap. Place the cap on the bottle, but do not seal it. Rinse the bottle and red cap and discard the rinse water. Repeat. Then fill the bottle from the churn splitter to the shoulder/neck of the bottle. After filling the bottle, add 5.0 mL of 96% sulfuric acid and seal the red cap on the bottle. Upend the bottle with the red cap several times to mix the sulfuric acid in the water sample. Immediately place the red cap bottle into an ice chest and cover with wet ice. Discard the empty ampoule in the acid-waste ampoule container.
# 4.5 Profile Sheet Completion and Review

Write any comments on the profile sheet, then review the sheet to ensure completeness. Have the second field person (i.e., a person other than the one who filled out the form) check over the profile sheet before leaving the site.

# 4.6 Chlorophyll-*a* Sample Preparation

Prepare chlorophyll-*a* samples as soon as possible in an area out of direct sunlight and protected from wind to prevent sample contamination.<sup>5</sup> Rinse the entire chlorophyll-*a* filter press and tweezers with deionized water. Place one chlorophyll-*a* filter on the filter press stage and assemble the filter press. Upend the sample bottle several times to mix sample and pour a measured amount of sample water into the upper chamber of the filter press to optimize the sample collected on the filter. Slowly draw the sample water through the filter. Take care not to exceed 7 inches of mercury (vacuum pressure) on the filtration pump vacuum gauge.

After all the sample water has passed through the filter then check the color of the filter.<sup>6</sup> If no color is visible then pour additional sample water into the upper chamber of the filter press. Ultimately, the filter should be pale yellowish-green to green in color. Once the filter is the appropriate color, record the amount of sample water filtered on the bottle label. Then rinse the inside of the upper chamber of the filter press with deionized water to dislodge any chlorophyll-*a* remaining on the walls. After the rinse water has passed through the filter, carefully remove the filter from the filter press stage with tweezers. Fold the filter into quarters (colored side on the inside) and immediately wrap in aluminum foil. Place the aluminum-foil-wrapped filter in the labeled bottle and place in a freezer immediately. Keep frozen until delivery to the laboratory.

# 4.7 Decontamination of Field Equipment to Limit the Spread of Invasive Species

After sampling lakes and reservoirs that are suspected or known to contain invasive species, clean and decontaminate all sampling equipment (including boat and trailer) prior to the leaving the sampling site. For further information read the SOP for *Decontamination of Field Equipment to Limit the Spread of Invasive Species* (see Appendix A-9).

# 4.8 Filling out Bacteria Forms and Chain-of-Custody Sheet Prior to Sample Delivery

Samples must remain under the samplers' control until the samples are delivered to the laboratory, as indicated on the chain-of-custody sheet. Fill out the bacteria forms and the chain-of-custody sheet before arriving at the laboratory. As a courtesy, when delivering samples to the Nevada State Health

<sup>&</sup>lt;sup>5</sup> Chlorophyll-*a* filtration must be completed within 24 hours of sample collection.

<sup>&</sup>lt;sup>6</sup> If all the water in the filter press cannot be drawn through the filter then the remaining water in the filter press and the filter must discarded. The filter press must be cleaned and the processing will start over from the beginning with less sample water.

Laboratory for analysis, be sure to call the lab after collecting the last sample, or about 30 to 60 minutes prior to arriving at the laboratory.

#### REFERENCES

*Hydrolab DS5X, DS5, and MS5* Water Quality Multiprobes - User Manual, Hach Environmental. *Surveyor 4a 0* User Manual. Hach Environmental.

Hach LDO Sensor Instruction Sheet. Hach Environmental.

*Hydras 3 LT* Software Manual. Hach Environmental.

Attachments

# Lake and Reservoir Sampling Equipment and Supply Checklist

E	acteria	tles						
	120 ml Bacteria bottle(s) <sup>1</sup> , 1 per sample site							
	Routine Parameters         □      Blue lid bottle(s), 1 per sample         □      Red lid bottle(s), 1 per sample         □      5.0 ml ampoule(s) of 96% H <sub>2</sub> SO <sub>4</sub> , 1 per red lid bottle <sup>2</sup> □       Container for empty acid ampoules							
	fetals Trace metals 500 ml bottles, 2 per sar Filter(s), 1 per sample Pump to filter Filter transfer vessel	mple <sup>3</sup>						
	<u>hlorophyll-a</u> 500 ml opaque HDPE bottle(s) with t Chlorophyll-a filters, 1 per sample Small bottle(s) for Chlorophyll-a filte Chlorophyll-a filter press Pump for filter press Tweezers Aluminum foil Graduated cylinder	ape, 1 er, 1 pe	per sample er sample					
	Equip	ment						
	<ul> <li>Personal Floatation Devices</li> <li>Large churn splitter</li> <li>Secchi disk/marked rope</li> <li>Hydrolab DS5 data sonde, cable, rope, and weight</li> <li>Surveyor or Laptop/connection cable</li> <li>Discrete Depth Sampler (Kemmerer)</li> </ul>		Freezer Ice Chest(s)/Ice Deionized water (DIW) squirt bottle 8 – C-size batteries GPS Bag of nitrile gloves Satellite phone					
	Paper	work						
	Chain of custody Lake profile sheet, 1 per station Bacteria slip(s), 1 per sample		Pens Sharpies 2 Lakes Clipboards					

<sup>1</sup> 120 ml Bacteria bottle is pre-prepared with sodium thiosulfate.

 $^{1}$  The 5.0 ml of H<sub>2</sub>SO<sub>4</sub> is added to the bottle after it is filled with the water sample.

<sup>1</sup> Bottles contain 15% HNO<sub>3</sub> before addition of the water sample, 0.15% HNO<sub>3</sub> after. 1 sample is filtered.

FOR COMPLIANCE

#### NEVADA STATE HEALTH LABORATORY CHAIN OF CUSTODY FORM FOR WATER CHEMISTRY ANALYSIS NEVADA DIVISION OF ENVIRONMENTAL PROTECTION

University of Nevada School of Medicine 1660 North Virginia Street, Reno, NV 89503-1738 Phone: (775) 688-1335 Fax: (775) 688-1460

XXX NOT FOR COMPLIANCE

OWNER INFO	RMATION		REPORT TO	INFORMATION		DELIVERE	D ON ICI	E BILL TO	INFORMATION						
Owner: Address: City, St, Zip: Phone:	Bureau of Water 901 S. Stewart S Carson City 687-9444	Quality Planning t., Suite 4001 NV 89701 FAX: 687-5856	Owner: ATTN: Address: City, St, Zip: Phone:	BWQP John Heggene 901 S. Stewar Carson City, N 687-9444 <b>F</b> a	ess t St., Suite 4001 IV 89701 IX: 687-5856	Initals (Lab) Shipped Sa Temp Blank	mples:	No Owner: Address City, St, Phone: °C	BWQP 901 S. Stewart St., Suite Zip: Carson City, NV 89701 687-9444 Fax: 687-5856 USE OF WATER	4		ble Metals	ls		
_	SOURCE OF V	VATER	SAMPLE T	YPE	REASON F	OR ANALY	SIS	C Domes	tic Drinking Water		s	era	leta		
	Spring	Filter	SDWA		Public Wat	ter Supply		C Geother	mal 🔲 Irrigation	uo	etal	Š	2 2		
~	Surface		CWA		Private Re	sidence		Industria	al or Mining	luti	Ž	a l	Š		
	Well	Depth (ft)	C Other		Other Stat	te Surface Wa	ater	✓ Other:	Various Uses	Pol	ace	g	SSC		ž
RIVER B	ASIN:									ne	Ē	Ě	ā		ē _
Line	Date Ti	me Station	Control Point			Sta	ate	County	Remarks	tout	Ü	Ü		0	the
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/							_			+	$ \rightarrow $	+	+	$\vdash$	++-
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Collected E	By:					Sa	ampler	Signature:							
FOR LAB US How sample w	E ONLY: vas delivered	Co	ourierD	rop Off	Fe	d Ex		UPS	U.S. Postal				Campu	s Ma	il
Delivered By		4		Date		Received B	у					Date			

Sample is tested as received. Analytical results associated with this requisition and generated by NSHL are representative only of the sample submitted to this laboratory.

NOTE: This document will be destroyed at NSHL after 12 years, unless Client requests otherwise

Page \_\_\_\_ of \_\_\_\_

# NDEP LAKE PROFILE FIELD SHEET

Date:	Time:		Collected by:		
Lake:			Station ID:		
Instrument:		<b>Calibration Date:</b>		<b>Calibration Time:</b>	
Air Temperature (°C):		Weather:			
Surface Conditions: O FLAT	o RIPPLES	O CHOPPY O WHIT	ECAPS		
Floating debris: • YES • NO			Oil, grease, scum,	o yes o no	
Odor: • YES • N	0		Color, turbidity, o	r other conditions:	o yes o no
Secchi Depth (m):			Bottom Depth (m):		

Depth (m)	Temp (°C)	<b>pH</b> (Std.)	<b>SpC</b> (μS/cm)	DO (mg/L)	Depth (m)	Temp (°C)	<b>pH</b> (Std.)	<b>SpC</b> (μS/cm)	DO (mg/L)
0					16				
1					17				
2					18				
3					19				
4					20				
5					21				
6					22				
7					23				
8					24				
9					25				
10					26				
11					27				
12					28				
13					29				
14					30				
15					DUP 0				

Epilimnion Sample?	o YES ⊙ NO	Depth:	0 m	Hypolimnion Sample?	o yes o no	Depth:	m
Metalimnion Sample?	o yes o no	Depth:	m	Middle Sample?	o yes o no	Depth:	m

Comments:

Appendix A-4: Standard Operating Procedures for Transporting and Operating Boats

# **Standard Operating Procedures for Transporting and Operating Boats**

Prepared by: State of Nevada Department of Conservation and Natural Resources Division of Environmental Protection Bureau of Water Quality Planning Carson City, Nevada

February 2020

**APPROVALS:** 

Paul Comba NDEP BWOP Chief:

and

Dave Simpson NDEP BWOP Quality Assurance Officer:

Date: 3/5/2020

Date:

3-4-20

# Standard Operating Procedure for Transporting and Operating Boat

# 1.0 PURPOSE AND APPLICABILITY

This standard operating procedure (SOP) is intended to standardize procedures for transporting and operating boats for use in sampling and monitoring activities. However, this SOP is not intended as a substitute for information on local, state, and federal regulations concerning boat operation and transport.

# 2.0 TRAINING

All NDEP BWQP personnel who will use boats are required to complete a boater safety course approved by the National Association of State Boating Law Administrators and retain a Nevada Boater Education Card (also known as a Nevada Boating Safety Certificate Card). All BWQP personnel that will use boats must also be familiar with the owner's manual for the particular boat and this SOP.

# 3.0 HEALTH AND SAFETY CONSIDERATIONS

A minimum of two individuals is required to be on board at all times during boat operation. All individuals on board a boat will wear Type III, United States Coast Guard (USCG)-approved personal floatation devices at all times. If conditions require further protection, Type I or II personal floatation devices will be used.

BWQP staff will comply with all waterbody speed limits and restrictions.

# 4.0 PREPARING TRAILERED BOATS FOR TRANSPORT

See attachments for Checklist for Preparing Trailered Boats.

# 5.0 TRANSPORT OF BOATS

All boats will be transported in accordance with local, state, and federal regulations.

# 6.0 LAUNCHING BOATS

See attachments for Checklist for Launching Trailered Boats.

# 7.0 OPERATION OF BOATS

All boats will be operated in accordance with local, state, and federal regulations. The following highlights critical procedures for operating boats:

- Obey all posted signs and signals such as "no wake zones," posted speed limits, etc.
- Take extra care when operating boats around sailboats or human powered watercrafts (e.g. rowing shells, kayaks, or canoes). Give these watercrafts a wide berth when overtaking or meeting, and reduce speed of the boat to produce as little wake as possible.
- When approaching another watercraft from any direction, make your intentions known early and clear to the other watercraft as to how you will pass them. This may be done by signaling and then making course corrections deliberately and in an obvious manner.
- When operating boats in heavy boat traffic areas, monitor appropriate radio channels.

- Remember the phrase "red, right, returning." When traveling in a channel or a shipping lane returning to a harbor or landing, red-colored "cans" mark the right-hand side of the channel or shipping lane; green or black colored "cans" mark the left hand side of a channel or shipping lane. Keep the appropriate navigation aid on your right when entering or leaving.
- When crossing areas of heavy traffic, cross at right angles to the channel lanes. When traveling with heavy traffic, if possible stay to the edge of the marked channel.

For additional information see attachment for *Checklist for Operation of Boats*.

# 8.0 LOADING OF BOAT ONTO TRAILER

See attachments for Checklist for Loading of Boat onto Trailer.

# 9.0 DECONTAMINATION OF FIELD EQUIPMENT TO LIMIT THE SPREAD OF INVASIVE SPECIES

For further information read the SOP for *Decontamination of Field Equipment to Limit the Spread of Invasive Species* (Appendix A-9).

# **10.0 STORING BOATS AFTER USE**

The boat should be stored in a secured area whenever possible. If it is not possible to store the boat in a secured area, lock the trailer coupler latch. See attachments for *Checklist for Storing Trailered Boats*.

# **11.0 BOAT MAINTENANCE**

The boat motor(s) is maintained and stored per manufacturer's instructions. The boat motor and trailer will get a professional tune-up prior to the start of every field season.

#### **12.0 REFERENCES**

Federal Requirements for Recreational Boats, (2001) United States Coast Guard, http://www.uscgboating.org/fedreqs/default.html.

Reference Guide to State Boating Laws, 6th Edition, (2000) (Chris Moore and Ron Sarver, Editors), National Association of State Boating Law Administrators, Lexington, KY, 90pp.

Navigational Rules and Regulations (1995), United States Coast Guard, United States Government Printing Office, Pittsburgh, PA, 214pp.

100<sup>th</sup> Meridian Initiative, <u>http://www.100thmeridian.org/decon.asp</u>.

Attachments

Boat Transport Equipment
<ul> <li>Proper sized trailer</li> <li>Proper sized ball hitch</li> <li>Locking hitch pin</li> <li>Lock for trailer coupler</li> <li>Proper sized spare tire</li> <li>Lug wrench for trailer</li> <li>Jack for trailer</li> </ul>
Boat Equipment
<ul> <li>Bow and stern lines</li> <li>Ground tackle</li> <li>Paddles</li> <li>United States Coast Guard approved Personal Floatation Devices for each individual</li> <li>Gasoline motor/fuel line or electric trolling motor</li> <li>Full gasoline tank or fully charged battery for electric trolling motor</li> <li>Drain plug</li> <li>Bailer</li> <li>Fire extinguisher</li> <li>GPS</li> <li>Depth finder</li> <li>Satellite phone</li> </ul>

## **CHECKLIST FOR PREPARING TRAILERED BOATS**

#### BOAT

- □ Safety chain and cable attached and snugged to bow roller.
- Belly strap attached and snugged, visually inspected.
- $\Box$  Bow and stern line on board.
- □ Ground tackle on board and visually inspected.
- Electronics working (depth finder, etc.).
- □ Drain plug inserted.
- $\Box$  Oil reservoir in motor full.
- □ Gasoline tank full.
- □ Motor starts and runs (locked in upright position for travel).
- □ Paddles on board.
- □ Fire extinguisher on board.
- □ USCG-approved personal flotation devices for each individual on board plus one additional.
- □ Properly stow everything for transport.

#### TRAILER

- □ Inspect trailer tires (including spare) to make sure they are properly inflated.
- Check padlock on the spare tire, make sure that key works.
- □ Make sure lug wrench and jack for trailer are in the truck.
- □ Lock trailer hitch assembly onto vehicle.
- □ Attach trailer to vehicle.
- □ Check to make sure trailer coupler is secure on the ball hitch by pulling up on trailer.
- $\Box$  Lock the trailer coupler.
- □ Check trailer safety chains for wear and tear.
- Attach trailer safety chains in crisscrossed fashion.
- $\Box$  Check for wear and tear on trailer electrical connection wires and plugs.
- □ Connect trailer electrical connection to vehicle electrical plug.
- □ Confirm that the trailer's brake lights, turn signals, running lights, and reverse lights are functional.

## **CHECKLIST PRIOR TO LAUNCHING TRAILERED BOATS**

## Prior to Moving the Vehicle to Boat Ramp

- Prior to and during operation of boats, monitor both weather forecasts and current weather conditions.
- Attach bow and stern lines to boat. Make sure length of lines is such that the lines reach the dock or shore where the boat will be placed.
- □ Remove the belly strap from the boat and trailer.
- Disconnect trailer lights from vehicle.
- Determine one individual who will assist driver in backing boat down ramp. Work out audio and visual signals to assist driver in unloading process.
- $\hfill\square$  Check to make sure drain plug is inserted in the boat.

## At the Boat Ramp

- Before backing vehicle and trailer down boat ramp, make sure the trailer and vehicle are in a straight line.
- Check to make sure that boat ramp is clear of personnel, vehicles, or boats before proceeding.
   Individual assisting driver in backing up should stand to the driver's side of vehicle and well clear of trailer.
- Back trailer down boat ramp to edge of water and stop. The driver's assistant should disconnect safety chain and cable from boat, and roll up excess cable on trailer winch (ONLY disconnect safety chain and cable if located on a LEVEL surface, otherwise leave cable and safely chain attached until the boat is floated off the trailer). The driver's assistant should take bow and stem lines in hand, and then move clear of trailer and vehicle.
- Once all personnel are clear of vehicle, back trailer into water until wheels are covered or boat begins to float on its own. The backing momentum will push boat away from trailer. Once boat is clear of trailer, the trailer can be pulled out of the water. The boat should be pulled to the dock or shore and secured using bow and stern lines.

## **CHECKLIST FOR SAFE OPERATION OF BOATS**

#### **Starting the Motor**

- □ Lower the motor into the water. If starting in a shallow area, make sure that the motor is at least lowered to the point where the cooling water intake is below the waterline.
- □ Check to make sure the fuel line is properly attached, prime the fuel line by squeezing the fuel "bulb" until it becomes firm and open the air vent on the top of the gas can cap.
- □ Make sure throttle position is in neutral and turn choke on (if necessary).
- $\Box$  Turn switch to "Run" if the motor is so equipped.
- Pull starter rope to start motor. Inspect motor to make sure that coolant system is working (i.e., a stream of water is flowing from motor compartment). If coolant system is not working, stop motor immediately and make sure water intake and exit ports are clear.
- □ Allow motor to warm up at idle speed. Once motor is warmed up, turn choke off before leaving dock or shore.

#### Leaving Dock or Shore

- □ Make sure all personnel on board have life vests (i.e., personal floatation devices) on.
- Untie bow and stern lines, the individual shoving off the boat will keep one line in hand.
- □ If leaving from a dock, walk boat to end of dock.
- Prior to leaving shore or dock, driver will look around to determine if there are any oncoming boats or other hazards.
- □ Once clear, the driver should indicate when the line tender should board.
- □ Once all personnel are on board and in position, the driver make way.

#### Anchoring

- □ Select an area that offers maximum shelter from wind, current, and boat traffic.
- Determine depth of water and type of bottom (preferably sand or mud). Calculate the amount of anchor line you will need. General rule: 6 times as much anchor line as the depth of water plus the distance from the water to where the anchor will attach to the bow. For example, if the water depth is 8 feet and it is 2 feet from the top of water to your bow cleat, you would multiply 10 feet by 6 to get the amount of anchor line to put out.

(Continued on next page)

# **CHECKLIST FOR SAFE OPERATION OF BOATS (Continued)**

- □ Secure the anchor line to the bow cleat at the point you want it to stop; make a couple wraps around the cleat prior to "cleating off."
- Bring the bow of the vessel into the wind or current. When you get to the spot you want to anchor, place the motor in neutral. When the boat comes to a stop, slowly lower the anchor. Do not throw the anchor over, as it will tend to entangle the anchor.
- □ When all anchor line has been let out, back down on the anchor with motor in idle reverse to help set the anchor. If the holding ground is questionable, "cleat off" and then back down on the anchor to get a good "bite" into the bottom.
- □ When anchor is firmly set, use reference points (landmarks) in relation to the boat to make sure you are not drifting. Check these points frequently.

#### **Returning to Dock or Shore**

- Before approaching dock or shore, determine which personnel will be in charge of bow and stern lines. Notify line tender(s) not to "pull" the boat in by the line while docking causing loss of control by the driver.
- Approach dock or shore at low speed. Place throttle in neutral position when arriving at dock, if the boat is still moving forward when at the dock apply a quick burst of reverse throttle to stop forward motion of boat.
- When the boat has stopped its forward motion, have the bow and stern personnel disembark to secure the lines. Shut off motor. If necessary, secure fenders to the side of the boat next to the dock prior to landing.

## CHECKLIST FOR LOADING OF BOAT ONTO TRAILER

#### **Prior to Loading Boat**

Determine job assignments for personnel, one person will have to drive the boat onto the trailer and one person will have to attach the safety cable, reel the winch, and drive the vehicle.

#### Loading Boat onto Trailer

- □ Back the vehicle and trailer down the boat ramp, stopping when the tires of the trailer are submerged. Apply the parking brake and the emergency brake on the vehicle.
- □ Back the boat away from the dock, and approach the trailer at a very slow speed. The driver of the boat should aim the bow of the boat for the bow roller. Place the throttle of the boat in neutral just before arriving at the trailer.
- When the boat comes to a complete stop, the shore person attaches the safety cable to the boat and begins to reel in the cable. As the boat is being reeled in, care should be taken to keep the boat in line with the trailer.
- Once the bow of the boat is snug with the bow roller, the boat driver disconnects gas from motor to let it run out of gas (the intake for the motor's coolant system must remain in the water).
   Once engine quits, raise the motor and lock it for transport.
- □ The driver can then climb out of the boat. Care should be taken when climbing out of the boat.
- Once all personnel are clear of the boat and trailer, the vehicle driver places the vehicle in drive and slowly begins to apply the accelerator. As this is being done, the emergency brake is released and the trailer is pulled from the water. Once the trailer is completely out of the water, stop the vehicle on a level surface. Make sure the boat is resting on all of the trailer rollers in an even manner. If this is not the case, then back the trailer into the water, loosen the safety cable and reposition the boat.
- □ Move the trailer from the boat ramp.

#### After Loading Boat onto Trailer

- Removal all equipment from boat and secure any compartments anchors, etc.
- $\Box$  Re-attach belly strap on the boat to the trailer.
- □ Remove boat drain plug.
- □ Follow directions in Checklist for Preparing Trailered Boats.

## **CHECKLIST FOR STORING TRAILERED BOATS**

#### Trailer

- □ Re-inspect the trailer to ensure that it has been properly decontaminated.
- Before disconnecting trailer electronics check to make sure that the trailer lights are working (turn signals, brake lights, running lights).
- □ If the trailer has brakes, check the brakes for proper operation.
- □ Chock the trailer wheels and elevate trailer tongue to a height where any water entering the boat will drain out. Remove the drain plug and leave next to the transom.
- □ If any problems are encountered during use of trailer or boat, notify personnel in charge of boat operations immediately upon return.

#### Boat

- □ Re-inspect the boat to ensure that it has been properly decontaminated.
- □ Safety chain and cable attached and snugged to bow roller.
- □ Belly strap attached and snugged.
- $\hfill\square$  Bow and stem line on board and stowed.
- $\Box$  Anchor and tackle on board and stowed.
- □ Remove gas from motor. Motors down for storage.
- □ Electric trolling motor battery connected to trickle charger.
- □ Remove drain plug.
- Return equipment to boat room, if equipment is still wet, let dry then store.
- □ Return boat keys to key storage area.

Appendix A-5: Standard Operating Procedures for Deployment of Temperature Loggers

# Standard Operating Procedures for the Deployment of Temperature Loggers

Prepared by: State of Nevada Department of Conservation and Natural Resources Division of Environmental Protection Bureau of Water Quality Planning Carson City, Nevada

February 2020

**APPROVALS:** 

Paul Comba NDEP BWQP Chief:

Dave Simpson NDEP BWQP Quality Assurance Officer:

Date: 3/1/2020

Date:

3-4-20

# Standard Operating Procedures for Deployment of Temperature Data Loggers

# 1.0 APPLICABILITY

This standard operating procedure (SOP) applies to the collection and analysis of continuous water temperature data from rivers and streams in Nevada using a HOBO<sup>®</sup> Water Temp Pro v2 Logger from Onset Computer Corporation, which requires HOBOware Pro<sup>®</sup> software.

# 2.0 PURPOSE

The purpose of this SOP is to provide standardized methods for collecting and processing continuous water temperature data from rivers and streams in Nevada.

# 3.0 **DEFINITION**

Continuous water temperature data are those that are collected at certain time intervals (e.g., every 30 or 60 minutes) for an extended period of time (typically 8 weeks to 1 year) using an electronic temperature logger deployed in a river or stream.

# 4.0 **RESPONSIBILITIES**

#### 4.1 Training

It is the responsibility of the Standards and Monitoring Supervisor to ensure that the field staff using the loggers are familiar with this SOP.

# 4.2 Tracking of Temperature Logger Usage

The disposition of each temperature logger will be recorded. The record must include the temperature logger serial number, current status of each temperature logger (available for use, launched and awaiting deployment, deployed, or retrieved and awaiting upload), deployment location, person responsible for the temperature logger, date of checkout, and any other pertinent information. The disposition of all temperature logger-related accessories, such as optic shuttles and base stations will also be recorded.

It is the responsibility of the field staff launching, deploying, or retrieving a logger to note these activities on the appropriate tracking forms or field sheets. It is the responsibility of the field staff to place completed tracking forms and field sheets in the appropriate folder in BWQP files.

# 4.3 Data Retrieval and Processing

It is the responsibility of the staff member retrieving and processing the data to note these activities on the appropriate tracking forms. After all data have been processed, these forms will be stored electronically on the BWQP server.

# 5.0 GUIDELINES AND PROCEDURES

# 5.1 Measurement Period

The time period of data collection varies depending upon the purposes of the particular study. In some cases, the deployments will be temporary in nature and typically targeted at characterizing summer temperatures. Other deployments will be longer term to characterize year-round conditions. Year-round sites will generally require more involved installations to withstand high flow and frozen conditions.

# 5.2 Precautions and Limitations

The HOBO Water Temp Pro is only suitable for temperature measurements in water in the range of 0° C to 50° C ( $32^{\circ}$  F to  $122^{\circ}$  F).

## 5.3 Procedures

#### 5.3.1 Pre-Deployment Logger Launch

- (a) Prior to deploying loggers, check the battery and accuracy of the data loggers as described in Section 6.
- (b) Before leaving for the field, launch each logger with the desired start date and logging interval. To launch, connect each data logger to the computer using the HOBO Optic USB Base Station and appropriate coupling. Set computer clock to Standard Time (unclick "Automatically adjust clock for daylight saving changes"). Using HOBOware Pro software, set the data logger to begin collecting data at a delayed start time (typically on top of the hour) and date prior to the anticipated actual installation in the field. The logger interval can be adjusted depending upon the needs of the study; however, the more frequent the readings, the sooner the memory capacity of the logger will be used up. It is recommended that readings be taken at least every hour, if not more frequently.
- (c) To ensure that the loggers are set to launch, look for the red LED light on the logger to be blinking about every 5 seconds.

#### 5.3.2 Logger Deployment

- (a) Do not wade a stream to deploy a logger if conditions are unsafe. Site conditions or project-specific objectives for data collection may necessitate the use of alternative field procedures not included in this SOP. The use of field methods other than those presented in this SOP must be approved by the BWQP branch supervisor, and alternative methods must be accurately and adequately documented.
- (b) Determine a suitable site for deployment in line with the program's objectives. In general, the logger should be deployed near the sample location in an area that is well mixed and is likely to stay inundated throughout the sampling period. Select locations representative of ambient conditions. Deploy the temperature logger in water with a consistent flow. Avoid locations in shallow riffles or in deep pools with poor circulation. Ensure that under expected flow conditions, the temperature logger will be continually submerged but not buried in sediment. Also, locate in shaded areas if possible.

- (c) Attach logger inside a white, opaque PVC pipe with a zip tie and then attach that assembly to a suitable deployment point, for example:
  - i. a sturdy structure such as a large tree root;
  - ii. a rebar stake driven into the stream bed; or
  - iii. sandbag filled with soil and/or rocks.
- (d) The Hobo Water Temp Pro loggers tend to float and steps must be taken to ensure the logger remains completely submerged throughout the sampling period.
- (e) Fill out the Temperature Logger Deployment Form (see Attachments).

#### 5.3.3 Mid-Deployment Check

- (a) It is recommended that the logger installations be checked periodically throughout the deployment period to ensure that the logger is still in well-mixed flow conditions. If necessary, the logger should be moved to a more suitable location with the changes noted on the temperature logger form.
- (b) Data collected can be retrieved from the temperature logger using the HOBO waterproof shuttle. Use of the shuttle allows for the available data to be retrieved without a laptop. Before using the HOBO waterproof shuttle, make sure its clock is synchronized with the standard time clock of the computer originally used to launch the loggers.

#### 5.3.4 Logger Retrieval

- (a) Do not wade a stream to retrieve a logger if conditions are unsafe.
- (b) Locate the logger using drawings, notes, flagging, marking, or GPS coordinates as available and necessary. Retrieve logger and fill in the logger retrieval section.
- (c) Keep logger in a safe location and return it to the BWQP office for data retrieval and processing.

#### 5.3.5 Data Retrieval and Processing:

- (a) Connect each data logger to the computer using the HOBO optic USB base station and appropriate coupling. Using HOBOware Pro software, download the temperature data for each logger. HOBOware Pro automatically assigns filenames for the data files based upon the serial number of the temperature logger.
- (b) Export data to Excel as needed using HOBOware Pro software. Edit the data to exclude pre-deployment and post-deployment periods where the datalogger was out of the water. Plot the data and inspect for abnormalities caused by dying batteries, sensor dewatering (out of the water), or unit malfunctions. Daily temperature fluctuations of more than 10-15° C could be an indication that the sensor was out of the water.
- (c) After downloading the data, check the post-deployment accuracy of the temperature loggers as discussed in Section 6. If inaccuracies are identified, include descriptive notes in the data file.

# 6.0 TEMPERATURE LOGGER ACCURACY VERIFICATION AND QUALITY ASSURANCE

The accuracy of all temperature data loggers will be checked both pre- and post-deployment in a water bath of two different temperatures: ~0° C and ~20° C. Steps in the accuracy verification begin by preparing both a room-temperature bath and an ice bath to test the loggers. Prepare the baths as follows:

- a. To prepare a room temperature bath, partially fill an insulated cooler with approximately room temperature water and allow about six hours for the water temperature to equilibrate to room temperature.
- b. To prepare an ice bath, half fill an insulated cooler with ice and add cold water until ice is full immersed in water. Close the lid and let sit for about six hours.
- c. Launch temperature loggers to record at one minute intervals. During the launch process, check battery levels to make sure there is sufficient capacity for the intended use.
- d. Place loggers in the room temperature bath and allow approximately one hour for sensor temperatures to equilibrate with the bath temperatures. Rather than having individual loggers floating loose in the bath, it is most efficient to tape 15-20 loggers together. Make sure the sensor end of the loggers is submerged in the bath.
- e. Using a NIST-certified thermometer, measure the temperature of the bath in close proximity to the location of the sensors. Gently move the cluster of loggers mixing the water bath. If the NIST-certified thermometer temperatures are stable, take three temperature readings (one every minute) close to the location of the sensors in the bath. The NIST-certified thermometer readings should be taken at times synchronized with the data logger temperature measurements. Record the time and temperatures for later comparison with the loggers' measurements.
- f. Place loggers in the ice bath and allow approximately one hour for sensor temperatures to equilibrate with the ice bath. Using a NIST-certified thermometer, measure the temperature of the bath in close proximity to the location of the sensors. Gently move the cluster of loggers mixing the water bath. If the NIST-certified thermometer temperatures are stable and close to 0° C, take three temperature readings (one every minute) close to the location of the sensors in the bath. The NIST-certified thermometer readings should be taken at times synchronized with the data logger temperature measurements. Record the time and temperatures for later comparison with the loggers' measurements.
- g. Use HOBOware Pro software and optic USB base station to download the temperature logger data from each logger to file server. HOBOware Pro automatically assigns filenames for the data files based upon the serial number of the temperature logger. For each logger, compare the three NIST thermometer readings to the corresponding three data logger readings. Record the result of the tests (folder has been established on the file server for this purpose) and include the temperature logger unit's serial number, test date, logger temperature data, NIST temperature readings, temperature discrepancy. If the values are not within ±0.5° C of the certified thermometer, repeat accuracy check.

After testing is completed, evaluate the results and return any temperature loggers that fall outside the acceptable accuracy range to the manufacturer. Data loggers that are reading outside of acceptable limits of accuracy should be returned to the manufacturer

# 7.0 CARE AND MAINTENANCE

The temperature loggers will be maintained per manufacturer's recommendations.

- After use, clean the temperature loggers using non-abrasive, mild, antibacterial soap and warm water with a non-scratching sponge or cloth. Any scratches on a logger's communication window may impair downloading of data. If necessary a plastic polish may be used for tougher cleaning jobs.
- If the temperature loggers were deployed in waterbodies that are suspected or known to contain invasive species, additional decontamination measures must be taken. For further information read the SOP for *Decontamination of Field Equipment to Limit the Spread of Invasive Species* (see Appendix A-9).
- Be sure to keep the temperature logger free from dirt and dust when not in use.

# 8.0 **REFERENCES**

HOBOware Pro Software User's Manual, Onset Computer Corporation, Bourne, MA.

HOBO Water Temp Pro User's Manual, Onset Computer Corporation, Bourne, MA.
Attachments

Calibration Equipment							
<ul> <li>NIST-certified thermometer – an accuracy of <u>+</u> 0.2° C or better</li> <li>Insulated coolers</li> <li>Ice</li> </ul>							
Equipment							
<ul> <li>GPS</li> <li>Laptop</li> <li>Connection cable from laptop to Hobo</li> <li>HOBO® Optic USB Base Station with coupler for Water Temp Pro v2 Logger(s)</li> <li>HOBO® Waterproof Shuttle with USB cable and coupler for Water Temp Pro v2 Logger(s)</li> <li>HOBO® Water Temp Pro v2 Logger(s)</li> <li>HOBO® Water Temp Pro v2 Logger(s)</li> <li>White, opaque PVC shade device (1 ½ inch Sch. 40 PVC, ~6 inches long)</li> <li>Onset Solar Radiation Shield - RS1 (for air temperature loggers)</li> <li>Rebar of various lengths and pounder</li> </ul>							
<ul> <li>Sandbags (14 x 26 <u>http://www.mcmaster.com</u> product #454014)</li> <li> 36" zip ties (<u>http://www.drillspot.com</u> product #131995)</li> <li> Onset Water Detection TidbiT(s) (Electrical Resistance Sensor)</li> <li>Sledge hammer</li> <li>Securing material such as zip ties, cable clamps, hose clamps</li> <li>Camera</li> <li>Flagging tape</li> <li>Wire cutters, pliers, and other tools as needed</li> <li>Maps</li> </ul>							
Personal Equipment							
<ul> <li>Waders</li> <li>Work Gloves</li> </ul>							
Paperwork							
<ul> <li>Clipboard</li> <li> Temperature Logger Field Sheets, 1 per site</li> <li>Pencils, pens, sharpies</li> </ul>							

# **BWQP Temperature Logger Deployment Form**

Data		<b>T</b> :			Creative				
Date:		TIME			Crew:				
Stream:					Site #:				
UTMzone		UTM	le:		UTMn:			Elevation	ft
Air Temp:				°C	H₂O				°C
Hobo #:		Inter	val:	min	Logger Star	rt		c	<b>PST</b> o <b>PDT</b>
Tidbit #:		Inter	val:	min	Tidbit Start	t		c	PST o PDT
Location:	○ Great	0	ОК	o Poor	Commen				
Bank:	○ Left	0 <b>M</b>	iddle	○ Right	Anchor:	○ Zip	ties	0	○ Other
Sun	o yes			0 <b>NO</b>	Flagging:	C	> YES		0 <b>NO</b>
Fish:	○ YES			0 <b>NO</b>	Commen				
Skotch /No	toc:								
Sketchy NO									
		_							
Camera:		Phot	o #:		Description	า:			
Camera:		Phot	o #:		Description	า:			

○ Logger Retrieval			• 1 <sup>st</sup> Logger Redeployment (revise sketch if			
Date: Time:			Logger Start	○ PST ○ PDT		
Download	File Name:					
Comments	:					

<ul> <li>Logger Retrieval</li> </ul>				• 2 <sup>nd</sup> Logger Redeployment (revise sketch if			
Date:		Time:		Logger Start	○ PST ○ PDT		
Download	File Name:						
Comments	:						

Appendix A-6: Standard Operating Procedures for the Unattended Deployment of Data Sondes

# Standard Operating Procedures for the Unattended Deployment of Data Sondes

Prepared by: State of Nevada Department of Conservation and Natural Resources Division of Environmental Protection Bureau of Water Quality Planning Carson City, Nevada

February 2020

**APPROVALS:** 

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and Com

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Date: 2020

Date:

3-4-20

# Standard Operating Procedure for Unattended Deployment of Data Sondes

### **1.0 PURPOSE**

This document describes the procedures for the unattended deployment of the Hydrolab MS5 sonde (Hydrolab) for the continuous collection of dissolved oxygen (DO), temperature, pH, and specific conductance data in wadeable rivers and streams.

## 2.0 MAINTENANCE AND CALIBRATION

All handheld DO probes are to be maintained and calibrated per manufacturer's recommendations. Because pH buffer solutions typically have conductivities higher than conductivity standards or environmental waters, the following calibration order is recommended: 1) specific conductance, 2) pH, and 3) DO.

### **3.0 DEPLOYMENT PROCESS**

### 3.1 Site Selection

Whenever possible, find an out-of-the-way location where the Hydrolab is not easily detectable by the general public. The location should be in an area of free-flowing water with adequate water depth to cover the Hydrolab's probes.

### 3.2 Installation

Typically an unattended Hydrolab is mounted inside a PVC sleeve with holes that allow for flow across the probes. Ideally, the Hydrolab should be deployed upright in the centroid of flow where the sensors are most likely to remain submerged and off the stream bottom. One method involves the attachment of the Hydrolab and PVC sleeve to one or two steel fence posts driven in to the stream bottom. Pipe clamps can be used to secure the Hydrolab and sleeve to the fence posts. A clevis pin and padlock should be used for hanging the Hydrolab within the sleeve and for securing the equipment (Figure 1).

If the Hydrolab and sleeve cannot be placed upright, it may be laid horizontally on the substrate and secured to a stable object. It may be necessary to place rocks, bricks, etc. under the Hydrolab and sleeve to ensure the probes are not directly on the stream bottom.

### 3.3 Initiate Operation

Prior to going to the field, make sure that the Hydrolab, Surveyor, and YSI 550a handheld DO meter are working properly and the batteries have sufficient charge. To check the Hydrolab and Surveyor battery levels, connect the two instruments and turn on the Surveyor. The display has been initially set up to display the following:

### Surveyor Data

D/T	Date/Time
IBV	Internal battery voltage
BP	Barometric pressure

#### Hydrolab Data

Temp	Temperature in Celsius
рН	рН
LDO	DO in milligrams per liter (mg/L)
LDO%	DO in percent saturation
IBa	Internal battery voltage
SpC	Specific conductance
D/T	Date/Time

If the Surveyor battery voltage (IBV) is less than 6.5 volts, it is recommended that the battery pack be recharged. If Hydrolab batteries are needed, do not mix depleted and fresh batteries together or serious injury and instrument damage may occur.



Figure A-1. Installing Sample Hydrolab for Unattended Deployment

If you wish to change the parameters on the Surveyor display, do the following: Select Setup/Cal

Select Setup

Select Display: Tabular

Remove or add any new parameters as desired

Before heading out into the field, calibrate the specific conductance, pH, and DO probes per manufacturer's recommendations. Calibration can be performed with either the Surveyor or a laptop computer loaded with Hydras 3 LT attached to the Hydrolab. Record information about the deployment on the field sheet.

A log file must be created and then enabled before data can be collected by the Hydrolab and stored for later retrieval. Perform the following steps to establish the log file and initiate the logging process:

- 1. Connect Hydrolab to Surveyor or laptop computer
- 2. Start Hydras 3 LT if using laptop computer
- 3. If using Hydras Click on Log Files tab
- 4. If using Surveyor Select "Files"; Select "Sonde"
- 5. Click on **CREATE** button
- 6. Enter the name for the new log file (an empty log file is now created)
- 7. Enter the start and end time of the logging, the logging interval (should not be longer than 1 hour), the sensor warm-up time before logging, and if audio signals will be used while logging. Set sensor warm up and circulator warm up at 30 seconds. The end time of the logging should be set at a date beyond the next planned visit to lessen the chance of lost data.
- 8. Select the parameters in the "Parameter in Sonde" list and click the **ADD** button to place them in the "Parameters in log file" list. Change the order of the parameters using the **ARROW** buttons.
- 9. Click **UPDATE SETTING** to send the configuration to the Hydrolab.
- 10. Click **ENABLE** to start collecting data. Click **DISABLE** to stop collecting data during logging. A fully completed logging run will automatically disable at the end of the run.

## 3.4 Periodic Maintenance

During the deployment period, it is necessary to periodically inspect and clean the Hydrolab, check the calibration of the Hydrolab probes, and download the data. Maintenance frequency generally is governed by the fouling rate of the sensors, and this rate varies by sensor type, hydrologic and environmental conditions, and season. The performance of the temperature and SpC sensors tend to be less affected by fouling than the DO and pH sensors. Monitoring sites with nutrient-enriched waters and moderate to high temperatures will likely require more frequent maintenance than at a site with higher quality water. In streams with lots of algae, attached algae have been known to detach from upstream locations and wrap around the Hydrolab.

In addition to fouling problems, the calibration of the probes may drift over time. Periodic checking of the calibration will reduce the need to adjust the data due to drift, and will improve the quality of the data. The results of the fouling and calibration checks are to be recorded on the field sheet.

### 3.4.1 Fouling Check

To check the effect of fouling on the Hydrolab and the associated data, it is necessary to collect Hydrolab readings before and after cleaning of the probes and the protective PVC sleeve. An independent field meter is used to quantify changes of DO, etc. over the time it takes to clean and redeploy the Hydrolab. Use of an independent field meter is most important at sites with rapidly changing conditions.

- 1. Remove Hydrolab from installation and attach the Surveyor to Hydrolab
- 2. Return Hydrolab to the installation and record pre-cleaning Hydrolab readings
- 3. Using an independent field meter, record readings near the Hydrolab
- 4. Remove Hydrolab from installation and clean sensors, sensor guard, and PVC sleeve
- 5. Return Hydrolab to the installation and record post-cleaning Hydrolab readings
- 6. Using an independent field meter, record readings near the Hydrolab

Record results on the field sheet for later use in adjusting the data as needed.

### 3.4.2 Calibration Check

To check the calibration of the probes, remove the Hydrolab from the installation with the Surveyor still attached, and perform the following steps. It is important to maintain temperature stability during the calibration check and recalibration. Care should be taken to keep the Hydrolab out of direct sunlight. To check calibration of specific conductance, pH, and DO (LDO sensor), prepare calibration cup and sensors in accordance with manufacturer's calibration recalibration.

<u>Specific Conductance</u> – If the reading is within 0.005 mS/cm of the standards, there is no need to recalibrate. Otherwise, recalibrate following the manufacturer's recommendations.

 $\underline{pH}$  - If pH readings are within 0.2 of the buffers there is no need to recalibrate. Otherwise, recalibrate following the manufacturer's recommendations.

<u>DO (LDO Sensor)</u> – Once equilibrium is reached within the calibration cup, record temperature, barometric pressure, and DO readings from the Hydrolab. Using the DO solubility table in the attachments, estimate the DO level expected in the calibration cup. The difference between this value and the Hydrolab reading is the calibration error. If the DO reading is within 0.3 mg/L of the expected value, there is no need to recalibrate. Otherwise, recalibrate following the manufacturer's recommendations.

Record the results of the calibration check on the attached field sheet.

## 3.5 Data Retrieval

To download the Hydrolab data, perform the following steps:

- Attach the Surveyor to the Hydrolab
- Power up the Surveyor
- Select "Files"
- Select "Sonde"
- Select "Download"
- Select the desired file

Upon completion of the data transfer, it is suggested that the existing log file be deleted and a new log file be created as described earlier. To delete the log file:

- Select "Files"
- Select "Sonde"
- Select "Delete"
- Select the desired file

## 3.6 Data Transfer from Surveyor to Computer

Perform the following steps to enable a PC to receive data from the Surveyor:

- Connect the Surveyor to PC using a 9 pin connector and a Belkin USB adapter to an available USB port
- Open HyperTerminal
  - Start>Programs>Accessories>Communication>HyperTerminal
- Enter a name for the connection (can be anything)
- Set "Connect using" to COM1, COM2, or COM3...., whichever port being used If you don't know which COM port will be used, do the following:
  - Connect the Surveyor to PC using 9 pin connector and Belkin USB adapter to an available USB port
  - From Windows START>SETTINGS>CONTROL PANEL> SYSTEM>HARDWARE>DEVICE MANAGER
  - o From screen, Expand "Ports (COM & LPT)"
  - Look for "Belkin Serial on USB Port" and the COM port number will be there.
- Set the following
  - "Bits per second" = 19200 (or whatever baud rate the Surveyor is set to).
  - o "Data bits" = 8
  - o "Parity" = None
  - o "Stop bit" = 1
  - "Flow control" = Xon/Xoff
- You should now be connected. At the bottom of the HyperTerminal window, it might say "Connected 0:00:xx" with a clock counting.

Perform the following steps to download data from the Surveyor to a PC:

- From HyperTerminal menu, select the following:
  - o Transfer>Receive File
- Set download file destination
- Set "Receiving Protocol" as 1k Xmodem; then hit "Receive" button
- Enter file name with the extension "csv"
- From Surveyor menu, select "Files" then "Transmit"
- Select the file to be transmitted
- Select "SS importable" option for transfer
- Press any button on Surveyor to start download
- When done, close Hyperterminal

For a detailed discussion of techniques for adjusting the data for fouling and calibration drift, refer to USGS's *Guidelines and Standard Procedures for Continuous Water-Quality Monitors: Station Operation, Record Computation, and Data Reporting, Techniques and Methods 1-D3.* 

### 3.7 Data Adjustment

Prior to use, the retrieved data should be adjusted for fouling and calibration drift effects as described by Wagner and others (2006).

### 3.8 Hydrolab Storage

Upon retrieving the Hydrolab, clean and store the equipment per the manufacturer's recommendations.

### 4.0 **REFERENCES**

*Hydrolab DS5X, DS5 and MS5 Water Quality Multiprobes - User Manual.* Hach Environmental. *Surveyor 4a 0 User Manual.* Hach Environmental.

Hach LDO Sensor Instruction Sheet. Hach Environmental.

Hydras 3 LT Software Manual. Hach Environmental.

Wagner, R.J., R.W. Boulger, Jr., C.J. Oblinger and B.A. Smith. 2006. *Guidelines and Standard Procedures* for Continuous Water-Quality Monitors: Station Operation, Record Computation, and Data Reporting, US Geological Survey Techniques and Methods 1-D3. Attachments

# Unattended Sonde Equipment and Supply Checklist

Calibration Equipment
$\Box$ NIST-certified thermometer – an accuracy of <u>+</u> 0.2° C or better
□ pH buffers (7.0 & 10.01)
Appropriate conductivity standard
Equipment
Hydrolab MS5 sonde with Hach LDO sensor
Surveyor handheld datalogger (Surveyor)
YSI 550a handheld DO meter
Interface cable
PVC sleeve with holes
$\Box$ Steel fence posts (with holes to facilitate hanging of Hydrolab within PVC sleeve) and driver
Pipe clamps
Clevis pin with padlock
Small folding table
GPS unit
5-gallon bucket
Small cooler with calibration standards
Spare batteries – Hydrolab (8 - AAs), YSI 550a (4 - Cs)
Kimwipes, Qtips
Tools – screwdriver, pliers
Deionized water squirt bottle
Personal Equipment
□ Waders
Work Gloves
Paperwork
Clipboard
Continuous Water Quality Monitoring Field Form
Pencils, pens, sharpies

Continuous	Water	Ouality	Monitoring	Field	Sheet
continuous	<b>H</b> ater	Quanty		,	0

Station Name/Number:		Personnel:
Date:	Data Sonde Model:	

SpC Calibration							
Date	Standard (mS/cm)	Temperature (ºC)	Initial Reading	g Final Reading			
	0.0						
pH Calibration							
Date	Buffer Value	Temperature (ºC	Initial Reading	g Final Reading			
	7.0						
	10.01						
DO Calibration							
Date	Barometric Pressure (mmHg)	Temperature (ºC)	% DO Saturatio	on DO (mg/L)			
Deployment Inf	Deployment Information						
Date Logging Initiated: Time Logging			iated: Sampling Interval:				
Date Data Sonde	e Placed in River:	·	Time Data Sonde Placed in River:				

Data Sonde Check and Data Download								
Date:								
Fouling Checks								
Parameter	Before Cleaning After Cleaning				leaning			
	Time = Time =							
	Data Sonde Value	Fie	eld Meter	Data Sono	de	Field Meter Value		
			Value	Value				
Temp (ºC)								
рН								
DO (mg/L)								
SpC (mS/cm)								
<b>SpC Drift Check</b> (If within <u>+</u> 0.005 (mS/cm) of Standard or <u>+</u> 3% of Standard (whichever is greater), no need to recalibrate)								
Standard Value	Standard Temperat (ºC)	ure	SpC Readi	ng (mS/cm)		Error		

<i>pH Calibration Drift Check</i> (If pH within <u>+</u> 0.2 of Standard, no need to recalibrate)								
Buffer Value	Buffer Temperature		pH Reading		Error			
	(≝C)							
7.0								
10.01								
<i>DO Calibration Drift Check</i> (If DO within <u>+</u> 0.3 of expected, no need to recalibrate)								
Temperature (ºC)	Temperature (ºC) Barometric Pressure (mmHg)		(mg/L) at ration from Table	DO (mg/L) Reading from Data Sonde		Error		
Comments								

Temp.								At	mosphe	eric pi	ressure	∋, mmHg	3							
С	760.0	750.0	740.0	730.0	720.0	710.0	700.0	690.0	680.0	670.0	660.0	650.0	640.0	630.0	620.0	610.0	600.0	590.0	580.0	570.0
0	14.6	14.4	14.2	14.0	13.8	13.6	13.4	13.2	13.0	12.8	12.7	12.5	12.3	12.1	11.9	11.7	11.5	11.3	11.1	10.9
	14.2	14.0	13.8	13.6	13.4	13.2	13.1	12.9	12.7	12.5	12.3	12.1	11.9	11.7	11.6	11.4	11.2	11.0	10.8	10.6
2	13.8	13.0	13.4	13.3	12.7	12.9	12./	12.5	12.3	11 0	11 7	11 5	11 2	11.4	10 0	10 0	10.9	10.7	10.5	10.3
3	12 1	12.3	12.1	12.9	12./	12.5	12.4	11 0	11 7	11 5	11 2	11 2	11.3	10 0	10.9	10.8	10.0	10.4	10.2	10.0
	13.1	12.9	12.7	12.0	12.1	12.2	12.0	11.9	11./	11.5	11.3	11.2	11.0	10.0	10.7	10.5	10.5	10.1	10.0	9.0
5	12.7	12.6	12.4	12.2	12.1	11.9	11.7	11.6	11.4	11.2	11.1	10.9	10.7	10.5	10.4	10.2	10.0	9.9	9.7	9.5
6	12.4	12.3	12.1	11.9	11.8	11.6	11.4	11.3	11.1	10.9	10.8	10.6	10.4	10.3	10.1	9.9	9.8	9.6	9.5	9.3
7	12.1	12.0	11.8	11.6	11.5	11.3	11.1	11.0	10.8	10.7	10.5	10.3	10.2	10.0	9.9	9.7	9.5	9.4	9.2	9.1
8	11.8	11.7	11.5	11.3	11.2	11.0	10.9	10.7	10.6	10.4	10.2	10.1	9.9	9.8	9.6	9.5	9.3	9.1	9.0	8.8
9	11.5	11.4	11.2	11.1	10.9	10.8	10.6	10.5	10.3	10.2	10.0	9.8	9.7	9.5	9.4	9.2	9.1	8.9	8.8	8.6
10	11.3	11.1	11.0	10.8	10.7	10.5	10.4	10.2	10.1	9.9	9.8	9.6	9.5	9.3	9.2	9.0	8.9	8.7	8.6	8.4
11	11.0	10.9	10.7	10.6	10.4	10.3	10.1	10.0	9.8	9.7	9.5	9.4	9.2	9.1	9.0	8.8	8.7	8.5	8.4	8.2
12	10.8	10.6	10.5	10.3	10.2	10.0	9.9	9.8	9.6	9.5	9.3	9.2	9.0	8.9	8.7	8.6	8.5	8.3	8.2	8.0
13	10.5	10.4	10.2	10.1	10.0	9.8	9.7	9.5	9.4	9.3	9.1	9.0	8.8	8.7	8.5	8.4	8.3	8.1	8.0	7.8
14	10.3	10.1	10.0	9.9	9.7	9.6	9.5	9.3	9.2	9.0	8.9	8.8	8.6	8.5	8.4	8.2	8.1	7.9	7.8	7.7
15	10.1	9.9	9.8	9.7	9.5	9.4	9.3	9.1	9.0	8.8	8.7	8.6	8.4	8.3	8.2	8.0	7.9	7.8	7.6	7.5
16	9.8	9.7	9.6	9.5	9.3	9.2	9.1	8.9	8.8	8.7	8.5	8.4	8.3	8.1	8.0	7.9	7.7	7.6	7.5	7.3
17	9.6	9.5	9.4	9.3	9.1	9.0	8.9	8.7	8.6	8.5	8.3	8.2	8.1	8.0	7.8	7.7	7.6	7.4	7.3	7.2
18	9.4	9.3	9.2	9.1	8.9	8.8	8.7	8.6	8.4	8.3	8.2	8.0	7.9	7.8	7.7	7.5	7.4	7.3	7.2	7.0
19	9.3	9.1	9.0	8.9	8.8	8.6	8.5	8.4	8.3	8.1	8.0	7.9	7.8	7.6	7.5	7.4	7.3	7.1	7.0	6.9
20	9.1	8.9	8.8	8.7	8.6	8.5	8.3	8.2	8.1	8.0	7.8	7.7	7.6	7.5	7.4	7.2	7.1	7.0	6.9	6.7
21	8.9	8.8	8.6	8.5	8.4	8.3	8.2	8.1	7.9	7.8	7.7	7.6	7.5	7.3	7.2	7.1	7.0	6.9	6.7	6.6
22	8.7	8.6	8.5	8.4	8.2	8.1	8.0	7.9	7.8	7.7	7.5	7.4	7.3	7.2	7.1	7.0	6.8	6.7	6.6	6.5
23	8.6	8.4	8.3	8.2	8.1	8.0	7.9	7.7	7.6	7.5	7.4	7.3	7.2	7.0	6.9	6.8	6.7	6.6	6.5	6.4
24	8.4	8.3	8.2	8.0	7.9	7.8	7.7	7.6	7.5	7.4	7.3	7.1	7.0	6.9	6.8	6.7	6.6	6.5	6.3	6.2
25	8.2	<u>8</u> 1	8 0	79	78	77	76	75	73	7 2	71	7 0	6 9	68	67	6 6	64	63	6.2	6 1
26	8 1	8 0	79	78	7.6	75	7.0	7.5	7.5	7 1	7.1	69	6.8	67	65	6 4	63	6.2	6 1	6 0
27	7.9	7.8	7.7	7.6	7.5	7.4	7.3	7.2	7.1	7.0	6.9	6.7	6.6	6.5	6.4	6.3	6.2	6.1	6.0	5.9
28	7.8	7.7	7.6	7.5	7.4	7.3	7.2	7.1	6.9	6.8	6.7	6.6	6.5	6.4	6.3	6.2	6.1	6.0	5.9	5.8
29	7.7	7.6	7.5	7.3	7.2	7.1	7.0	6.9	6.8	6.7	6.6	6.5	6.4	6.3	6.2	6.1	6.0	5.9	5.8	5.7
30	7.5	7.4	7.3	7.2	7.1	7.0	6.9	6.8	6.7	6.6	6.5	6.4	6.3	6.2	6.1	6.0	5.9	5.8	5.7	5.6

Solubility of oxygen in water at various temperatures and pressures [In milligrams per liter. Values based on Weiss (1970). C, degrees Celsius;mmHg, millimeters of mercury]

Appendix A-7: Standard Operating Procedures for Unattended Deployment of the Onset HOBO Dissolved Oxygen Data Logger

# Standard Operating Procedures for Unattended Deployment of the Onset HOBO Dissolved Oxygen Data Logger

Prepared by: State of Nevada Department of Conservation and Natural Resources Division of Environmental Protection Bureau of Water Quality Planning Carson City, Nevada

February 2020

**APPROVALS:** 

Paul Comba

aul

Dave Simpson NDEP BWQP Quality Assurance Officer:

Date:

3/5/2020

Date:

3-4-20

# Standard Operating Procedure for Unattended Deployment of the Onset HOBO Dissolved Oxygen Data Logger

## 1.0 PURPOSE

This document describes the procedure for an unattended deployment of the Onset HOBO dissolved oxygen data logger (DO logger) for the continuous collection of dissolved oxygen (DO) and temperature data in wadeable streams.

## 2.0 EQUIPMENT

The list of equipment used for unattended deployment of the HOBO DO data logger is provided in the attachment: *DO Logger Deployment Equipment and Supply Checklist* 

### 3.0 MAINTENANCE AND CALIBRATION

Onset HOBO DO data loggers are to be maintained and calibrated per manufacturer's recommendations.

## 4.0 DEPLOYMENT PROCESS

### 4.1 Site Selection

Whenever possible, find an out-of-the-way location where the DO logger is not easily detectable by the general public. The location should be a reach where water is free flowing with adequate water depth to cover the DO logger.

### 4.2 Installation

Typically, an unattended DO logger is mounted inside a PVC sleeve with holes that allow for flow across the DO logger. Ideally, the DO logger should be deployed in the centroid of flow where the DO Logger is most likely to remain submerged and off the stream bottom. One method involves laying the DO logger and PVC sleeve horizontally on the substrate and secured to a stable object with a cable or zip-ties. It may be necessary to place rocks, bricks, etc. under the DO logger and sleeve to ensure the DO logger is not directly on the stream bottom.

### 4.3 Initiate Operation

Prior to going to the field, make sure that the DO logger and surveyor (used to acquire for barometric pressure) are working properly and the batteries have sufficient charge. If the surveyor battery voltage (IBV) is less than 6.5 volts, it is recommended that the battery pack be recharged by Onset.

## 4.3.1 Calibration (Manufacturer's Recommendations).

- 1. Connect the DO logger to a computer, using the Onset HOBO USB shuttle by unscrewing the pointed cap on the communications end of the DO Logger. Insert the DO Logger into the shuttle coupler, aligning the bump/arrow on the coupler with the notches on the DO logger. Be sure that it is properly seated in the coupler.
- 2. Use the lab calibration tool under the device option in the HOBOware menu to calibrate the DO logger before deploying it or after replacing an expired sensor cap. The tool sets the gain and offset adjustment values for the DO logger.
- 3. Calibrate using the 100% air saturation procedure in the lab calibration window and enter the barometric pressure (BP) for your current location. If you cannot obtain the current BP at you location you may find local BP on the internet from weather stations nearby. If the barometric pressure reading has been adjusted for sea level (such as a reading taken from the National Weather Service weather station), select the "If using sea level barometric pressure, enter elevation" checkbox and enter your elevation in either meters or feet.
- 4. Make sure the DO Logger either has the protective guard or the anti-fouling guard installed (whichever guard you plan to use in the deployment) so that the sensor is covered.
- 5. Wet the small sponge with fresh water. Squeeze out any excess water.
- 6. Place the sponge in the end of the calibration boot.
- 7. Insert the DO Logger in the calibration boot so that there is approximately a 1 cm (0.5 inch) overlap between the end of the boot and the body of the DO Logger. This will ensure there is enough space between the end of the DO Logger and the sponge (the DO Logger should not be pressed up tightly against the sponge).
- 8. Wait for approximately 40 minutes or until the DO Logger reaches temperature equilibrium (Note: the DO Logger may go to sleep after 30 minutes).
- 9. Click the "Get DO value from the DO Logger" button to display the 100% saturation results (connection time is slow). You can click this button as often as needed. The results are updated each time you click the button. To check for equilibrium, click the "Get DO value from the DO Logger" button several times in a row to check the current "DO Conc from DO Logger at 100% Saturation" value. If the value remains the same or varies very little with each button click, then temperature equilibrium has likely been reached.
- 10. When you are satisfied with the results displaying in the "100% Saturation" tab, click the Next button to finish.
- 11. Record the values on the Field Form.

### 4.3.2 Launch Device

- 1. Name the device (use default Serial Number)
- 2. Check the sensors to log. Special labels are not necessary.
- 3. Set the logging interval to 30 minutes
- 4. Start logging on Date/Time

### 4.4 Periodic Maintenance and Data Retrieval

During the deployment period, it is necessary to periodically inspect and clean the DO Logger, check calibration of the DO Logger, and download the data. Maintenance frequency generally is governed by the fouling rate of the DO Logger sensor, and this rate varies by hydrologic and environmental conditions, and season. Monitoring sites with nutrient-enriched waters and moderate to high temperatures will likely require more frequent maintenance than at a site in higher quality water.

In addition to fouling problems, calibration of the DO Logger may drift over time. Periodic checking of the calibration will reduce the need to adjust the data due to drift, and will improve the quality of the data. The results of the fouling and calibration checks are to be recorded on the attached form.

### 4.4.1 Fouling Check

To check the effect of fouling on the DO Logger and the associated data, it is necessary to collect DO Logger readings before and after cleaning of the probes and the protective PVC sleeve. To collect readings from the DO Logger connect the DO Logger to the computer and use the Status tool (under Device) in HOBOware. An independent field meter is used to quantify changes of DO, etc. over the time it takes to clean and redeploy the DO Logger. Use of an independent field meter is most important at sites with rapidly changing conditions.

- 7. Remove DO Logger from installation
- 8. Connect the DO Logger to a computer, using the Onset HOBO USB Shuttle
- 9. Return DO Logger to the installation and record pre-cleaning DO Logger readings
- 10. Using an independent field meter, record readings near the DO Logger
- 11. Remove DO Logger from installation and clean sensors, sensor guard, and PVC sleeve
- 12. Return DO Logger to the installation and record post-cleaning DO Logger readings
- 13. Using an independent field meter, record readings near the DO Logger

Record results on the field sheet for later use in adjusting the data as needed.

# 4.4.2 Calibration Drift Check

To check the calibration of the DO Logger, remove the DO Logger from the installation with the computer still attached, and perform the following steps using the Status tool (under Device) in HOBOware. It is important to maintain temperature stability during the calibration check and recalibration. Care should be taken to keep the DO Logger out of direct sunlight.

- 1. Make sure the protective guard or anti-fouling guard is installed on the DO Logger.
- 2. Wet the small sponge with fresh water. Squeeze out any excess water.
- 3. Place the sponge in the end of the calibration boot. Insert the DO Logger in the calibration boot so that there is approximately a 1 cm (0.5 inch) overlap between the end of the boot and the body of the DO Logger. This will ensure there is enough space between the end of the DO Logger and the sponge (the DO Logger should not be pressed up tightly against the sponge).
- 4. Allow at least 40 minutes for the DO Logger to reach temperature equilibrium, and then write down the date and time on the field sheet.
- 5. Write down the barometric pressure at that time (note the elevation if the barometric reading has been adjusted for sea level).
- 6. Once equilibrium is reached, record temperature, barometric pressure, and DO readings from the DO Logger. Using the DO solubility table in the attachments, estimate the DO level expected in the calibration cup. The difference between this value and the DO Logger reading is the calibration error. If the DO reading is within 0.3 mg/l of the expected value, there is no need to recalibrate. Otherwise, recalibrate following the manufacturer's recommendations and note the new gain on the field sheet.
- 7. Record the results of the calibration check on the field sheet.

### 4.4.3 Data Retrieval

To download the DO Logger data, perform the following steps:

- Attach the Computer to the DO Logger
- Open HOBOware
- Readout data from Device

For a detailed discussion of techniques for adjusting the data for fouling and calibration drift, refer to USGS's *Guidelines and Standard Procedures for Continuous Water-Quality Monitors: Station Operation, Record Computation, and Data Reporting, Techniques and Methods 1-D3.* 

### 4.5 Data Adjustment

Prior to use, the retrieved data should be adjusted for fouling and calibration drift effects as described by Wagner and others (2006).

### 4.6 Storage of the DO Data Logger

Upon retrieving the DO Logger, clean and store the equipment per the manufacturer's recommendations.

### 5.0 References

Onset HOBO Dissolved Oxygen Logger (U26-001) - Manual. Onset HOBO Data Loggers.

Onset HOBOware Pro Dissolved Oxygen Assistant – User's Guide. Onset HOBO Data Loggers.

Wagner, R.J., R.W. Boulger, Jr., C.J. Oblinger and B.A. Smith. 2006. *Guidelines and Standard Procedures for Continuous Water-Quality Monitors: Station Operation, Record Computation, and Data Reporting*, US Geological Survey Techniques and Methods 1-D3.

Attachments

Nevada Division of Environmental Protection, Bureau of Water Quality Onset HOBO DO Continuous Water Quality Equipment Supply Checklist										
Calibration Equipment										
<ul> <li>Lab temp water</li> <li>Surveyor or Hach Multimeter for measuring barometric pressure (BP)</li> <li>Onset DO rubber calibration cup with sponge</li> <li>Computer</li> <li>Onset HOBO USB shuttle</li> </ul>										
Equipment										
□       GPS         □       Laptop         □       Onset HOBO USB shuttle         □       Onset HOBO dissolved oxygen data loggers         □       PVC protection shield         □       Rebar of various lengths         □       Sandbags (14" x 26" http://www.mcmaster.com product #4540T4) 36" zip ties (http://www.drillspot.com product #131995)         □       Sledge hammer         □       Pipe pounder         □       Installation toolbox         ○       Wire cutters, pliers, and other tools as needed         ○       Securing material such as zip ties, cable clamps, hose clamps         ○       Flagging tape         ○       Drivers for cable clamps         ○       Cable         ○       Cable clamps         ○       Cable clamps										
□ Camera										
Equipment for Cleaning the Logger										
Shop/lab towels										
Cotton swabs (aka Q-Tips)										
Paperwork										
<ul> <li>Clipboard</li> <li>DO Logger Deployment Field Sheets, 1 per site</li> <li>Pencils, pens, sharpies</li> <li>DO Logger Manual</li> <li>DO Logger Deployment SOP including Dissolved Oxygen Solubility Table</li> </ul>										

Nevada Division of Environmental Protection, Bureau of Water Quality											
Onset HOBO DO Continuous Water Quality Monitoring Field Form											
Station ID/Name:			Personnel:								
UTM Zone 11 Coordina	ates : NAD 83 Easting:	NAD 83 N	lorthing:								
Date:	Elevation:	DO Logge	er S/N:								

DO Calibration											
Date	Barometric	Temperature	DO Conc (mg/L)								
	Pressure (mmHg)	(ºC)	Lo	ogger	Calculated	New Gain	Final				
Deployment Information											
Date/Time Logging Ir	nitiated:		Sampli	ng Interval:							
Date/Time Data Logger Placed in River:											

Data Logger Check and Data Download										
Date:										
Fouling Checks										
Parameter	Before C	leaning	After Cleaning							
	Time =		Time =							
	DO Logger Value	Field Meter Value	DO Logger Value	Field Meter Value						
Temp (ºC)										
DO (mg/l)										
DO Calibration Drift	<b>Check</b> (If DO within	+0.3 mg/L of expe	cted, no need to recalib	orate)						
Temperature (ºC)	Barometric Pressure (mmHg)	DO (mg/L) Calculated	DO (mg/L) Reading from DO Logger	Error	New Gain					
Comments										
Solubility of oxygen in water at various temperatures and pressures [In milligrams per liter. Values based on Weiss (1970). C, degrees Celsius; mmHg, millimeters of mercury]

Temp.								At	cmosphe	eric pr	ressure	e, mmHg	ſ							
С	760.0	750.0	740.0	730.0	720.0	710.0	700.0	690.0	680.0	670.0	660.0	650.0	640.0	630.0	620.0	610.0	600.0	590.0	580.0	570.0
0	14.6	14.4	14.2	14.0	13.8	13.6	13.4	13.2	13.0	12.8	12.7	12.5	12.3	12.1	11.9	11.7	11.5	11.3	11.1	10.9
1	14.2	14.0	13.8	13.6	13.4	13.2	13.1	12.9	12.7	12.5	12.3	12.1	11.9	11.7	11.6	11.4	11.2	11.0	10.8	10.6
2	13.8	13.6	13.4	13.3	13.1	12.9	12.7	12.5	12.3	12.2	12.0	11.8	11.6	11.4	11.2	11.1	10.9	10.7	10.5	10.3
3	13.4	13.3	13.1	12.9	12.7	12.5	12.4	12.2	12.0	11.8	11.7	11.5	11.3	11.1	10.9	10.8	10.6	10.4	10.2	10.0
4	13.1	12.9	12.7	12.6	12.4	12.2	12.0	11.9	11.7	11.5	11.3	11.2	11.0	10.8	10.7	10.5	10.3	10.1	10.0	9.8
5	12.7	12.6	12.4	12.2	12.1	11.9	11.7	11.6	11.4	11.2	11.1	10.9	10.7	10.5	10.4	10.2	10.0	9.9	9.7	9.5
6	12.4	12.3	12.1	11.9	11.8	11.6	11.4	11.3	11.1	10.9	10.8	10.6	10.4	10.3	10.1	9.9	9.8	9.6	9.5	9.3
7	12.1	12.0	11.8	11.6	11.5	11.3	11.1	11.0	10.8	10.7	10.5	10.3	10.2	10.0	9.9	9.7	9.5	9.4	9.2	9.1
8	11.8	11.7	11.5	11.3	11.2	11.0	10.9	10.7	10.6	10.4	10.2	10.1	9.9	9.8	9.6	9.5	9.3	9.1	9.0	8.8
9	11.5	11.4	11.2	11.1	10.9	10.8	10.6	10.5	10.3	10.2	10.0	9.8	9.7	9.5	9.4	9.2	9.1	8.9	8.8	8.6
10	11.3	11.1	11.0	10.8	10.7	10.5	10.4	10.2	10.1	9.9	9.8	9.6	9.5	9.3	9.2	9.0	8.9	8.7	8.6	8.4
11	11.0	10.9	10.7	10.6	10.4	10.3	10.1	10.0	9.8	9.7	9.5	9.4	9.2	9.1	9.0	8.8	8.7	8.5	8.4	8.2
12	10.8	10.6	10.5	10.3	10.2	10.0	9.9	9.8	9.6	9.5	9.3	9.2	9.0	8.9	8.7	8.6	8.5	8.3	8.2	8.0
13	10.5	10.4	10.2	10.1	10.0	9.8	9.7	9.5	9.4	9.3	9.1	9.0	8.8	8.7	8.5	8.4	8.3	8.1	8.0	7.8
14	10.3	10.1	10.0	9.9	9.7	9.6	9.5	9.3	9.2	9.0	8.9	8.8	8.6	8.5	8.4	8.2	8.1	7.9	7.8	7.7
15	10.1	9.9	9.8	9.7	9.5	9.4	9.3	9.1	9.0	8.8	8.7	8.6	8.4	8.3	8.2	8.0	7.9	7.8	7.6	7.5
16	9.8	9.7	9.6	9.5	9.3	9.2	9.1	8.9	8.8	8.7	8.5	8.4	8.3	8.1	8.0	7.9	7.7	7.6	7.5	7.3
17 İ	9.6	9.5	9.4	9.3	9.1	9.0	8.9	8.7	8.6	8.5	8.3	8.2	8.1	8.0	7.8	7.7	7.6	7.4	7.3	7.2
18	9.4	9.3	9.2	9.1	8.9	8.8	8.7	8.6	8.4	8.3	8.2	8.0	7.9	7.8	7.7	7.5	7.4	7.3	7.2	7.0
19	9.3	9.1	9.0	8.9	8.8	8.6	8.5	8.4	8.3	8.1	8.0	7.9	7.8	7.6	7.5	7.4	7.3	7.1	7.0	6.9
20	9.1	8.9	8.8	8.7	8.6	8.5	8.3	8.2	8.1	8.0	7.8	7.7	7.6	7.5	7.4	7.2	7.1	7.0	6.9	6.7
21	8.9	8.8	8.6	8.5	8.4	8.3	8.2	8.1	7.9	7.8	7.7	7.6	7.5	7.3	7.2	7.1	7.0	6.9	6.7	6.6
22	8.7	8.6	8.5	8.4	8.2	8.1	8.0	7.9	7.8	7.7	7.5	7.4	7.3	7.2	7.1	7.0	6.8	6.7	6.6	6.5
23	8.6	8.4	8.3	8.2	8.1	8.0	7.9	7.7	7.6	7.5	7.4	7.3	7.2	7.0	6.9	6.8	6.7	6.6	6.5	6.4
24	8.4	8.3	8.2	8.0	7.9	7.8	7.7	7.6	7.5	7.4	7.3	7.1	7.0	6.9	6.8	6.7	6.6	6.5	6.3	6.2
25	8.2	8.1	8.0	7.9	7.8	7.7	7.6	7.5	7.3	7.2	7.1	7.0	6.9	6.8	6.7	6.6	6.4	6.3	6.2	6.1
26	8.1	8.0	7.9	7.8	7.6	7.5	7.4	7.3	7.2	7.1	7.0	6.9	6.8	6.7	6.5	6.4	6.3	6.2	6.1	6.0
27	7.9	7.8	7.7	7.6	7.5	7.4	7.3	7.2	7.1	7.0	6.9	6.7	6.6	6.5	6.4	6.3	6.2	6.1	6.0	5.9
28	7.8	7.7	7.6	7.5	7.4	7.3	7.2	7.1	6.9	6.8	6.7	6.6	6.5	6.4	6.3	6.2	6.1	6.0	5.9	5.8
29	7.7	7.6	7.5	7.3	7.2	7.1	7.0	6.9	6.8	6.7	6.6	6.5	6.4	6.3	6.2	6.1	6.0	5.9	5.8	5.7
30	7.5	7.4	7.3	7.2	7.1	7.0	6.9	6.8	6.7	6.6	6.5	6.4	6.3	6.2	6.1	6.0	5.9	5.8	5.7	5.6
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Appendix A-8: Standard Operating Procedures for Streamflow Measurements of Wadeable Streams

# Standard Operating Procedures for Streamflow Measurements of Wadeable Streams

Prepared by: State of Nevada Department of Conservation and Natural Resources Division of Environmental Protection Bureau of Water Quality Planning Carson City, Nevada

February 2020

**APPROVALS:** 

Paul Comba NDEP BWOP Chief:

1,0

Dave Simpson NDEP BWQP Quality Assurance Officer:

Date: 3/5/2020

Date: 3-4-20

## Standard Operating Procedure for Streamflow Measurements in Wadeable Streams

### **1.0 PURPOSE**

This document describes the procedure for measuring streamflow in wadeable streams.

### **2.0 PROCEDURES**

### 2.1 Selecting a Cross Section of the Stream

Select a straight reach where the streambed is uniform and relatively free of boulders and aquatic growth. Avoid stagnant areas or those with irregular bottoms, turbulent flow, standing waves, or strongly sloping bottoms. Depths should be at least 0.3 feet, with velocities mostly greater than 0.5 feet per second, if available.

### 2.2 Setting the Tagline

String the tape measure across the stream at the chosen cross section and secure the ends using pins, stakes, or vegetation. The tape measure should be perpendicular to the flow and about one foot above the water. Make sure the tape measure is tight, level, and not in contact with the water.

### 2.3 Determining Measurement Intervals

Before measurements begin, the stream cross section should be divided into measurement intervals. In general, the accuracy of the results increases with the number of measurement intervals. According to USGS protocols, the intervals should be spaced so that no subsection has more than 10 percent of the total discharge. However, the USGS protocols go on to state that the ideal measurement is one in which no measurement subsection has more than 5 percent of the total discharge. Obviously, meeting the 5 percent threshold requires more measurement intervals (more than 20 if the flow is completely uniform, about 25-30 in more realistic situations) than the 10 percent thresholds. However, the 5 percent threshold is likely to be excessive in most situations where NDEP would be measuring flows. It is recommended that the 10 percent threshold be the target used in most cases.

Measurement intervals need not be equally spaced, unless the flow is evenly distributed across the stream. The spacing between intervals will need to be closer in those parts of the cross section that have the greater depths and velocities. It is recommended that the measurement intervals be determined prior to initiating the velocity measurements. Using the tape measure, record the "left edge of water" and "right edge of water" on the field sheet, and determine the measurement locations needed to approximately meet the 10 percent goal. Measurement intervals should be no closer than 0.25 feet.

### 2.4 Making Depth and Velocity Measurements

The next step is to take depth and velocity measurements at each of the measurement intervals identified above. To measure the depth, the top-setting wading rod is placed in the stream at the predetermined location along the tape measure. Estimate the depth to the nearest 0.01 feet, based on gradations on the wading rod.

If the depth is less than 2.5 feet, one velocity measurement needs to be taken at the 60% depth point.

To locate the velocity meter at the 60% depth, move the sliding shaft of the wading rod so that the correct one foot line on the sliding rod lines up with the correct tenth foot line on the vernier scale. For example if the stream depth is 1.4 feet, move the 1 on the sliding rod until it is adjacent to the 4 on vernier scale.

For depths equal to or great than 2.5 feet, velocity measurements are to be taken at both the 20% and 80% depth.

To locate the velocity meter at the 20% depth, double the depth measurement then move the sliding shaft so that the line corresponding to twice the depth lines up with the correct tenth foot line on the vernier scale. For example if the stream depth is 2.8 feet (double the depth = 5.6 feet), move the 5 on the sliding rod until it is adjacent to the 6 on vernier scale.

To locate the velocity meter at the 80% depth, halve the depth measurement then move the sliding shaft so that the line corresponding to half the depth lines up with the correct tenth foot line on the vernier scale. For example if the stream depth is 2.8 feet (half the depth = 1.4 feet), move the 1 on the sliding rod until it is adjacent to the 4 on vernier scale.

When taking the velocity measurements, the wading rod should be kept vertical. When using a FlowTracker, the flow sensor kept perpendicular to the tape measure. When using a Pygmy Meter, the instrument should be lined with up the flow.

Stream velocities in natural conditions tend to pulse over time at the same stage. To average these conditions, allow at least 40 seconds for each velocity measurement with either the FlowTracker or a Pygmy Meter.

### 2.5 Use Of Flowtracker

Prior to using the FlowTracker, a BeamCheck diagnostic (see FlowTracker user's manual) should be run before an extended field trip (about once per week). In addition, the temperature sensor should be checked for accuracy as the device uses temperature in calculating velocity. Once in the field, perform a number of field diagnostics as described in the user's manual:

- Recorder Status (2 in System Function Menu)
- Temperature Data (4 in System Function Menu)
- Battery Data (5 in System Function Menu)
- Raw Velocity Data (6 in System Function Menu)
- System Clock (9 in System Function Menu)

Refer to the user's manual for a detailed description of its operation.

### 2.6 Use of Pygmy Meter

Prior to its use, remove the shipping pin beneath the bucket wheel that prevents the wheel from rotating while not in use. Install the pivot pin in its place. To spin test the meter, hand spin the bucket wheel counterclockwise. If it spins less than 90 seconds, clean, lubricate, and adjust the pivot pin.

Once the Pygmy Meter is located at the desired location on the tape measure and at the necessary depth, allow a few seconds for the meter to stabilize. For at least 40 seconds, count the number of revolutions the bucket wheel makes during that period. Refer to the rating table in the attachments to determine the number of revolutions needed to easily determine the velocity at that measurement point. In lieu of using the table, the following equation can also be used to calculate the velocity:

Velocity (fps) = 0.9604 \* Revolutions/sec+ 0.0312

Use the forms in the attachments for recording the data collecting and calculating the result flow rate.

### 3.0 **REFERENCES**

Rantz, S.E. and other. 1982. Measurement and Computation of Streamflow: Volume 1. Measurement of Stage and Discharge. USGS Water-Supply Paper 2175.

SonTek/YSI, Inc. 2009. FlowTracker Technical Manual.

Attachments

# Streamflow Measurement Equipment and Supply Checklist

Equipment	
<ul> <li>Velocity meter         <ul> <li>Sontek/YSI FlowTracker Handheld-ADV</li> <li>Pygmy Meter</li> </ul> </li> <li>Top set wading rod</li> <li>100-foot tape measure</li> <li>Pins/stakes</li> <li>Stopwatch (if using Pygmy Meter)</li> <li>Headphones (if using Pygmy Meter)</li> </ul>	
Personal Equipment	
□ Waders or water shoes	
Paperwork	
<ul> <li>Clipboard</li> <li>Streamflow Measurement Field Form</li> <li>Pencils, pens, sharpies</li> </ul>	

## NDEP Streamflow Measurement Form (for all depths < 2.5 feet)

Stream:	Date:
Station Description:	
Beginning Time:	Ending Time:
Meter Type:	Observers:

Section Midpoint (ft)	Section Width (ft)	Section Depth (ft)	Velocity (fps)	Area (width x depth) (ft²)	Flow (velocity x area) (cfs)

Total Flow =

## NDEP Streamflow Measurement Form (for all depths ≥ 2.5 feet)

Stream:	Date:
Station Description:	
Beginning Time:	Ending Time:
Meter Type:	Observers:

Section	Section	Velocity	Velo	ocity	Area	ea Flow				
Midpoint (ft)	Depth (ft)	Depth (ft)	At Point (fps)	Average (fps)	(width x depth) <b>(ft<sup>2</sup>)</b>	(velocity x area) <b>(fps)</b>				

Total Flow =

### STANDARD RATING TABLE NO. 2 FOR PYGMY CURRENT METER (6/99)

spu						VELOO	CITY IN	FEET P	ER SEC	OND					
eco							Re	volution	s						
S	3	5	7	10	15	20	25	30	40	50	60	80	100	150	200
40	0.103	0.151	0.199	0.271	0.391	0.511	0.631	0.752	0.992	1.23	1.47	1.95	2.43	3.63	4.83
41	0.101	0.148	0.195	0.265	0.383	0.500	0.617	0.734	0.968	1.20	1.44	1.91	2.37	3.54	4.72
42	0.100	0.146	0.191	0.260	0.374	0.489	0.603	0.717	0.946	1.17	1.40	1.86	2.32	3.46	4.60
43	0.098	0.143	0.188	0.255	0.366	0.478	0.590	0.701	0.925	1.15	1.37	1.82	2.26	3.38	4.50
44	0.097	0.140	0.184	0.249	0.359	0.468	0.577	0.686	0.904	1.12	1.34	1.78	2.21	3.31	4.40
45	0.095	0.138	0.181	0.245	0.351	0.458	0.565	0.671	0.885	1.10	1.31	1.74	2.17	3.23	4.30
46	0.094	0.136	0.177	0.240	0.344	0.449	0.553	0.658	0.866	1.08	1.28	1.70	2.12	3.16	4.21
47	0.093	0.133	0.174	0.236	0.338	0.440	0.542	0.644	0.849	1.05	1.26	1.67	2.07	3.10	4.12
48	0.091	0.131	0.171	0.231	0.331	0.431	0.531	0.631	0.832	1.03	1.23	1.63	2.03	3.03	4.03
49	0.090	0.129	0.168	0.227	0.325	0.423	0.521	0.619	0.815	1.01	1.21	1.60	1.99	2.97	3.95
50	0.089	0.127	0.166	0.223	0.319	0.415	0.511	0.607	0.800	0.992	1.18	1.57	1.95	2.91	3.87
51	0.088	0.125	0.163	0.220	0.314	0.408	0.502	0.596	0.784	0.973	1.16	1.54	1.91	2.86	3.80
52	0.087	0.124	0.160	0.216	0.308	0.401	0.493	0.585	0.770	0.955	1.14	1.51	1.88	2.80	3.73
53	0.086	0.122	0.158	0.212	0.303	0.394	0.484	0.575	0.756	0.937	1.12	1.48	1.84	2.75	3.66
54	0.085	0.120	0.156	0.209	0.298	0.387	0.476	0.565	0.743	0.920	1.10	1.45	1.81	2.70	3.59
55	0.084	0.119	0.153	0.206	0.293	0.380	0.468	0.555	0.730	0.904	1.08	1.43	1.78	2.65	3.52
56	0.083	0.117	0.151	0.203	0.288	0.374	0.460	0.546	0.717	0.889	1.06	1.40	1.75	2.60	3.46
57	0.082	0.115	0.149	0.200	0.284	0.368	0.452	0.537	0.705	0.874	1.04	1.38	1.72	2.56	3.40
58	0.081	0.114	0.147	0.197	0.280	0.362	0.445	0.528	0.694	0.859	1.02	1.36	1.69	2.51	3.34
59	0.080	0.113	0.145	0.194	0.275	0.357	0.438	0.520	0.682	0.845	1.01	1.33	1.66	2.47	3.29
60	0.079	0.111	0.143	0.191	0.271	0.351	0.431	0.511	0.671	0.832	0.992	1.31	1.63	2.43	3.23
61	0.078	0.110	0.141	0.189	0.267	0.346	0.425	0.504	0.661	0.818	0.976	1.29	1.61	2.39	3.18
62	0.078	0.109	0.140	0.186	0.264	0.341	0.418	0.496	0.651	0.806	0.961	1.27	1.58	2.35	3.13
63	0.077	0.107	0.138	0.184	0.260	0.336	0.412	0.489	0.641	0.793	0.946	1.25	1.56	2.32	3.08
64	0.076	0.106	0.136	0.181	0.256	0.331	0.406	0.481	0.631	0.782	0.932	1.23	1.53	2.28	3.03
65	0.076	0.105	0.135	0.179	0.253	0.327	0.401	0.474	0.622	0.770	0.918	1.21	1.51	2.25	2.99
66	0.075	0.104	0.133	0.177	0.249	0.322	0.395	0.468	0.613	0.759	0.904	1.20	1.49	2.21	2.94
67	0.074	0.103	0.132	0.175	0.246	0.318	0.390	0.461	0.605	0.748	0.891	1.18	1.46	2.18	2.90
68	0.074	0.102	0.130	0.172	0.243	0.314	0.384	0.455	0.596	0.737	0.879	1.16	1.44	2.15	2.86
69	0.073	0.101	0.129	0.170	0.240	0.310	0.379	0.449	0.588	0.727	0.866	1.14	1.42	2.12	2.81
70	0.072	0.100	0.127	0.168	0.237	0.306	0.374	0.443	0.580	0.717	0.854	1.13	1.40	2.09	2.78

EQUATION: V = 0.9604 R+ 0.0312 (R=revolutions per second)

Appendix A-9: Standard Operating Procedures for Transporting and Operating All-Terrain Vehicles

# Standard Operating Procedures for Transporting and Operating All-Terrain Vehicles

Prepared by: State of Nevada Department of Conservation and Natural Resources Division of Environmental Protection Bureau of Water Quality Planning Carson City, Nevada

January 2020

**APPROVALS:** 

Paul Comba NDEP BWQP Chief:

Dave Simpson NDEP BWQP Quality Assurance Officer:

Date: 3/5/2020

Date:

3-4-20

### Standard Operating Procedure for Transporting and Operating All-Terrain Vehicles

### 1.0 PURPOSE AND APPLICABILITY

This standard operating procedure (SOP) is intended to standardize procedures for transporting and operating all-terrain vehicles (ATVs) for use in sampling and monitoring activities. However, this SOP is not intended as a substitute for information on local, state, and federal regulations concerning ATV operation and transport.

### 2.0 TRAINING

All Nevada Division of Environmental Protection – Bureau of Water Quality Planning (BWQP) personnel that will use ATVs are required to complete an ATV safety course approved by the State of Nevada Risk Management Division and retain a certificate of completion. All BWQP personnel who will use ATVs must also be familiar with the ATV owner's manual and this SOP.

### 3.0 ATV USAGE

The ATVs will only be used when a site cannot be accessed by truck. The ATV must be transported from site to site on a trailer or truck and cannot be operated on public roads. At the site, the ATV can be used to transport equipment and personnel to, from, and during assigned work. All site speed limits and off-road restrictions apply.

### 4.0 PREPARING ATVS FOR TRANSPORT AND USE

See attachments for Checklist for Preparing ATVS for Transport and Use

### 5.0 TRANSPORT OF ATVS

The ATV must be transported from site to site on a trailer and cannot be operated on public roads. All ATVs will be transported in accordance with local, state, and federal regulations.

### 6.0 PRE-RIDE INSPECTION

See attachments for Pre-Ride Inspection Checklist.

### 7.0 UNLOADING/LOADING ATVS

See attachments for Checklist for Unloading/Loading ATVs.

### 8.0 SAFE OPERATION OF ATVS

### 8.1 General Safety Precautions

- Do not carry passengers.
- Do not operate an ATV on pavement. The ATVs are not designed to be used on paved surfaces and may be difficult to control.

- Be cautious when operating an ATV, especially when approaching hills, turns, and obstacles and when operating on rough terrain.
- Go at a speed that is appropriate for the terrain, visibility conditions, and your experience.
- Never attempt to do wheelies, jumps, or other stunts.

### 8.2 Riding in Reverse

- First, bring the vehicle to a complete stop and make sure the transmission is in neutral.
- Depress the knob on the gear shift and maneuver the gear shift into reverse.
- Open the throttle gradually and ride slowly. Do not open the throttle suddenly or make abrupt turns.
- To stop, release the throttle and gradually apply both the front and rear brakes.

<u>Note</u>: Do not abruptly apply the rear brake by itself.

• To shift from reverse to neutral, depress the knob on the gear shift and maneuver the gear shift into neutral.

### 8.3 Transporting Equipment

When carrying a load, ensure that it is properly balanced and secured to a rack that is intended for this purpose. When transporting extra fuel it must be in a DOT-approved container.

Note: Never transport additional personnel on the ATV.

# 9.0 DECONTAMINATION OF FIELD EQUIPMENT TO LIMIT THE SPREAD OF INVASIVE SPECIES

For further information read the SOP *Decontamination of Field Equipment to Limit the Spread of Invasive Species* (Appendix A-9).

### **10.0 PREPARING THE ATVS FOR STORAGE**

The ATVs must be stored inside a secure location. The ATVs will be stored on the trailer. While the ATVs are in storage, the trickle charger for the ATV batteries will be connected. If the ATVs will not be used for extended periods of time, a fuel stabilizer will be added to the gasoline tank according to the manufacturer's instructions.

### **11.0 MAINTENANCE**

The ATVs and the ATV trailer are maintained per manufacturer's recommendations.

Attachments

# All-Terrain Vehicle Equipment and Supply Checklist

All-Terrain Vehicle Transport Equipment
<ul> <li>Proper sized ball hitch</li> <li>Locking hitch pin</li> <li>Proper sized trailer</li> <li>Lock for trailer coupler</li> <li>Proper sized spare tire</li> <li>Lug wrench for trailer</li> </ul>
<ul> <li>Jack for trailer</li> <li>Front tie down strap for ATV</li> <li>Rear tie down strap for ATV</li> </ul>
All-Terrain Vehicle Equipment
<ul> <li>DOT rated motorcycle helmet (supplied by BWQP)</li> <li>Eye protection (or helmet face shield)</li> <li>Sturdy boots with ankle support</li> <li>Gloves</li> <li>Long-sleeved shirt or jacket (optional)</li> <li>Tool kit – emergency maintenance tools located in rear compartment of ATV</li> <li>First Aid kit</li> </ul>
All-Terrain Vehicle Storage Equipment
<ul> <li>Trickle charger</li> <li>Fuel Stabilizer</li> </ul>

### CHECKLIST FOR PREPARING ATVS FOR TRANSPORT AND USE

### ATVs

- □ Front tie down strap is attached and snugged.
- □ Rear tie down strap attached and snugged.
- □ Battery is fully charged.
- □ Oil reservoir in main engine is full.
- □ Gasoline tank is full.
- Dashboard indicators working (fuel indicator, oil indicator, etc.).
- □ Headlights and brake lights working.
- □ Check steering function.
- □ Engine starts and runs.
- DOT-rated motorcycle helmet for each individual are in the vehicle.

### Trailer

- □ Inspect trailer tires (including spare) to make sure they are properly inflated.
- □ Check padlock on the spare tire, make sure that key works.
- □ Make sure lug wrench and jack for trailer are in the vehicle.
- □ Lock trailer hitch assembly onto vehicle.
- □ Attach trailer to vehicle.
- □ Check to make sure trailer coupler is secure on the ball hitch by pulling up on trailer.
- $\hfill\square$  Lock the trailer coupler.
- $\hfill\square$  Check trailer safety chains for wear and tear.
- $\hfill\square$  Attach trailer safety chains in crisscrossed fashion.
- $\hfill\square$  Check for wear and tear on trailer electrical connection wires and plugs.
- □ Connect trailer electrical connection to vehicle electrical plug.
- □ Confirm that the trailer's brake lights, turn signals, running lights, and reverse lights are functional.

### **PRE-RIDE INSPECTION CHECKLIST**

- □ Set PARKING BRAKE. The parking brake is engaged by pulling the left hand grip and pushing the lever marked Parking Brake.
- □ Transmission is in NEUTRAL.
- Brakes. The right hand grip and the right foot pedal are the rear wheel brakes. The left hand grip is the front wheel brake. Check operation. Make sure there is no brake fluid leakage. Make sure that brake lights are functioning properly.
- □ Fuel. Fill the fuel tank with unleaded gas when necessary. Check for leaks.
- □ Tires and wheels. Check condition and pressure.
- $\Box$  Controls. Check for proper function.
- Lights and switches. Check for proper function.
- Drive shaft and chassis. Check for damage or leaking fluids.
- Steering. Check that the wheels turn properly as you turn the handlebars.
- □ Cargo. Check that all cargo is properly secured.
- Headlights. Check for proper function.
- Engine oil level. Check the oil level and add oil if required. Check for leaks.
- □ Throttle. Check for smooth opening and closing in all steering positions.
- Nuts, bolts, and fasteners. Check the wheels to see that the axle nuts are tightened. Check the security of all other nuts, bolts, and fasteners.
- Underbody and exhaust system. Check for, any dirt, vegetation, or other debris that could be a fire hazard or interfere with the proper operation of the vehicle. If necessary, clean the underbody and exhaust system.
- Air cleaner housing drain tube. Check for deposits in the drain tube. If necessary, clean the tube and check the air cleaner housing.
- □ Confirm that tool kit and owner's manual are in the seat storage box.

### CHECKLIST FOR UNLOADING/LOADING ATVs

### Trailer

- □ Unload/load ATVs on level ground, if possible.
- □ Make sure trailer is attached to tow vehicle.
- $\hfill\square$  Fold down loading ramp.

### **Unloading ATVs**

- □ Remove straps securing ATV to the trailer.
- $\hfill\square$  Don helmet and gloves.
- □ Make sure gear shift is in neutral and turn choke on (if necessary). <u>Note</u>: starter will not operate unless the transmission is in neutral.
- $\hfill\square$  Lock the parking brake and make sure the transmission is in neutral.
- $\hfill\square$  Turn the fuel valve to RUN.
- $\Box$  Turn the ignition switch to ON.
- $\Box$  Turn the engine stop switch to ON.
- □ Turn all auxiliary switches on.
- $\Box$  Press the starter button. Let the ATV warm up, if necessary.
- □ Allow motor to warm up at idle speed. Once motor is warmed up, turn choke off before riding ATV.
- □ Apply brakes and remove parking brake.
- □ Shift ATV into gear.
- $\hfill\square$  Slowly ride forward or backward onto ramp.
- Adjust rider weight to compensate for ramp angle.
- □ Slowly apply brakes as the ATV rolls down the ramp.

### Loading ATVs

- □ Slowly ride forward or backward onto ramp.
- Adjust rider weight to compensate for ramp angle.
- □ Slowly apply throttle as the ATV rolls up the ramp.
- □ Carefully maneuver the ATV into position on the trailer.
- $\hfill\square$  Lock the parking brake and make sure the transmission is in neutral.
- □ Turn the fuel valve off and let the ATV run until it stops.
- □ Turn the ignition switch to OFF.
- $\hfill\square$  Turn the engine stop switch to OFF.
- □ Turn all auxiliary switches off.
- □ Check for damages and leaks.
- □ Secure the ATVs to the trailer for transport. Checklist for Preparing ATVs for Transport and Use.

Appendix A-10: Standard Operating Procedures for Decontamination of Field Equipment to Limit the Spread of Invasive Species

# Standard Operating Procedures for Decontamination of Field Equipment to Limit the Spread of Invasive Species

Prepared by: State of Nevada Department of Conservation and Natural Resources Division of Environmental Protection Bureau of Water Quality Planning Carson City, Nevada

February 2020

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Date: 12020

Date: 3-4-20

## Standard Operating Procedures for Decontamination of Field Equipment to Limit the Spread of Invasive Species

### 1.0 SCOPE AND APPLICABILITY

This standard operating procedure (SOP) provides general guidelines for decontamination of field equipment to limit the spread of invasive species. Limiting the spread of invasive species is important because invasive species can cause serious environmental and economic harm.

Invasive species can be spread in numerous ways. For example, soil and mud accumulated on undersides of vehicles can carry seeds or viable fragments of invasive plants. Lodged material from plants or animals is often not easily recognizable by casual inspection of equipment and vehicles. In addition, foreign material can become lodged in areas of limited sight and access. Also, the use of boats, pumps, in-water equipment, and even waders in waters infested with invasive plants and animals can easily become vectors for spread of invasive species. Therefore, it is vital that BWQP personnel working in areas where invasive species are present (or suspected to be present) have sufficient training in inspecting and decontaminating equipment used in such areas.

### 2.0 METHOD SUMMARY

This SOP describes the process to pre-inspect, clean, and re-inspect all equipment before moving or placing the equipment into service. Properly conducted inspection and decontamination of equipment prior to entry at a new location limits introduction of invasive species. Generally, equipment of all types should be decontaminated at the location of last use before being moved to a new location. If this is not possible, arrange for cleaning at a facility that is specifically designed for equipment cleaning. Inspection of equipment is the primary tool for preventing the introduction of an invasive organism into a new location.

The following decontamination procedures are followed by all BWQP personnel involved in surfacewater sampling and monitoring. The required decontamination equipment is carried in BWQP field vehicles and the procedures are understood and implemented by all BWQP field staff. These procedures are consistent with the best available science for managing the risk of spreading invasive species and have been found effective in significantly reducing the survival of some of the most insidious invasive species. Further information can also be obtained by reviewing the reference materials for this SOP.

Field crews must be aware of regional species of concern, and take appropriate precautions to avoid transfer of these species. Prior to going into the field, crews must review the most up-to-date invasive species notifications. Personnel must be trained to look for problem areas that are not apparent upon casual observation. Effective inspections require good lighting conditions (preferably daylight hours) and training of personnel to use systematic techniques.

When possible, keep several changes of field gear and sampling equipment for use in different aquatic systems (especially within an area of suspected or confirmed infestation). This is the preferred method to limiting the spread of invasive species.

### 3.0 SAMPLING STRATEGY

Whenever practical, the least infested (or least likely to be infested) sites should be visited first to reduce the risk of accidentally introducing invasive species a new area during field work. In circumstances when the existence of invasive species is unknown, BWQP samples from upstream to downstream (whenever practical) to avoid carrying invasive species farther upstream.

### 4.0 DECONTAMINATION PROCEDURES

Invasive species can become lodged in or on personal gear, sampling equipment, vehicles, boats, as well as associated equipment and trailers. Rigorous inspection must be used to find problems, and total removal of aquatic invasive species must take place before moving to other aquatic systems. Each equipment type has its own particular requirements for inspection.

Even the most careful inspection of equipment will not guarantee that the equipment is absolutely free of contamination. Successful decontamination is dependent upon many factors, such as the amount of care taken during the decontamination operation, the type of decontamination equipment being used, the level of training of the decontamination operator, the type of equipment being decontaminated, and the particular invasive species.

If equipment is used at a location known or suspected to be infested with a high risk invasive species, the equipment should undergo vigorous inspection, followed by thorough decontamination, and a final re-inspection before being moved off the worksite. At the new worksite location, the equipment should be inspected again, preferably by someone other than the original inspector before the equipment is placed into service. If, on re-inspection, contamination is found on the equipment, do not allow the equipment entry on the new worksite; either return the equipment to the location of last use for additional decontamination or arrange for decontamination at a location that is specifically designed for equipment decontamination.

Decontamination of field equipment should always occur after each use in areas of suspected or confirmed infestation and before equipment is used if the cleanliness of equipment is unknown. The use of a dilute bleach solution, followed by a potable-water rinse is a routine procedure at each site where water samples are collected or instream measurements are made. Decontamination of ropes, cables, and electrodes must be done at each sampling site where these are deployed.

### 4.1 Decontamination of Sampling Equipment and Personal Gear

Clothing, shoes, and waders<sup>7</sup> can become vectors of spread when personnel leave infested areas that contain soil or mud laden with seed, plant fragments, pathogens, insects, and other animals. Equipment that can be easily inspected and decontaminated should be used.

### 4.1.1 Inspection Procedure

All personal gear (e.g., clothing, waders, hats, socks, shoes, gloves, etc.) and sampling equipment should be thoroughly inspected for seeds, plant material, algae, mud, soil, insects, and other invertebrates such as snails, mussels, and other aquatic species. Particular attention must be given to places where foreign material could become accidentally trapped, such as in the cuffs and folds of clothing, treads of boots or waders, or closures such as zippers or ties. Pockets should be turned inside out to remove debris. Shoelaces and shoe tongues should be checked. In addition, all sampling equipment that was in contact with water must be thoroughly inspected as well.

For in-water equipment, inspect for zebra and quagga mussel infestations. Look for adult mussels and feel by hand for very small veligers (the mussel immature life stage) attached to anything that has made contact with raw water. On a smooth surface, mussel veligers will feel like gritty sandpaper. As the veliger matures, it may become visible to the unaided eye, appearing as a nondescript speck.

### 4.1.2 Decontamination Procedure<sup>8</sup>

- After exiting the waterbody, immediately remove any personal gear that came in contact with water. Make sure the wetted personal gear and sampling equipment does not come in contact with other equipment.<sup>9</sup>
- Thoroughly inspect the wetted personal gear and sampling equipment.
- Before leaving the sample site area, remove conspicuous mud, debris, and plant material from wetted personal gear and sampling equipment using stiff-bristled brush.<sup>10</sup> If any material is removed, either throw it in a trashcan or dispose of it on high, dry ground. Do not put it back into the waterbody or along the waterline.
- If equipment will not be put into immediate use it can be placed out to air-dry in a low-humidity environment for at least 72-hours after all mud and debris has been removed. All surfaces of air-dried equipment should remain free of surface contact, allowing for maximum airflow across all surfaces. Drying is the preferred treatment.
- Alternatively, if gear will be used immediately, thoroughly spray all wetted personal gear and sampling equipment with white vinegar or other approved decontamination solution.

<sup>&</sup>lt;sup>7</sup> It is the policy of the BWQP that felt-soled waders and boots will not be used.

<sup>&</sup>lt;sup>8</sup> Certain species of concern may require more substantial decontamination measures. For example, white vinegar is not effective against *Didymosphenia geminate*.

<sup>&</sup>lt;sup>9</sup> Invasive species can be transferred to any surface they come in contact with and they could later be transferred back to decontaminated personal gear and sampling equipment.

<sup>&</sup>lt;sup>10</sup> If there is a nap, brush with the nap rather than against it. Brushing against the nap could further embed small seeds into the weave of fabric.

- Re-inspect the personal gear and sampling equipment for attached organisms or propagules, making sure to examine all crevices. If necessary, use a stiff bristled brush to remove any remaining debris and mud.
- After re-inspection, spray the personal gear and sampling equipment with clean rinse water. DO NOT USE WATER FROM THE INFESTED SOURCE. This may reintroduce invasive species to the personal gear and sampling equipment.
- After personal gear and sampling equipment are decontaminated, ensure that they remain clean when leaving the site.

If adult mussels are found during inspection, the equipment should be washed with hot (≥140°F), high-pressure water or dipped treated in hot water (≥140°F), and allowed to dry completely before the next use.

**Note:** This decontamination procedure does not apply to electronic equipment such as dissolved oxygen and pH meters. Rinse meter probes with clean water between sites, remove all plant fragments and other debris from meters and cables by hand (clean paper towels may be used if needed), and allow equipment to air dry. Meters and data sondes may be disinfected with an appropriate decontamination solution, if deemed necessary by the Standards and Monitoring Branch Supervisor. Alternatively, designated electronic equipment can be used for waterbodies of suspected or confirmed infestation.

### 4.2 Decontamination of Boats and Associated Equipment

Boats and trailers are major contributors to the spread of invasive aquatic plants and animals. Detailed inspections must be made before the boat, trailer, and associated equipment in contact with water are moved from one waterbody to another.

### 4.2.1 Inspection Procedure

Zebra mussels and quagga mussels are a complex inspection problem. Adult mussels are likely to be visually identified; however, the mussel veliger (the immature life stage) can attach to boat hulls, trailers, anchor ropes, and anything else that contacts an infested water body without being visually identified. Since the veliger is microscopic and cannot be seen without laboratory equipment, do not rely on visual inspection alone. Veligers are detectable only by feeling by hand along all surfaces and inside holes and crevices. On a smooth surface, mussel veligers will feel like gritty sandpaper. As the veliger matures, it may become visible to the unaided eye, appearing as a nondescript speck. Equipment that has been in water for a long period of time can become infested with adult mussels.

#### 4.2.2 Decontamination Procedure

- Prior to leaving a site, inspect the boat and trailer including running your hands up and down the equipment and feeling all around for any attached organisms.
- Remove any visible mud, plants, invertebrates, or vertebrates from the anchor, boat, motor, and trailer. If any material is removed, either throw it in a trashcan or dispose of it on high, dry ground. Do not put it back into the waterbody or along the waterline.
• Drain the water from your outboard motor<sup>11</sup>, bilge, and every other conceivable space or item than can hold water on land before leaving the immediate area of the waterbody. Oily or dirty bilge water must be contained and disposed of properly.

#### When a boat decontamination facility is available:

- Wash the hull, external areas of motor, and any other exposed surface with hot, pressurized water (≥140°F).<sup>12</sup> Water temperature used during hot water washing or rinsing must be maintained at ≥140°F at surface contact for 1-3 minutes exposure time to bring the surface temperature up to ≥140°F for 30 seconds. In addition, flush the internal water passages of the outboard motor until the water temperature exiting the motor is ≥140°F for 30 seconds.
- Completely re-inspect your boat and trailer, removing any visible mussels, but also feel for any rough or gritty spots on the hull.
- Before leaving to enter another waterbody, check the boat and trailer for plant material or mussels. Remove anything visible. You can be cited for transporting mussels, even if they are dead.

When a boat decontamination facility is not available:

- Wash the hull, external areas of motor, and any other exposed surface with a 5% bleach solution. Flush the internal water passages of the outboard motor with white vinegar or a 5% bleach solution, then rinse with clean water and allow to dry.
- Completely re-inspect your boat and trailer, removing any visible mussels, but also feel for any rough or gritty spots on the hull.
- Before leaving to enter another water body, check boat and trailer for plant material or mussels. Remove anything visible. You can be cited for transporting mussels, even if they are dead.

Drying times capable of killing mussels vary according to the month of the year, location, and relative humidity; therefore, no single drying time estimate can ensure a complete kill for all situations. For specific information for a given month and location, refer to the 100th Meridian Quarantine Estimator for Zebra Mussel Contaminated Boats drying schedule at the following Web site: <a href="http://www.100thmeridian.org/Emersion.asp">http://www.100thmeridian.org/Emersion.asp</a> (100th Meridian Initiative, 2008).

## 4.3 Decontamination of Rubber-Tired Land Vehicles

Rubber-tired land vehicles can become vectors of spread when driven out of infested areas that contain soil or mud laden with seed, plant fragments, pathogens, invertebrates, and vertebrates.

<sup>&</sup>lt;sup>11</sup> Follow factory guidelines for eliminating water from motors.

<sup>&</sup>lt;sup>12</sup> Using a car wash or home power water sprayer is not adequate to kill and/or remove zebra or quagga mussels. Use a power washer unit that is capable of applying a flow rate of at least 4 gallons per minute with a nozzle pressure of 3,000 psi, and that is able to supply water at 140°F or hotter at the surface point of contact.

#### 4.3.1 Inspection Procedure

In the field, all vehicles should be carefully inspected. Invasive species can be deposited on fuel tanks, wheel wells, behind the bumpers of vehicles, among other locations. Particular attention must be given to places where foreign material could become accidentally trapped, such as in cracks and crevices, in undercarriages, and in the treads of tracks or tires. In addition, the interiors of vehicles must be thoroughly inspected for invasive species.

#### 4.3.2 Decontamination Procedure

Clean vehicles and equipment thoroughly, and ensure that they remain clean when leaving the site. Follow up cleaning operations with final inspections.

All vehicles used for monitoring activities shall be inspected before going into the field and between sites. Any visible mud, plants or animals shall be removed immediately to prevent transfer. Vehicles shall be periodically washed at car wash facilities. Keeping vehicles and equipment clean and free of mud and debris will aid in preventing the spread of invasive species.

If rubber-tired land vehicles come in contact with a waterbody that is known or suspected to be infested with an invasive species, follow decontamination procedures outlined in Section 4.2.2.

#### REFERENCES

- Bureau of Reclamation. 2010. Technical Memorandum No. 86-68220-07-05: Inspection and Cleaning Manual for Equipment and Vehicles to Prevent the Spread of Invasive Species, 2010 Edition. <u>http://www.usbr.gov/mussels/prevention/docs/EquipmentInspectionandCleaningManual2010.pdf</u>
- California Department of Fish and Game. 2005. Controlling the Spread of New Zealand Mud Snails on Wading Gear. May 16, 2005.
- Colorado Division of Wildlife. 2011. "Aquatic Nuisance Species (ANS) Watercraft Decontamination Manual." June 2011. <u>http://wildlife.state.co.us/SiteCollectionDocuments/DOW/WildlifeSpecies/AquaticNuisance/ANSWat</u> ercraftDecontamManual.pdf
- Schisler, G.J., Vieira, N.K.M, and Walker, P.G. 2008. "Application of Household Disinfectants to Control New Zealand Mudsnails." North American Journal of Fisheries Management, 28: 1172-1176.
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- 100th Meridian Initiative. 2008. Cooperative Federal, State, and provincial agency Web site: <u>http://www.100thmeridian.org</u>.

## Invasive Species Decontamination Equipment and Supply Checklist

Decontamination of Sampling Equipment and Personal Gear							
Nitrile or rubber protective gloves							
Fve Protection							
Portable evenuesh bottle containing saline solution.							
□ Stiff-bristled brush.							
One pump sprayer containing white vinegar.							
One pump sprayer containing clean rinse water.							
□ Paper towels.							
Decontamination of Boats and Associated Equipment							
Nitrile or rubber protective gloves.							
$\square$ Eve Protection.							
<ul> <li>Portable eyewash bottle containing saline solution.</li> </ul>							
□ Stiff-bristled brush.							
One pump sprayer containing 5% bleach solution.							
One pump sprayer containing clean rinse water.							
Outboard motor flushing attachment.							
□ Hose siphon mixer.							
Paper towels.							
Decontamination of Rubber-Tired Land Vehicles							
□ Nitrile or rubber protective gloves.							
Eye Protection.							
Portable eyewash bottle containing saline solution.							
Stiff-bristled brush.							
One pump sprayer containing 5% bleach solution.							
One pump sprayer containing clean rinse water.							
Flashlight(s).							
│ └┘ Mirror(s).							

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Appendix A-11: Standard Operating Procedures for Sampling Harmful Algal Blooms (HABs) This page intentionally blank.

## **Standard Operating Procedures for Sampling for Harmful Algal Blooms**

Prepared by: State of Nevada Department of Conservation and Natural Resources Division of Environmental Protection Bureau of Water Quality Planning Carson City, Nevada

February 2020

**APPROVALS:** 

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Date: 3/5/2020

Date:

3-4-20

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## Standard Operating Procedures for Sampling for Harmful Algal Blooms

## 1.0 Background

Under normal conditions, cyanobacteria are present in the water column at low levels. Under the right conditions, cyanobacteria can multiply rapidly and become visibly abundant, typically forming dense colonies on the water surface as a scum and generally making the water green to bluish-green in appearance. Some toxin-producing blooms may occur deeper in the water column and are not visible at the surface. Other blooms may appear brownish-green in turbid water, and golden algae have an iced-tea appearance with no surface film.

Blooms of cyanobacteria are known as harmful algal blooms (HABs) because many species of cyanobacteria can produce cyanotoxins, such as microcystins, anatoxin-a, saxitoxin, and cylindrospermopsin. These freshwater cyanotoxins have the potential to cause adverse health effects in wildlife, humans, pets and livestock. Cyanotoxins can also accumulate in fish and in some cases, the HABs may contribute to fish mortalities due to the depletion of oxygen in the water resulting in hypoxic conditions.

Many factors including excess nutrients, sunlight, wind, and temperature contribute to the formation of HABs. Although blooms can occur at any time, they are more likely to occur in late summer and early fall when lake and reservoir temperatures warm, water levels stabilize, nutrients are assimilated, and phytoplankton productivity increases. The turn-over of reservoirs and lakes may also result in blooms occurring as the nutrients are released from the bottom when cooler water is brought toward the surface of the waterbody. Shallow reservoirs, those with long residence times, or those with elevated concentrations of nutrients have an increased likelihood of blooms.

## 2.0 Targeted Monitoring Program for HABs in Nevada

A select number of reservoirs in the State have been targeted to measure levels of cyanobacteria populations and other variables in the waterbodies throughout the year. Reservoirs identified for targeted monitoring in 2019 include Chimney Reservoir, Topaz Lake and Lake Lahontan; however, field personnel should collect algal samples if they are at any location and see a suspected HAB. At the targeted monitoring locations, the following measurements will be taken:

- Water transparency or clarity (Secchi disk)
- Chlorophyll-a levels
- Water temperature and pH.

Additionally, at the targeted monitoring locations, an integrated water sample is taken from euphotic zone for water chemistry (nutrient levels), and cyanobacteria and algal toxin identification and analysis.

Information and data from the targeted monitoring program provide information on the following:

- Seasonal patterns exhibited by cyanobacteria populations in the waterbodies
- Existence of spatial variability throughout the year
- Water conditions and environmental factors that contribute to formation of HABs
- How and why HAB problems occur and predicting development of HABs

The environmental outcomes of targeted monitoring program include a better understanding of variables and conditions that may contribute to formation of HABs in reservoirs. In addition, the study will better describe the reliability of satellite imagery for remotely monitoring HAB formation in Nevada lakes and reservoirs.

## 3.0 Field Protocols for Grab Sampling of HABs from Shore

This SOP is recommended as the procedure for the staff performing algal bloom sampling in lakes and reservoirs. The goal of HAB sampling is to provide results that may be used to provide other agencies, including local health departments, with information to evaluate potential recreational health risks. Additionally, HAB sampling data provides public water systems with information to evaluate potential risks to drinking water supplies, and for BWQP to record bloom conditions for use in evaluating water quality.

The primary purpose of the sampling is to characterize the bloom with respect to possible exposure pathways, especially blooms with potential to harm people and pets. Therefore, samples should target areas where there is the highest likelihood or risk of human interaction and maximum recreational exposure to HAB cyanotoxins. This includes sampling areas such as beaches, piers, boat launches, shoreline access areas, and drinking water intakes. Consider wind direction when sampling, because blooms may be blown to the downwind side of the waterbody.

## 3.1 Collection of Cyanotoxin Grab Samples

The sampler should wade to where the sample will be collected, and that sample should be collected before other work is done at that location to minimize collection from a disturbed water column. Sampling should be within the area of the public access point. Perform an initial visual survey of the public access area to identify the locations where reasonable maximum exposure may occur, and collect samples at these locations.

Upon arrival at the sampling site, note your approximate location if it is not a designated monitoring site (i.e., the site does not have an existing site identification number). Before collecting a sample or wading into the water, always use appropriate personal protective gear such as gloves, eye protection, mask, and waders or boots to minimize exposure to cyanotoxins in the water.

To collect a surface-water grab sample that includes a surface scum, follow the instructions below.

- Use a clean wide-mouth shallow glass jar (about 8 cm diameter and 10 cm depth) and label the sample bottle with the sampling location, sample type, date and time of collection.
- Collect a grab sample from the upper 8-10 cm of the water column.
- Open jar. Tip mouth of jar towards the water (at approximately a 45 angle) and slowly break water surface and begin to dip jar into the water. Turn the sampling container so that bottom side of jar is horizontal to the surface. The jar will fully enter the water, but the top rim and side will not go below the surface (see figure). Do not move the sampling bottle along the surface to fill.
- Tilt the jar upright as it is slowly removed from the water and carefully lift the partially full jar from the water.
- Fill algal ID centrifuge tube with sample and place on wet ice. Keep glass algal sample bottles 50% full and place ice or thermoelectric freezer.
- Complete a chain-of-custody form for the sample.

## 4.0 Field Protocols for Targeted HAB Sampling by Boat

Four components are targeted when sampling for HABs by boat (Table X). The cyanotoxin grab sample is collected as described in Section 3, above.

Components	Purpose
Cyanotoxin Grab Sample	Collected from an area of reasonable maximum exposure to public.
Secchi Disk Measure	Measured to determine depth of euphotic zone within waterbody.
Integrated Water Sample	Used to compare nutrients and algal species in the euphotic zone.
Depth Profile	Used to determine lake stratification (DO, temperature profile)

### 4.1 Cyanotoxin Grab Sample

Collecting a grab samples for analysis of cyanotoxins requires minimal equipment (Section 3.0). A camera and GPS unit are helpful, and nitrile gloves and waterproof footware or waders are generally needed, along with the following containers:

- Acid-washed wide-mouth shallow jar
- Glass algae bottles washed and pre-acidified
- One 50 ml centrifuge tube



## 4.2 Secchi Disk Measurement

Taking a Secchi depth assumes that you are on a boat in a lake or reservoir, so supplies necessary for taking measurements from a boat are needed (e.g., personal flotation device, sonic depth finder, rope, etc.). The following steps describe how to take a Secchi disc measurement:

- Remove hat and/or sunglasses.
- Lower the Secchi disk over the shaded side of the boat until it disappears.
- Read the depth indicated on the lowering line. If the disappearance depth is <1.0 meter, determine the depth to the nearest 0.05 meter by marking the line at the nearest depth marker and measuring the remaining length with a tape measure or meter stick. Otherwise, record the disappearance depth to the nearest 0.1 meter. Record the disappearance depth on the form.</li>



- Lower the disk a bit farther and then slowly raise the disk until it reappears and record the reappearance depth, using the same level of precision as before.
- Calculate the euphotic zone depth by multiplying the depth where the Secchi disk reappears by two. Use this calculation to determine the depth at which water samples will be taken with the integrated water sampler:
  - If euphotic zone is less than 2 meters, water samples are only within the euphotic zone.
  - If euphotic zone is greater than 2 meters, water samples are from the top 2 meters of the water column.
- Record the targeted depth for the integrated water samples.
- Note any conditions that might affect the accuracy of the measurement in the comments field.

### 4.3 Integrated Water Sample

Collect water samples using an "integrated sampler," which is based on a design by the Minnesota Pollution Control Agency (MPCA). The device is a PVC tube 6.6 feet (2 meters) long with an inside diameter of 1.24 inches (3.2 centimeters), fitted with a stopper plug on one end and a valve on the other. The device allows collection of water from the upper two meters of the water column (i.e., within the euphotic zone). If the euphotic zone is < 2.0 m deep (as calculated in the Secchi disk section of the form), lower the integrated sampler only to the depth of the euphotic zone, and take additional grab samples as necessary to collect the total volume needed for the samples



- Put on surgical gloves (non-powdered).
- Rinse each water sample collection container with lid and churn splitter with surface water three times.
- Remove the rubber stopper cap and open the valve on the bottom end of the integrated sampler. Rinse by submerging it three times in the lake and draining after each rinse. Complete rinsing on the opposite side of the boat from which you plan to sample. Do not take samples near the motor or other sources of contamination.
- Slowly lower the sampler into the lake as vertically as possible. For a 2 m sample, stop lowering the device when the upper end is just above the surface. If the euphotic zone is < 2.0 m deep (as calculated in the Secchi Disk Transparency section of the form), the integrated sampler is lowered only to the depth of the euphotic zone; additional samples will be taken to collect the volume needed for the samples.</li>
- Cap the upper end with the rubber stopper firmly and slowly raise the sampler.
- When the bottom of the sampler is near the surface, reach underwater and close the valve on the bottom end.



- Lift the sampler into the boat, keeping it as vertical as possible. When possible, move the containers to a shaded area of the boat to avoid exposing the sample to direct sunlight when dispensed.
- Carefully open the valve and dispense the contents of sample into churn splitter.
- Rinse routine pollution and chlorophyll-*a* three times from churner. Fill sample bottles from churner and preserve as appropriate.
- Place in the cooler with ice.

### 4.4 Depth Profile

The procedure to obtain a depth profile consists of the following steps:

- Calibrate Instrument
  - Check meter and probes and calibrate according to manufacturer's specifications.
- Determine Site Depth
- Determine Measurement Intervals:
  - The number of readings and the depth intervals taken depends on the site depth. Below is a list of rules for determining the intervals:
- The profile will always begin with a measurement just below the surface (e.g., approximately 10 cm or the minimum depth required to keep all probes submerged).
- The last (deepest) measurements will always be at 0.5 m above the bottom.

- If the site is < 3.0 m deep, record measurements beginning just below the surface and at 0.5 m intervals, until 0.5 m above the bottom.
- If the depth is between 3.0-20 m (inclusive), record measurements beginning just below the surface and then at 1.0 m intervals until reaching 0.5 m above the bottom.
- If the depth exceeds 20 m, record measurements beginning just below the surface, then at 1.0 m intervals until you reach 20 m, then at 2.0 m intervals until 0.5 m above the bottom.
- If the metalimnion is encountered (observed as a change of ≥1 °C per meter of depth), take measurements at least every meter within the metalimnion.
- Measure Temperature, DO, Specific Conductivity and pH:
  - Lower the sonde in the water and measure the vertical profile of parameters at the predetermined depth intervals. Be careful not to let the probe touch the bottom.
  - Record the intervals and measurements on the form.

#### 4.5 Chlorophyll-a Preparation

Samples collected for analysis of chlorophyll-a require some special handling. Prepare chlorophyll-a samples as soon as possible in an area out of direct sunlight and protected from wind to prevent sample contamination. For best results, adhere to the following steps:

- Rinse the entire filter press and tweezers with DI water.
- Place GF/F filter on the filter press stage and assemble the filter press.
- Homogenize the sample and pour an appropriate amount of sample water into the upper chamber of the filter press to optimize the sample collected on the filter.
- Slowly draw the sample water through the filter. Take care not to exceed 7 inches of Hg on the filtration pump's vacuum gauge.
- After all the sample water has passed through the filter, check the color of the filter.
- If no color is visible then pour additional sample water into the upper chamber of the filter press.
- Ultimately, the filter should be pale yellow/green to green in color.
- Record the amount of sample water filtered on the bottle label.
- Rinse the inside of the upper chamber of the filter press with DI to dislodge any chlorophyll-a remaining on the walls.
- After the rinse water has passed through the filter, carefully remove the filter from the filter press stage with tweezers.
- Fold the filter into quarters (colored side on the inside) and immediately wrap in aluminum foil.
- Place aluminum foil-wrapped filter in the labeled bottle and place in a freezer immediately. Keep frozen until delivery to the laboratory.

## 5.0 Supplies for Sampling HABs and Conducting Related Lake Studies

## **Supplies**

- Boat
- Personal safety gear, including personal floatation device
- GPS
- Camera
- Field and chain-of-custody forms
- Nitrile gloves
- Sonic Depth Finder

## Cyanotoxin Grab Sample

- Acid-Washed wide-mouth shallow jar
- Glass Algae Bottles pre-acid washed
- 1 50 ml Centrifuge Tube

#### Secchi Disk Transparency

• Secchi disk with rope

#### **Integrated Sample Collection**

- Integrated water sampler
- Churn splitter
  - 1.9 L General parameter bottles (x2) blue cap (unpreserved) and red cap (preserved)
  - Sulfuric acid (H<sub>2</sub>SO<sub>4</sub>) preservative ampules
  - Ampule waste bottle
- 2 L Nalgene amber bottle
  - Filter stage
  - Hand pump
  - GF/F filters
  - De-ionized water
  - Aluminum foil
  - 1 50 mL centrifuge tubes

### **Depth Profile**

- Multi-parameter sonde
- Wet ice
- Thermoelectric freezer
- Decontamination equipment

Date: Time:				Collected by:								
Lake:					Station ID:	Station ID:						
*GPS of Profile Site:					*GPS of RME Site:							
Instrument: Calibration Date:						Cal	ibration Ti	ne:				
Air Temperature (°C):					Precipitation last 72 hours: • YES • NO							
Weather:	Weather:											
Surface Conditions: O Flat O Ripples O Choppy O Whitecaps												
Color, turbidity, or other conditions: O YES O NO												
Odor:		o yes o i	NO									
Visible Alg	gal Bloom*:	: o yes o i	NO		Color of Alg	al Bloom:						
Secchi De	pth (m):				Bottom De	oth (m):						
*Mark attached map where evidence of HAB has been observed and approximate size.												
Depth	Temp	рН	SpC	DO	Depth	Temp	рН	SpC	DO			
(m)	(°C)	(Std.)	(µS/cm)	(mg/L)	(m)	(°C)	(Std.)	(µS/cm)	(mg/L)			
-												
-												
					-							
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							ļ					

#### **Samples Collected**

- □ Routine Pollution (1.9 L General Parameter blue cap)
- □ Routine Pollution Preserved (1.9 L General Parameter red cap)
- Phytoplankton/Algal Toxin (Glass Algae Bottles pre-washed) (#\_\_\_\_\_\_
- \_) Chlorophyll-*a* (2 L Nalgene Amber bottle, 50 mL Centrifuge Tube, GF/F Filters) Filtered Volume (mL):\_\_\_\_\_
- Algal ID sample (50 mL Centrifuge Tube) (#\_\_\_\_\_\_ and note GPS location for multiple samples)

# APPENDIX B: BWQP HEALTH AND SAFETY PLAN

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## **BUREAU OF WATER QUALITY PLANNING**

## Field Staff Safety Guidance and Recommended Protective Measures

### November 2012, revised February 2020

## 1.0 BACKGROUND

Surface-water sampling is conducted regularly by Bureau of Water Quality Planning (BWQP) staff. Surface-water monitoring and sampling are conducted at hundreds of locations under many different conditions. The hazards presented by this work can vary widely depending on the site being sampled. BWQP field staff will use best professional judgment at all times, and at no time allow personal safety to be compromised. In addition, all BWQP field staff are trained in field safety issues, including what to do in the event of an emergency. The "Safety First" principle will be adhered to at all times.

This document describes some of the hazards to which BWQP field staff may be exposed to during monitoring activities. Protective measures are recommended for each of the identified hazards. These hazards and protective measures are only presented as guidelines. Each BWQP field staff and his/her supervisor should evaluate the activities of the field staff to determine which hazards may be of concern at work sites and whether the protective measures recommended here are adequate or appropriate. The field staff and supervisor are required to address any additional worksite hazards in the field staff's job safety analysis.

## 2.0 GENERAL

This guidance is not intended to be a description of the specific hazards or every hazard that could be associated with a particular site or area. Due to the various sites and areas that are within the BWQP's jurisdiction, one should never visit a site without a reasonable understanding of the expected hazards. All personnel will do the following prior to performing field work:

- A trip schedule or travel record will be prepared by the employee, identifying the sites or areas to be visited, the purpose of the trip, and approximate times. A contact phone number (mobile phone) will be provided. If the trip involves staying overnight, the name and phone number of the hotel will be included.
- The trip schedule or travel record will be reviewed by the supervisor. Potential hazards that could be encountered will be discussed by the supervisor and the field staff prior to the trip.

- If there is uncertainty regarding hazards likely to be encountered, the field staff will proceed with best professional judgment to determine potential hazards.
- If a reasonable understanding of the potential hazards at a site cannot be determined based on previous records of the site, the field staff will contact other responsible agencies (e.g., Bureau of Land Management, U.S. Forest Service, State Parks, etc.), as needed to obtain additional information.

## 3.0 PHYSICAL HAZARDS

During sampling activities, field staff must wear the appropriate protective clothing. For most of the sites that BWQP field staff are likely to visit, sturdy boots, personal floatation devices, waders, and rubber gloves are adequate protective clothing. Additional protection is afforded by a hat, long pants, and a long-sleeved shirt.

In addition to the above, the field staff must be aware of potential hazards that include, but not limited to, the following physical hazards:

- (a) Obstacles, holes, ditches, or uneven walking surfaces that could cause the employee to trip or fall.
- (b) Precariously positioned objects, such as rocks or branches that may fall and strike the field staff.
- (c) Sharp objects, such as nails, metal shards, and broken glass that may cause punctures or cuts.
- (d) Slippery surfaces, such as algae-covered rocks that may cause a fall.
- (e) Steep grades that present a falling hazard.
- (f) Unstable surfaces, such as streambanks that may collapse or unstable rocks.

Field staff must be alert to and avoid these hazards.

### 4.0 ELECTRICAL HAZARDS

Overhead power lines, downed electrical wires, and buried cables all pose a danger of shock or electrocution if field staff contact or sever them during monitoring activities. Electrical equipment used on site may also pose a hazard to field staff. To help minimize this hazard, low-voltage equipment with ground-fault interrupters and water-tight corrosion-resistant connecting cables must be used on site. Additional electrical hazards involve capacitors that may retain a charge.

In addition to the above, lightning is a hazard during outdoor operations, and particularly for field staff handling metal containers or equipment. Weather conditions will be monitored and work will be suspended during electrical storms.

## 5.0 HEAT STRESS

BWQP field staff are rarely required to work strenuously for long periods in hot weather. If such activities are required, however, heat stress is a substantial hazard and must be addressed. Heat stress is a particular concern during hot weather or for field staff that are required to wear protective clothing. Heat stress occurs when there is an imbalance between the heat the body is producing during its work and the heat it can get rid of through perspiring to the environment. The same protective materials that shield the body from chemical or water exposure also limit the dissipation of body heat and moisture. Heat stress can impact the human body very rapidly, within as little as 15 minutes of working.

Early symptoms of heat stress include the following:

- Heavy sweating.
- Extreme weakness or fatigue.
- Clammy skin.
- Pale or flushed complexion or rash.
- Dizziness.
- Nausea.
- Headache.

These symptoms will be treated immediately with rest in a cool place and cool drinking water.

More severe symptoms leading to heat stroke include the following:

- Painful muscle spasms.
- Vomiting.
- Convulsions.
- Severe headache.
- Mental confusion or extreme anxiety.
- Loss of consciousness.
- Hot, dry skin (may perspire).

These symptoms require medical attention as soon as possible. Cool the employee down by wetting and fanning until medical treatment is available or he/she can be transported to nearest medical facility.

The following protective measures must be taken when BWQP field staff are required to work strenuously or with protective equipment in hot weather:

- Acclimate to the heat through gradual buildup in the work load.
- Take frequent rest periods during strenuous work.
- Replace fluids frequently
- Monitor employees frequently for symptoms of heat stress.

## 6.0 COLD EXPOSURE

Prolonged exposure to extreme cold can cause injuries such as frostbite or hypothermia. To guard against the effects of extreme cold, appropriate clothing must be worn. Frostbite is temporary or permanent tissue damage from exposure to subfreezing temperature. During the period of exposure to extreme cold, frostbite symptoms include gradual numbness, hardness, and paleness in the affected area, usually the extremities, such as fingers, toes, or nose.

Upon rewarming, the following symptoms may appear:

- Pain and tingling or a burning sensation (sometimes severe) in the affected area, with color change from white to red, then purple.
- Blisters (severe cases).
- Shivering.
- Slurred speech.
- Memory loss.

Risk of frostbite can be minimized or prevented by:

- Anticipating sudden temperature changes and carrying a jacket, gloves, socks, hat, and scarf.
- Not drinking or smoking prior to anticipated exposure.
- Continually moving one's arms and legs.

Hypothermia is a dangerous cooling of the body from exposure to cold air or water. Hypothermia symptoms include:

- Poor muscle coordination.
- Mental confusion.
- Shivering and low body temperature.
- Slow pulse.
- Rigid muscles.
- Purple fingers, toes and nail beds.
- Loss of consciousness.

Risk of hypothermia can be minimized or prevented by:

- Wearing windproof clothing in many layers, including a scarf, hat and gloves or mittens while exposed to cold weather.
- Changing to dry clothing as soon as possible, if one gets wet or damp.
- Continually moving to generate body heat.
- Not conducting field activities during severe winter storms.
- Not walking on frozen bodies of water.

## 7.0 BIOLOGICAL HAZARDS

Biological hazards that BWQP field staff may encounter include poisonous plants, insects, snakes, animals, and indigenous pathogens. Most of these hazards can be avoided by wearing long pants, a long-sleeved shirts, and boots during sampling activities. When possible, field staff will remain on designated paths and not walk through heavy brush. Always watch carefully where you are stepping. Do not put hands in areas that you cannot see into and take extra precautions when lifting items that snakes or scorpions may be under.

## 8.0 CHEMICAL HAZARDS

BWQP field staff may be required to use chemical decontaminants to help prevent the spread of invasive species via personal gear and sampling equipment. BWQP field staff are required to wear latex (or rubber) gloves and eye protection when using chemical decontamination agents such as bleach solutions or Sparquat 256<sup>®</sup>. When using such products, standard safety precautions will be followed. In addition, portable eye wash bottles containing saline solution must be readily available.

### 9.0 HOSTILITY

During sampling activities, BWQP field staff may be confronted by persons exhibiting hostile behavior. If at any time, field staff are threatened with aggression or violence, or if any member of a BWQP field team believes that any person, property owner, or operator may intend to harm him/her, the field staff must immediately leave the site and report the incident to their supervisor.

Field staff may not re-enter the sampling area until law enforcement personnel accompany them during field sampling and monitoring activities. The field personnel will provide written documentation of the incident to the supervisor within five working days. A Safety Investigation Team will be called and the findings will be provided to the Bureau's Safety Coordinator. The supervisor will be responsible for reporting the incident to the Bureau Chief or the Administrator, as appropriate.

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# APPENDIX C: NEVADA STATE PUBLIC HEALTH LABORATORY QUALITY ASSURANCE MANAGEMENT PLAN

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## NEVADA STATE HEALTH LABORATORY QUALITY ASSURANCE MANAGEMENT PLAN CHEMISTRY DEPARTMENT 1660 N. VIRGINIA ST. RENO, NV 89503 (775) 688-1335

December 29, 2010

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Stacey A. Rice Quality Assurance, Manager

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Stephanie Van Hooser Administrative Director Date

Date

Date

Date

Date

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## **CHAPTER 1 - QUALITY ASSURANCE**

#### QUALITY ASSURANCE POLICY

The Nevada State Health Laboratory offers this Quality Assurance Manual to outline the purpose, policies, organization, responsibilities, and operations related to ensuring high-quality performance in every aspect of activity within the laboratory. It is essential that all laboratory personnel understand the policies, objectives, and procedures that are outlined in this management plan. This will help them to understand the role that they play in the overall Quality Assurance Program.

Regulations and guidelines require the implementation of quality assurance activities and the maintenance of sufficient documentation to demonstrate the generation of legally defensible environmental data. The Nevada State Health Laboratory policies on quality are based on the following concepts:

- As a laboratory we must provide our clients with products and services that are of high quality. The quality that we strive to achieve is a continuous process and has measurable objectives that we monitor.
- Each employee of The Nevada State Health Laboratory is responsible and accountable for the quality of his or her own work.

The Nevada State Health Laboratory provides analytical data reports that meet client and regulatory requirements, are useable for their intended purpose, and are technically correct. It is our policy to improve any aspect of these areas on an on-going basis.

The Nevada State Health Laboratory has specific goals in order to achieve high quality data that is legally defensible and complies with environmental regulations established by local, state, and federal authorities.

The goals include the following:

- Establish the quality assurance objectives for the measurement systems and to assess and monitor analytical data quality in terms of precision, accuracy, representativeness, comparability, completeness, and detectability through the use of proven methods.
- To enable personnel responsible for the production of the data to identify and implement corrective actions necessary to ensure data integrity.
- To ensure adequate document control.
- To establish and maintain systems which identify problems at the earliest stages and provide direction for resolution of such problems.

- To establish and maintain standard operating procedures (SOPs) which govern all laboratory practices, procedures, and analytical methods.
- To couple well-trained personnel with state-of-the-art instrumentation and equipment.
- Development of and strict adherence to principles of good laboratory practice.
- To promote a positive attitude toward quality throughout the laboratory and a commitment of quality from all employees.

The Nevada State Health Laboratory provides service to a broad base of clients. The work that is performed at the laboratory can be broken down into four categories:

- Blood lead analysis
- Nevada Department of Environmental Protection Agency samples
- Clean Water Act samples
- Safe Drinking Water Act samples

Samples can be submitted to the laboratory for analysis for blood lead, CWA or SDWA from individuals, studies or larger groups.

#### **CHAPTER 2 - POLICIES**

#### ETHICS POLICY ON WASTE, FRAUD AND ABUSE

The Nevada State Health Laboratory requires and encourages all associates to report any activity that may be considered wasteful or fraudulent. Any incident reported is subject to a complete investigation. The Nevada State Health Laboratory does not support improper manipulation of analytical data and/or falsification of data or data reports. Annual data integrity training is documented for each chemistry employee and filed in the chemistry office. For details refer to the State Procedures Manual and NAC, NRS and in-house Directors Quality Assurance Manual.

#### DEVIATIONS FROM WRITTEN LABORATORY POLICY

Departures from documented policies and procedures or from standard specifications must be cleared with the chemistry supervisor. Deviations may be allowed under certain conditions, but any data obtained and/or reported where SOPs are not followed or specifications are not met must be annotated.

#### COMPLAINTS

All complaints or problems are to be investigated. An incident report detailing the complaint should be filled out and filed as soon as possible. This procedure is detailed in the Nevada State Health Laboratory General Quality Assurance Manual. This is a separate Quality Assurance Manual prepared by management for the laboratory as a whole. This manual describes operational procedures that are to be applied in every department. A problem involving sample data or analysis may be partially resolved, at the chemistry supervisors or Laboratory Director's discretion, by re-analyzing and/or resampling without additional charge.

#### **PROTECTING CONFIDENTIALITY**

If a client has a request not to have his sample report forwarded to the Bureau of Health Protection Services then a note is made on the report and that data report is not forwarded. A note is made in the comments section of sample log in the computer database for that sample. As a public agency, data is available and may be provided to the public. Anyone requesting such data must submit a request to the Director of the Nevada State Health Laboratory. The request must state the purpose the data is to be used for. Requests for data will be granted at the Directors discretion. Names of property owners will not be included in data supplied to the public. The data is on public record in hard copy form at the Bureau of Health Protection Services. No one who is not a current employee of Nevada State Health Laboratory is to have unrestricted access to computers or computer records.

#### **INCIDENT REPORT**

The laboratory has a form to report incidents concerning laboratory problems including matters of data integrity. Personnel have been directed to fill out the incident report and submit it to management either with or without their name on the report.

#### MANAGEMENT AUDITS

Key management will perform management audits on a yearly basis. Including, but not limited to, the following:

- The suitability of policies and procedures
- Reports from managerial and supervisory personnel
- The outcome of recent internal audits
- Corrective and preventive actions
- Assessments by external bodies
- The results of interlaboratory comparisons or proficiency tests
- Changes in the volume and type of the work
- Client feedback
- Complaints
- Other relevant factors, such as quality control activities, resources and staff training
- Customer Satisfaction Survey (every two years)

## **CHAPTER 3 - LABORATORY ORGANIZATION**

#### LABORATORY ORGANIZATION

The organization structure of the Nevada State Health Laboratory is designed to ensure that analytical operations are effective. All levels of employees are required to implement the Quality Assurance Program that has been established.

The Nevada State Health Laboratory hires qualified and capable personnel to fill their technical staff. They have the education, training, and experience needed to accomplish their assigned duties. There is ongoing training required to increase the skills that are needed for the individual positions.

#### **ASSOCIATE TRAINING**

Training is performed to develop and maintain proficiency, and to promote improvement. Training is performed by qualified individuals that may be internal staff or from external sources.

The Nevada State Health Laboratory employees become qualified based on the experience and training documented in the individual's training file, and is assigned duties within their experience and training. The employees training file may include a resume, initial demonstration of competency with a method, method detection limits, and records of other training they have received. Not all employees will have training records for all areas. It will depend upon their job function or tenure with the Nevada State Health Laboratory.

There are periodic chemistry staff meetings that may include training. Criteria and requirements are discussed at meetings along with other training material. Orientation and training is vital to new employee success and capability. The following includes, but is not limited to, a list of on-the-job training criteria that is used for a new employee:

- Receipt of assigned duties from the Supervisor.
- Observation of assigned duties by an experienced operator/analyst.
- Must read the Safety Manual.
- Must read the Standard Operating Procedure for the assigned methods.
- Performance of sample analysis under direct supervision of experienced personnel.
- Analyzing blind QC samples prepared in-house or by an outside agency.
- Perform initial demonstration of capability and method detection limit studies.

The individual members of the technical staff have key responsibilities for the quality of the data output and for all related laboratory operations.

Technical staff has the first opportunity to detect and correct any malfunctions of the measurement system. They are trained to notice any abnormal fluctuations and deviations.

#### AUTHORITY AND RESPONSIBILITY

The Nevada State Health Laboratory recognizes that the responsibility for high quality data starts with each individual; however, the ultimate responsibility for data and service quality and reliability resides with the Laboratory Director.

The Chemistry Supervisor is responsible for day-to-day operation associated with the laboratory workload. The Supervisor monitors the production of the analytical work and the process of reporting the results. The Supervisor oversees the programs that are in place to ensure compliance with laboratory environmental and radiation safety and health requirements. This includes preparing the Quality Assurance Manual and providing any training and follow-up with employees to ensure that each employee understands their personal roll in upholding the requirements outlined in the manual.

Currently the Supervisor also has full-time duties as a chemist and is responsible for analyzing samples and reporting data in that capacity.

The Nevada State Health Laboratory has a Quality Assurance Manager at this time. Some of these duties for the Supervisor and the Quality Assurance Manager include, but are not limited to, the following:

- Checking that the analyst and instrument logbooks are filled out correctly and completely, reviewed and signed periodically.
- Verify that proper QC, peer, and Supervisor data-review procedures are performed and documented.
- Maintaining QC records, including corrective action memo files, updates of SOPs, records of calibration and maintenance, and records of analyst qualifications.
- Coordinating a corrective action plan in response to deficiencies, nonconformance, or data identified as exceeding control limits.
- Informing management of system breakdowns or deficiencies, recommending corrective actions to improve the data-generating system and defining the validity of data generated in out-of-control situations.
- Verify compliance to all QC methods including frequency of spikes, blanks and duplicates, that appropriate QC criteria for matrix spike, surrogate and internal standard compounds are used,

proper instrument calibrations are performed, that correct stock, working and calibration standards and concentrations are employed and control charts are updated and used.

- Establishing QC procedures, providing control samples and setting warning and action limits for every test or parameter to standardize section operations and quality performance.
- Training analysts in the Laboratory Quality Assurance Program.
- Interact with local, state, and federal agencies in matters pertaining to regulations, certifications, methodologies, audits and performance evaluations.
- Interact with clients on matters pertaining to data integrity and quality.

The resumes of the employees of the Nevada State Health Laboratory are in Appendix A along with the organizational chart for the laboratory.

## **CHAPTER 4 - DOCUMENTATION AND RECORDS**

#### CONTROLLED/UNCONTROLLED DOCUMENTS

Quality control documents are prepared by the associates and then reviewed by the technical staff assigned to that method. These reviews are indicated by their signature on the last page of the document. These documents are required to be periodically reviewed and revised if necessary. The frequency depends on the type of document and the regulation requirements. They must also be revised when the activity, policy, or procedure they describe changes significantly.

Quality control documents are controlled by initially distributing them to the associates who need to be aware of the contained information or procedures. All subsequent revisions or updates to the document are then given to the associates working in that area. When a new document is given to an associate the old document is collected and permanently disposed of.

Uncontrolled bench copies are made and distributed as well. These are distributed with the understanding that no further revision or updated copy will be given.

#### **RECORDS MANAGEMENT**

It is important to the Nevada State Health Laboratory to keep records to demonstrate that all aspects of the laboratory are within required specifications. Some of the examples of the records that are kept are:

- Instrument logbooks
- Equipment monitoring records
- Standard preparation logbooks
- Performance Evaluation sample results
- Laboratory licenses and accreditations
- Waste disposal logbook

### **CHAPTER 5 - FACILITIES AND ANALYTICAL INSTRUMENTATION**

#### FACILITIES

Nevada State Health Laboratory is a state-of-the-art facility equipped with the latest in analytical chemistry instruments and technology. It is a secure facility, and it is the policy to allow only authorized personnel beyond the reception area, at the front entrance. It is located on the University of Nevada, Reno campus and is part of the School of Medicine-Pathology Department. A new section of the building was added and completed in 1995.

The water that is used for analysis is de-ionized water that is supplied by the large reverse osmosis system located in the glassware cleaning section of the laboratory. Milli-Q (MQ) water is supplied by filtering the de-ionized water through a series of filters; 2 deionization filters, 1 carbon filter and 1 organic extraction filter. The MQ water is available in the digestion laboratory.

Samples and standards are stored in the refrigerators in the sample receiving room or at workstations. The samples are segregated by sample type and are stored independently. Organic standards are stored in the refrigeration units in the VOC lab. Samples are kept in one refrigerator while the various standards are kept in the other refrigerator.

#### INSTRUMENTATION

Table 5.1 shows the instrumentation in place and operational for analysis of environmental samples. Wherever possible and cost effective, autosamplers are fitted to the instruments in order to improve efficiency and facilitate consistently accurate sample introduction to the instrumental system.

#### Inorganic Laboratory

The Inorganic Laboratory performs a variety of both instrumental and wet chemistry procedures for inorganic analyses. It is divided into three sections: the Wet Chemistry Lab Area, the Metals Sample Preparation Area and Metals Analysis Room. The Wet Chemistry Lab maintains a full range of instrumentation including UV-VIS Spectrophotometers, Ion Selective potentiometers, Turbidimeters, pH Meters, Conductivity Meters, BOD incubator, Balances, Hamilton Dilutors, as well as other general and specialized preparatory equipment and glassware. The Metals Sample Preparation Area includes hot blocks to digest the samples. The final dilutions and other necessary processes are done in the Wet Chemistry Lab. This room also includes the digestion units for Kjeldahl analysis and an ion selective meter to read the results for Kjeldahl and ammonia analysis. The Metals Analysis Room includes all the instrumentation needed to analyze for metals. The Dionex Ion Chromatograph is located in the Volatile Laboratory and is used for inorganic analyses pertaining to USEPA method 300.0.

#### Volatiles Laboratory

The Volatiles Lab analyzes samples containing volatile organic compounds by gas chromatography/mass spectrometry. This lab uses method USEPA 524.2.
# Table 5.1 - Instrumentation

<u>TYPE</u>	<u>#</u>	MANUFACTURER	MODEL
UV/VIS SPEC	2 1	Thermo Scientific Milton Roy	Genesys 6 Vis Spectronic 501
INDUCTIVELY COUPLED PLASMA	1	Varian	Vista MPX
ICP/MS	1	Varian	
ION CHROMATOGRAPH	1 1	Dionex Dionex	DX5000 ICS2000
GC/MS	1	Agilent	6890 Series MSD P & T
COLD VAPOR MERCURY ANA	LYZER		
	1	Cetac	m7500
pH METER	3 1 2 1	Orion Fisher Corning Beckman	pH/ISE 710A Accumet 25 125, 150 pHI 31
TURBIDITY METER	2	Hach	2100AN
CONDUCTIVITY METER	1 1 1	VWR Amber Science Fisher	1054 1052A XL-30
DISSOLVED O2 METER	1	Fisher	XL-40
ANALYTICAL BALANCE	1 1 1	Mettler-Toledo Mettler-Toledo Mettler	AG104 AT200 HL32
BALANCE - TOP LOADER	1 1 1 1 1	Mettler Mettler-Toledo Mettler Ohaus Sartorius	BB2400 PB3002 P162N Galaxy 400 CP34001-S

MICROWAVE DIGESTION SYSTEM	1	QUESTRON	Qwave 3000
AUTOCLAVE	2	STERIS	
BOD INCUBATOR	1 1	Precision Scientific Precision Scientific	815 808
REFRIGERATOR	4 1 2 1	True Silver King Superior/True True	TWT-27 T-49 T-23
FREEZER	3	Beverage Air	WFT-27
GAS FLOW PROPORTIONAL COUNTER	1	Tennelec	LB1000
	1	Tennelec	LB4110
OVEN	1 1 1 1	VWR Blue M Shel Lab Thermolyne Fisher Scientific	1630 Stabil Therm 1370FX 62700 Isotemp Oven
KJELDAHL DIGESTER	1 1 2	Buchi Buchi Buchi	430 435 K-438
KJELDAHL DISTILLATION	1	Buchi	321
CYANIDE DIGESTER	1	Kontes	Midi-Vap 2000
METALS DIGESTER	4	Environmental Express	Hot Block

# **CHAPTER 6 - MAINTENANCE**

#### **PREVENTIVE MAINTENANCE**

Preventive maintenance is an ongoing activity required to keep the instrumentation operating within the vendor and method specifications. Proper maintenance includes the following, but is not limited to: periodic instrument calibration, cleaning, periodic changing of oils and filters, and monitoring of known areas of wear or degradation to ensure the timely replacement of worn parts or components. Most of the instruments are under specific service contracts. Some contracts include annual or biannual visits from the servicemen for various maintenance and checks.

Preventative maintenance is scheduled on a daily, weekly, monthly, quarterly, and annual basis. All maintenance work is documented directly into the instrument maintenance log and noted by the person performing the repair. In the instance where an outside vendor conducts maintenance activities, a copy of the vendor's form is affixed to the instrument's maintenance logbook.

Instrument maintenance and calibration can be performed by qualified service technicians (usually service representatives of the instrument manufacturer). Instrument repair is also performed by these technicians.

A preventative maintenance program for the instrument ensures fewer interruptions of analyses, increases personnel efficiency, and lowers repair costs. It eliminates premature replacement of parts, and reduces discrepancy among test results. It increases reliability of results.

The Nevada State Health Laboratory has incorporated the following preventative maintenance procedures, including, but not limited to:

- Instrument operating manuals are maintained within easy access of the instrumentation.
- Analysts using the instruments are trained operators and can trouble-shoot equipment problems to reduce equipment failure and to reduce dependence on outside service agencies. When necessary, however, outside service agencies will be used.
- Written records are kept to document all equipment inspection, maintenance, trouble-shooting, calibration, or modifications. All equipment maintenance is documented in a logbook kept near the instrument as a means of monitoring the adequacy of maintenance schedules. The records contain the date, description of the maintenance done, the findings, the name of the maintenance person.
- Performance criteria are established for judging when data from instruments performance checks indicate the need to make equipment adjustments.

#### **Gas Chromatographic Instruments**

Preventative maintenance includes a daily performance check standard. Parameters such as retention time and response factors are observed and back-checked with prior operational performance.

Other preventative maintenance includes:

- GC detectors are cleaned whenever performance degradation is observed.
- Septa are replaced as needed.
- Columns are checked by performance and operating conditions when in use or prior to use.
- Oven performance is checked daily prior to use by standard retention time verification.

Gas Chromatography/Mass Spectrometer (GC/MS)

- Mechanical pump oil should be changed twice a year. The experience of the operator may yield increased oil change frequency.
- Clean the source as needed.
- Sensitivity analyses through the use of BFB tune criteria daily or every 12 hours.

Atomic Absorption Spectrophotometers/ICP

Preventative maintenance includes the following checks:

- Minimum 30-minute warm-up period.
- Alignment of hollow cathode tube to produce the maximum emitted light to the detector.
- Burner heads, nebulizers, quartz cells, and reduction flasks are cleaned according to manufacturer instructions whenever excessive noise is apparent or whenever indicated by visual inspection.
- Tygon tubing is replaced when deterioration is apparent.
- Optical lenses are cleaned as needed.

The following tables list the scheduled maintenance. It does not include all of the maintenance, but is a general list of what is performed routinely.

# Instrument Maintenance Schedule Ion Chromatograph

As Needed	Daily	Weekly	Monthly	Semi-annually
Clean	Check	Check pump	Check all air and	Lubricate left
micromembrane	plumbing/leaks.	heads for leaks.	liquid lines for	hand piston.
suppresser when			discoloration	
decreases in			and crimping, if	
sensitivity are			indicated.	
observed.				
Check fuses when	Check gases.	Check filter		
power problems		(inlet).		
occur.				
Reactivate or	Check pump			Clean valve.
change column	pressure.			
when peak shape				
and resolution				
deteriorate or				
when retention				
time shortening				
indicates that				
exchange sites				
have become				
deactivated.				
De-gas pump				
head when flow				
is erratic.				

## Instrument Maintenance Schedule Flame Atomic Absorption Spectroscopy

Daily	Monthly	As Needed
Verify proper safety		Check drain receptacle.
precautions are working.		
Verify gas box operates		Check background corrector
properly and safely.		for alignment.
		Clean nebulizer.
		Check Deuterium lamp.
		Clean all filters and fans.

# Instrument Maintenance Schedule Inductively Coupled Plasma/Mass Spectrometry (ICP/MS)

Daily	Weekly	Monthly	Quarterly	Annually	As Needed
Check sample	Check				Check
waste	peristaltic				electronic
container	pump:				settings for
level.	proper roller				optimum
	pressure,				sensitivity,
	sample				resolution,
	introduction				mass
	tubing,				calibration,
	correct pump				ion optics,
	rotation, and				CEM,
	condition of				reflector
	drain tubing.				voltage.
Check	Check	Check quartz			Clean all
recirculation	condition of	torch			filters and
water level.	sampler and	condition.			fans.
	skimmer				
	cones.				
Measure	Check drain				Replace oil in
quartz torch	oil mist				roughing
for proper	eliminator on				pumps.
alignment.	roughing				
	pumps.				
					Clean spray
					chamber and
					nebulizer.
					Check oil
					level of
					roughing
					pumps.
					Replace oil in
					turbo-
					molecular
					pump.

# Instrument Maintenance Schedule

ICP

Daily	As Needed	Semi-Annually	Annually
Check that argon tank	Clean plasma torch		Notify manufacturer
pressure is 50-60 psi	assembly to remove		service engineer for
and that a spare tank	accumulated		scheduled preventive
is available.	deposits.		maintenance service.
Check that cooling	Clean filters on back		
water supply system	of power unit to		
is full and drain bottle	remove dust.		
is not full. Also, that			
drain tubing is clear,			
tight fitting and has			
few bends.			
Check the nebulizer	Replace when		
to make sure that it is	needed: peristaltic		
not clogged.	pump tubing, sample		
	capillary tubing,		
	autosampier sipper		
Charly that capillary	probe.		
tubing is close and in	filter (may require		
cubing is clean and in	more or loss		
	frequently depending		
	on the quality of the		
	water).		
Check that the			
peristaltic pump			
windings are secure.			
Check that high			
voltage switch is on.			
Check that exhaust			
screens are clean.			
Check that torch,			
glassware, aerosol			
injector tube, bonnet			
are clean.			

# Instrument Maintenance Schedule Cetac -Cold Vapor Mercury Analyzer

Daily	Weekly	Quarterly	Annually	As Needed
Check to see if all	Monitor GLS for	Check air filter at	Install a new	Replace any tube
tubes are clean	cleaning	the rear of the	air filter.	that may be
and free from		controller.		damaged.
kinks.				
Check waste	Check source	Check the non-		Rinse fluid
bottle level.	lamp condition.	return valve.		system after
				analysis.
Check instrument			Change	Release the
and work area to			NaFion	tension on the
make sure they			cartridge as	pump tubes
are kept			needed.	when not in use.
absolutely clean.				
Check the			Replace 2um	Check fuses,
nitrogen gas inlet			filter as	when power
pressure to make			needed.	problems occur.
sure it is between				
100psi.				
Check main fume				Change source
ventilation system				lamp, if lamp
to make sure it's				fails.
functioning				
properly.				
				Check the
				absorbance of
				the cell window.
				Clean the inner
				surface of cell, if
				there is decrease
				in sensitivity.

# Instrument Maintenance Schedule Gas Chromatograph

Daily	As Needed	Quarterly/Semi-
		Annually/Annually
Check for sufficient	Replace front portion of column packing or break	Quarterly ELCD: change
supply of carrier and	off front portion of capillary columns. Replace	roughing resin, clean
detector gases.	column if this fails to restore column	cell assembly.
Check for correct	performance or when column performance (i.e.	
column flow and/or	Peak tailing, poor resolution, high backgrounds,	
inlet pressure.	etc.) indicates it is required.	
Check temperatures	Change glass wool plug in injection port and/or	Semi-annually ECD:
of injectors and	replace injection port liner when front portion of	perform wipe test.
detectors. Verify	column packing is changed or front portion of a	
temperature	capillary column is removed.	
programs.		
Check inlets, septa.	Replace septum.	Annually ELCD: change
		finishing resin, clean
		solvent filter.
Check baseline level.	Perform gas purity check (if high baseline	
	indicates that impure carrier gas may be in use).	
Check reactor	Replace or repair flow controller if constant gas	
temperature of	flow cannot be maintained.	
electrolytic		
conductivity		
detector.		
	Replace fuses.	
	Reactivate external carrier gas dryers.	
	Detectors: Clean when baseline indicates	
	contamination or when response is low.	
	FID: clean/replace jet, replace igniter.	
	NPD: clean/replace collector assembly.	
	PID: clean lamp window, replace seals.	
	ELCD: check solvent flow weekly, change	
	reaction tube, replace solvent, change reaction	
	gas, and clean/replace Teflon transfer line.	
	ECD: follow manufacturers suggested	
	maintenance schedule.	
	Reactivate flow controller filter dryers when	
	presence of moisture is suspected.	

# Instrument Maintenance Schedule Purge and Trap

Daily	As Needed	Quarterly/Semi- annually/Annually
	Periodic leak checks, replace/condition traps (when poor response or disappearance or reactive or poorly trapped compounds), clean sample lines, valves (if they become contaminated), clean glassware.	
	Autosamplers: leak check system, clean sample lines, valves.	

# Instrument Maintenance Schedule Mass Spectrometer

Daily	As Needed	Semi-Annually	Annually
Check for sufficient gas	Check level of oil in	Change oil in the	Replace the
supply. Check for correct	mechanical pumps and	mechanical rough	exhaust
column flow and/or inlet	diffusion pump if vacuum	pump.	filters on the
pressure.	is insufficient. Add oil if		mechanical
	needed between service		rough pump.
	contract maintenance.		
Check temperatures of	Replace electron		
injector, detector. Verify	multiplier when the		
temperature programs.	tuning voltage		
	approaches the maximum		
	and/or when sensitivity		
	fails below required		
Chack inlate canta	Clean course, including all		
Check mets, septa.	creation source, including an		
	source cleaning is		
	indicated by a variety of		
	symptoms including		
	inability of the analyst to		
	tune the instrument to		
	specifications, poor		
	response, and high		
	background		
	contamination.		
Check baseline level.	Replace filaments when		
	both filaments burn out		
	or performance indicates		
	need for replacement.		
Check values of lens			
voltages, electron			
multiplier, and relative			
abundance and mass			
assignments of the			
calibration compounds.			

## Instrument Maintenance Schedule pH Meter

As Needed	Daily
Clean electrode.	Verify electrodes are properly connected and filled
Refill reference electrode.	Make sure electrode is stored in buffer.

#### Instrument Maintenance Schedule Fluoride Probe/Meter

As Needed	Daily
Clean electrode.	Verify electrodes are properly connected and filled.
Refill reference electrode.	Make sure electrode is stored in distilled water with a concentration of fluoride standard.

#### Instrument Maintenance Schedule Ammonia Probe/Meter

As Needed	Daily
Clean electrode.	Verify electrodes are properly connected and
	filled.
Refill reference electrode.	Make sure electrode is stored in distilled
	water.
Change the membrane on the probe.	

#### Instrument Maintenance Schedule BOD Probe/Meter

As Needed	Daily
Clean electrode.	Verify electrodes are properly connected and
	filled.
Refill reference electrode.	Make sure electrode is stored above distilled
	water. Check for color in the water.
Check for battery power and change as	
needed.	

## Instrument Maintenance Schedule Turbidity Meter

As Needed	Daily
Clean lens.	Cover the sample site so that no dust particle
	get in.

# **CHAPTER 7 - SAMPLE MANAGEMENT**

## INTRODUCTION

Sample management is the overall process by which samples are controlled, transferred, handled, and stored from the time of collection through analysis and final disposition.

#### SAMPLE ATTESTATION

Sample management begins in the field when the sample is collected. The management of the collection process, with the exception of providing sample containers, is not within the jurisdiction of this lab. An attestation statement has been added to each requisition form. The sampler will sign that they attest to the validity and authenticity of the sample being submitted. Also, that they are aware that tampering with or intentionally mislabeling the sample location, date or time is considered fraud and may be grounds for legal action. All other sample management activities, specifically those related to sample shipment, sample containers, sample preservation, sample holding times, and sample preparation and analysis are discussed here.

#### SAMPLE CUSTODY

All samples received at The Nevada State Health Laboratory are considered to be physical evidence and are handled accordingly. Following are a few considerations in sample custody.

#### **Facility Security**

The Nevada State Health Laboratory is a secure facility utilizing perimeter, cardkey access points of entry/exit. Only authorized personnel are allowed beyond the reception area, at the front entrance.

#### Sample Receipt

Sample shipments are received and brought to the sample accessioning room. Sample control personnel verify that the containers received correlate to the analyses being asked for on the tracking sheets. Any damage to the containers or other discrepancies observed are noted on the tracking sheets and in the database.

After a sample shipment has arrived, personnel perform sample inspection. The following is an example of some of the check-off procedures to follow for sample verification:

- Presence/absence of "Chain of Custody" or Sample Tracking Sheet.
- Completeness of the Sample Tracking Sheet. Are the requested analyses listed correctly?
- Agreement/non-agreement between number of samples received with the Sample Tracking Sheet.

- Are the samples preserved correctly? The SOP for checking sample preservation should be followed when checking samples.
- Is there enough sample to do the requested analyses?
- Were they received cold or at ambient temperature? Temperature blanks are checked for VOC analysis and the sample temperature is checked for all other samples that need to be checked. The SOP for checking sample temperature should be followed when checking samples.
- Were the containers intact or broken and leaking?
- Was there headspace in VOA vials?
- Was the sample holding time exceeded for any of the requested analyses?

The client is notified immediately if any problems are noted during the sample verification process.

#### SAMPLE LOG-IN AND STORAGE

There are three distinct steps to the process of logging in samples.

The first step is logging the sample into the computer database in the Accessioning Department. At this time, analyses are assigned to each sample.

The second step is reviewing the data entry performed in the Accessioning Department against the requisition, which is performed in the Chemistry logging area.

The last step is the sample storage. After logging in the samples they are stored under refrigeration or are assigned to various workstations.

#### SAMPLE AND LABORATORY CONTAINERS

Container specifications depend on the analytical method and constituent of interest. Production of quality analytical data requires that the collected sample is representative. Sampling procedures should adhere to the guidelines established by EPA and other regulatory agencies and be appropriate for the sample matrix and types of analytical parameters to be determined. Lab staff can brief clients that collect their own samples by telephone on the proper methods of sample collection.

In general, use the following containers:

Volatile Organics:Standard 40 mL glass screw-cap vials with Teflon-faced silicone septum.They should be trace pure.These are not reused.

## Inorganic: Polyethylene bottles with screw caps for aqueous samples to be analyzed. New batches are tested for cleanliness.

SOC: Bottles are provided by the laboratory performing the analysis. They must be certified trace pure bottles.

Oil and Grease: Bottles need to be certified trace pure.

The client is given instructions for the analysis that they have requested.

A detailed description of container specifications is given in the Sample Preservation and Holding Times section.

# SAMPLE PRESERVATION AND HOLDING TIMES

The Nevada State Health Laboratory supplies the appropriate sample containers and preservatives to a client upon request. Sample preservation prevents or retards the degradation and/or reaction of chemicals or biological activity in samples during transit and storage. Efforts to preserve the integrity of the samples are initiated at the time of sampling and continue until analyses are performed. Preservation of aqueous samples are verified prior to the preparation step for metals, cyanide, radiochem, etc. and prior to analysis for volatile organics. The container types, bottle sizes, preservatives, container closures, and holding times are shown in the Holding and Preservation Table.

The maximum time a preserved sample may be held between sample collection and analysis depends on the stability of the constituents of interest. Holding-time limitations are intended to minimize chemical changes in a sample before it is analyzed. Maximum allowable holding times provided in the Holding and Preservation Table apply to aqueous samples when proper preservation procedures are followed. Holding times are measured from time of sample collection to time of analysis, unless otherwise specified by the method.

Constituent	Container	Storage & Preservation	Minimum Sample	Maximum Holding Time
			Quantity	
INORGANICS				
Alkalinity	P,G	Cool, 4°C	200 ml	14 days
Ammonia-N	P,G	H <sub>2</sub> SO <sub>4</sub> ,pH<2,Cool,4°	400 ml	28 days
		С		
Bicarbonate	Р	Cool, 4°C	250 ml	14 days
Biochemical Oxygen	P,G	Cool, 4°C	1000 ml	48 hours
Demand (BOD)				
Boron	Р	HNO <sub>3</sub> ,pH<2	100 ml	6 months
Chemical Oxygen	P,G	H <sub>2</sub> SO <sub>4</sub> ,pH<2,Cool,4°	100 ml	28 days
Demand (COD)		С		

# Table 7.1 - Holding and Preservatives

Chloride	P.G	None required	100 ml	28 davs
Chlorine Residual	P.G	Cool. 4°C: protect	500 ml	2 hours
	.,_	from light		
Color	P.G	Cool. 4°C	500 ml	48 hours
Conductivity	P.G		500 ml	28 days
Cvanide	P.G	NaOH, pH>12:	500 ml	14 days
	.,.	Cool. 4°C		,.
Filterable Residual (TDS)	P,G	Cool, 4°C	100 ml	7 days
Fluoride	Р	None required	300 ml	28 days
Hardness, Total	P,G	HNO <sub>3</sub> , pH<2	100 ml	6 months
MBAS	P,G	Cool, 4°C	500 ml	48 hours
Non-Filterable Residue (TSS)	P,G	Cool, 4°C	500 ml	7 days
рН	P,G	None required	50 ml	2 hours
Total Kjeldahl Nitrogen	P,G	H <sub>2</sub> SO <sub>4</sub> , pH<2, Cool, 4°C	500 ml	28 days
Nitrate, as N	P,G	W/o preservative, 4°C	100 ml	48 hours
Nitrate + Nitrite, as N	P,G	H <sub>2</sub> SO <sub>4</sub> , pH<2, Cool, 4°C	100 ml	28 days
Nitrite	P,G	Cool, 4°C	100 ml	48 hours
Orthophosphate, as P	P,G	Filter Immediately, Cool, 4°C	100 ml	48 hours
Total Phosphorous, as P	P,G	H <sub>2</sub> SO <sub>4</sub> , pH<2,Cool, 4°C	100 ml	28 days
Sulfate	P,G	Cool, 4°C	200 ml	28 days
Turbidity	P,G	Cool, 4°C; protect from light	100 ml	48 hours
METALS		1	1	
Mercury	P,G	HNO₃,pH<2, Cool, 4°C	200 ml	28 days
All other metals	Р	HNO <sub>3</sub> ,pH<2	200 ml	6 months
RADIOCHEM				
Gross Alpha/Beta	P,G	HNO₃,pH<2	500 ml	6 months
Radium-226	P,G	HNO <sub>3</sub> ,pH<2	1000 ml	6 months
Radium-228	P,G	HNO <sub>3</sub> ,pH<2	1000 ml	6 months
Radon	G	40 ml vial, no air bubbles	40 ml	72 hours
Uranium	P,G	HNO <sub>3</sub> ,pH<2	1000 ml	6 months
ORGANICS				

Oil and Grease	G	H <sub>2</sub> SO <sub>4</sub> ,pH<2,Cool,4°	1000 ml	28 days
Volatile Organics	G(VOA) TFE- Septa Cap	Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> if chlorinated and HCl pH<2;Cool,4°C	3/40 ml vials	14 days
EDB & DBCP	3 X 40 ml Glass Vial	100 ul Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> , Cool,4°C, No Headspace	25 ml	7 days Extraction
Organohalide Pesticides/PCBs	2 X 1 liter	2.5 ml Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> , Cool,4°C	1000 ml	7 days Extraction
N & P Containing Pesticides	2 X 1 liter	2.5 ml Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> , Cool,4°C	1000 ml	7 days Extraction
Chlorinated Pesticides	2 X 1 liter	2.5 ml Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> , Cool,4°C	1000 ml	7 days Extraction
PCB Screening	2 X 1 liter	Cool,4°C	1000 ml	14 days Extraction
Chlorinated Acids (Herbicides)	2 X 1 liter	2.5 ml Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> , Cool,4°C	1000 ml	14 days Extraction
Chlorinated Acids (Herbicides)	2 X 1 liter	$Na_2S_2O_3$ if pH<2;Cool,4°C	1000 ml	14 days Extraction
Organic Compounds (Extractable)	2 X 1 liter	10 drops Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> , pH<2;Cool,4°C	1000 ml	14 days Extraction
n-Methyl Carbamates	3 X 40 ml Glass Vial	100 ul Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> , pH=3 (1.2 ml MCAA),Cool,4°C	30 ml	28 days
Glyphosate	125 L Amber Glass	300 ul Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> , Cool,4°C, dark	40 ml	14 days
Endothall	1 Liter Amber Glass	2.5 ml Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> pH<2;Cool,4°C	500 ml	7 days Extract
Diquat & Paraquat	1 Liter HDPE	2.5 ml Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> pH<2	250 ml	7 days Extraction
Haloacetic Acids & Dalapon	250 ml Amber Glass	1 ml conc H <sub>2</sub> SO <sub>4</sub> , Cool,4°C, 100 mg/L NH <sub>4</sub> Cl	100 ml	14 days Extraction

# SAMPLE STORAGE

The primary considerations for sample storage include the following:

• Keeping the samples at the prescribed temperature, if required and as directed by the SOP.

- Keeping the samples stored away from standards or samples that are known to have high-level concentrations of the analytes of interest.
- Security of samples throughout the laboratory.

#### SAMPLE PREPARATION

The constituents that are requested for analysis help to determine the type of sample preparation. Sample preparation procedures for organic, inorganic, and radiochem analyses are provided in various method-specific SOPs. Water used in the course of inorganic, organic, and radionuclide analysis (dilutions, preparations of standard and blank samples, etc.) must meet or exceed the standards for purity of ASTM Type II reagent grade water. All digestates and filtered samples are collected and tracked in logbooks. Metal digestates are stored at room temperature in acidic solutions resulting from the digestion process.

For most inorganic analyses, chemical reagents and gases of analytical reagent grade are used. High purity acids are used for trace metals analysis. For radiochemical analyses special ultrapure reagents and gases are required. For methods in which the purity of reagents is not specified, analytical grade reagents and gases are used.

#### Filtration

The need to filter aqueous samples depends on whether total or dissolved constituents are of interest. Pore size of the filter used is specified in each method and can be found in the SOP for that method.

#### Digestion

Metals analyses of many aqueous samples requires digestion of the sample. These are outlined in the specific SOP.

#### SAMPLE ANALYSIS

All samples shall be analyzed within the appropriate calibration range of the instrument. Each sample that exceeds the calibration range shall be diluted and analyzed within the appropriate analytical range or have the calibration range extended. The method of constituent identification and quantitation is specified in the analytical methods.

#### SAMPLE DISPOSAL

Samples are typically held for 4 weeks after report generation. The report is printed, reviewed and sent to the customer or to the Bureau of Health Protection Services. Routine samples that do not show evidence of contamination are dumped and processed through the sewer system. Preserved samples

are dumped into 55-gallon storage containers. The University of Nevada's Campus Hazardous Waste Disposal team in contacted for pick-up when the container is full.

Samples that show evidence of contamination are treated as such, and are disposed of by the University of Nevada's Campus Hazardous Waste Disposal team.

Other chemical waste that needs to be disposed of is also handled by the Hazardous Waste Disposal team of the University of Nevada, Reno.

## SAFETY CONSIDERATIONS

Because sample constituents can be toxic or hazardous, take adequate precautions during sample handling. Toxic substances can enter through the skin and, in the case of vapors, through the lungs. Inadvertent ingestion can occur via direct contact with foods or by adsorption of vapors onto foods. Never have food or employee beverages near samples, sampling locations or in laboratories; always wash hands thoroughly before handling food or personal beverages. Other precautions may include wearing gloves or other protective apparel. Always wear eye protection. When toxic vapors might be present, handle sample in well ventilated areas such as a fume hood.

When in doubt as to the level of safety precautions needed, consult UNR Environmental Health and Safety. Samples with radioactive contaminants require other safety considerations; consult UNR Environmental Health and Safety.

# **CHAPTER 8 - DATA QUALITY OBJECTIVES**

# INTRODUCTION

Data quality objectives are the foundation for collecting environmental data that can provide a reliable basis for decisions concerning environmental remediation. The quantitative measurements that estimate the true value or true concentration of a physical or chemical property always involve some level of uncertainty. This uncertainty results from 1) the variability of sample collection, 2) sample handling and the conditions associated with the specific samples, and 3) analytical variability.

These uncertainties must be estimated and compared to standard, quantitative indicators of data quality.

# PRECISION AND ACCURACY

Precision is the measure of how well replicate analyses agree. Percent Difference (PD) is used to measure the relationship between the original and duplicate analyses. It is standard practice throughout the laboratory to prepare and analyze one duplicate sample for each batch of samples and each matrix type within the batch, and one duplicate for every ten samples thereafter. This represents a duplicate sample frequency of 10% for each batch of samples analyzed. The relative percent difference in duplicate samples is calculated by:

PD = D ----- X 100 S

where PD = Percent Difference S = First Sample Value (Original) D = Second Sample Value (Duplicate)

The precision of the method is expressed as the Relative Standard Deviation (RSD) of the percent recoveries. Percent RSD (%RSD) is calculated as follows:

%RSD = S X 100  

$$X_{AVG.}$$
  
where:  $X_{AVG.}$  = the arithmetic mean of the recovery values  
S = standard deviation

Accuracy and matrix bias are monitored by the use of spiked samples, and where possible, surrogate additions. It is standard practice throughout the laboratory to prepare and analyze one matrix spike for each batch of ten samples and one spike for every ten samples thereafter. This represents a matrix spike frequency of 10% for each batch of samples analyzed. Where surrogate spiking compounds are available, they will be added to and analyzed with every sample. See the method SOP for specific details.

A measured amount of known concentration of spike/surrogate is added to the sample prior to extraction or preparation. The actual test result is compared to the theoretical result of 100% recovery and the percent recovery is calculated. The sample result is only subtracted from the spike result if it is a significant amount. Follow the SOP of each individual method to determine what amount should be subtracted.

% Recovery = Spike result - Sample result ------ X 100 Amount spiked

The percent recovery must fall within specified control limits for the result to be accepted and subsequent data validated. If the recovery is outside of the specified control limits then the data is marked with a qualifier.

The laboratory fortified blank (LFB) percent recovery (% R) is calculated as follows:

LFB % Recovery = 
$$\underline{X} \times 100$$
  
t

where: X = observed concentration

t = concentration of spike added

## **QUALITY CONTROL CHARTS**

Quality control charts are a graphical representation of analytical accuracy. The charts display the arithmetic mean of a data set, the upper and lower warning limits ( $2\sigma$ ) and the upper and lower control limits ( $3\sigma$ ).

## COMPLETENESS

For the data to be valid it must meet all acceptance criteria including accuracy, precision, and any other criteria specified by the analytical method that is used for analysis. Data validation procedures are employed to prevent the reporting of unacceptable data.

Completeness is the amount of valid data obtained from a measurement system, expressed as a percentage of the expected number of valid measurements to be collected.

% Complete = (number of acceptable parameters) ------ X 100 total number of parameters analyzed

The influence of the laboratory on completeness involves three areas: appropriate sample handling and storage, conformance to holding time requirements, and data validity as measured by meeting acceptance criteria for the quality control parameters.

#### REPRESENTATIVENESS

Representativeness is the degree to which data accurately and precisely represent a characteristic of a population, a variation in a physical or chemical property at a sampling point, or an environmental condition. Representativeness is a qualitative parameter which depends on proper design of the sampling program: sampling locations must be selected carefully and a sufficient number of samples must be collected.

Representativeness is primarily a function of sampling strategy; therefore, the sampling scheme must be designed to maximize representativeness. Representativeness also relates to ensuring that, through sample homogeneity, the sample analysis result (concentration) is representative of the constituent concentration in the sample matrix.

# COMPARABILITY

Comparability is a measure of the confidence with which one data set can be compared to another. All laboratory analysts use uniform procedures and a uniform set of units and calculations for analyzing and reporting environmental data.

Data shall be comparable to data sets of similar samples, collected under similar conditions. Evidence of comparability is available through laboratory participation in several Performance Evaluation Sample Programs.

## DETECTABILITY

Detectability refers to the minimum concentration of a constituent that can be measured by a measurement system with a stated level of confidence. It is determined by assessing the variability of replicate measurements at zero or near zero constituent concentration, and it is reported in concentration units.

The detection limit is defined as the smallest observed signal with the reliability of 1 minus  $\infty$  (where  $\infty$  is the probability to Type I error) that can be considered a signal caused by the constituent of interest within a 99% confidence level.

#### METHOD DETECTION LIMITS

The Nevada State Health Laboratory uses the specifications outlined in U.S. EPA 40 CFR Part 136 Appendix B in determining MDLs for analyses. It is required that the MDLs be determined for each analyte of interest within the capability of the primary analytical methods each year or when there are significant changes in the method, instrument conditions or when there is a new operator.

#### **REPORTING LIMITS**

The reporting limit that the Nevada State Health Laboratory uses is based on the evaluation of the Practical Quantitation Limits (PQLs) for each method of interest. The PQL is the lowest concentration reliably achievable within limits of precision and accuracy, using a given method.

The PQL can be estimated from the MDL by multiplying the MDL by five (5) to ten (10). Five (or some lower multiplier) is used when a multiplier of ten would cause the PQL to be higher than the lowest calibration standard or for drinking water, the maximum contaminant limit (MCL). The MCL is the enforceable health goal defined as the "maximum level of a contaminant in drinking water at which no known or anticipated adverse effect on the health of persons would occur, and which allows an adequate margin of safety".

Reporting limits are reviewed to ensure that the PQL does not exceed the concentration needs of the client.

#### LABORATORY QUALITY CONTROL CHECKS

Quality assurance consists of general quality control and assessment procedures that are adapted to the specific operating conditions in each section. The elements of quality control are discussed in each method SOP.

# **CHAPTER 9 - CALIBRATION PROCEDURE**

The production of analytical data of known, and documented quality requires adherence to standardized procedures, which cover all aspects of laboratory operation. The following section provides details of the standardized procedures relating to instrumentation calibration.

#### INSTRUMENTATION CALIBRATION

Prior to use, every instrument must be calibrated according to a specified procedure found in the method specific Standard Operating Procedure (SOP). The SOP should minimally include the following:

- Instrument to be calibrated
- Reference number of standards that are used for calibration
- Acceptable performance tolerances and corrective actions required if specifications are not met
- Frequency of calibration

## **REAGENTS AND CALIBRATION STANDARDS**

A log book is maintained for all stock standards. Each log entry contains at least the following information:

- The date of preparation
- The manufacturers lot number and supplier
- The preparer's initials
- Amount made
- Complete description of how the solution or standard was made.

The expiration date of the working standard must not exceed the expiration date of the original material unless it is checked for accuracy. If the standard is analyzed against a standard that has not expired and proves to be accurate then the standard may be used. A note in the logbook must indicate that it was checked against unexpired standards and include date of verification and standard identification.

Stock standards and working standards are checked regularly for signs of deterioration, such as discoloration, formation of precipitates, or change in concentration. At the sign of any change a new standard is made and the old one is discarded according to the sample disposal policy. Most working standards have an expiration period depending on the methods recommendation.

#### **CALIBRATION POLICY**

This is designed to be a guideline to ensure that all data are treated alike, and thus ensuring that data generated on any particular day of analysis are representative of the normal. The policies are not intended to be absolute criteria for the acceptance or rejection of any analytical data.

There is no substitute for the inherent familiarity that each analyst has with his or her specific analysis, and consequently their assessment of the data must be considered in cases where the acceptance criteria outlined in policy or SOPs cannot be achieved.

#### MINIMUM NUMBER OF CALIBRATION LEVELS

The calibration must include the minimum number of calibration standards plus a blank unless specified otherwise in the specific SOP.

#### **CALIBRATION ANALYSIS SEQUENCE**

The calibration must progress from the analysis of the lowest to highest standard unless the instrument does not permit it. A blank must be analyzed after the highest calibration standard.

If the analysis requires an initial high standard to set the gain a blank must be run before starting with the low calibration standard unless the instrumentation does not permit it.

#### CALIBRATION ACCEPTANCE CRITERIA

In general, the calculated value for standards (using the calibration curve or response factor) must be within 10% of the nominal value. See the SOP for that method for the specific criteria that are acceptable. The calibration must be validated with a second source standard.

#### **CONTINUING CALIBRATIONS**

Continuing Calibrations (CC) are allowed for certain methods. Refer to specific SOPs to determine whether this is allowed. The continuing calibration standard must be near the mid-point of the calibration curve. The calculated value for the continuing calibration standard must be within  $\pm$ 30% of the true value for Volatile Organics and 10% for inorganics. If the specific SOP uses different percentages, those stated in the SOP will be used.

# **CHAPTER 10 - CORRECTIVE ACTION AND CONTINGENCY PLANNING**

The primary objective of the corrective action program is to identify, correct, and document any deviation from laboratory policy, standard operating procedures, regulatory methodology or requirements, contractual or internal product requirements. A final objective is to ensure that necessary steps are taken to prevent the reoccurrence of the deviation or nonconformity.

Every employee is responsible to identify and correct deviations regardless of how minor they appear. In this manner, repeated occurrences of what may appear to be isolated incidents can be identified and corrected before a systematic or out-of-control situation develops.

An out-of-control event is defined as any occurrence failing to meet pre-established criteria. Nonconformance is a deficiency in characteristic, documentation, or procedure sufficient to make the quality indeterminate or unacceptable. An out-of-control event is a subcategory of nonconformance.

When nonconformance is recognized, each individual involved with the analysis in question has a role in solving and documenting the problem.

The analyst must be able to recognize nonconformance and immediately notify the laboratory supervisor and work together to solve the problem. Each analyst is responsible for documenting and correcting problems that might affect quality.

The supervisors review the analytical data that is reported. They have the responsibility of noticing anything that might be an error and investigating what might be the cause. They determine if a sample should be reanalyzed and for what parameters.

Whenever the analytical system is out of control, investigation-correction efforts are initiated by all concerned personnel.

If the problem is instrumental or specific only to preparation of a sample batch, any samples prepared after the out-of-control event are reprocessed after the instrument has been repaired and recalibrated, providing holding times have not been exceeded.

If a sample batch is still out of control after reanalysis, all method-related activities shall stop immediately. A detailed investigation shall be conducted to isolate and correct faulty operations.

Investigation of an out-of-control situation could include the following:

- 1. Check for errors in calculation or transcription/data entry.
- 2. Check calibration and instrument performance. Prepare new standards if necessary.
- 3. Check the integrity of the samples.
- 4. Check the reagents.
- 5. Check the glassware.
- 6. Check the laboratory worksheets.

The need for corrective action comes from several sources: equipment malfunction, failure of internal QA/QC checks, failure of follow-up on performance, or noncompliance with QA requirements.

When measurement equipment or analytical methods fail QA/QC requirements, the problems will immediately be brought to the attention of the supervisor. Corrective actions will depend on the type of analysis, the extent of the error, and whether the error is determinable or not.

The corrective actions decided upon will be recorded in the maintenance log or equivalent and may include the following information:

- 1. What actions were taken to bring the process back into control.
- 2. What actions were taken to prevent recurrence of the out-of-control situation.
- 3. What was done with the data obtained while the process was out of control.
- 4. Nature of the problem.
- 5. Analytical parameter affected.
- 6. Sample lot affected.
- 7. Corrective action measures(s) taken and final disposition/resolution of the problem.
- 8. Dates (date recognized, date occurred, date corrected).
- 9. Signature of analyst and persons involved.

# **CHAPTER 11 - INTERNAL AUDITS**

Internal audits will be performed on the current methods performed at the Nevada State Health Laboratory on a yearly basis. The following sheet will be followed when performing the audit.

NEVADA STATE HEALTH LABORATORY			
IN-HOUSE AUDIT FORM			
TEST NAME/METHOD:			
AUDITOR:			
ANALYST INTERVIEWED:			
AUDIT DATE:			
	YES	NO	N/A
SOP AVAILABLE			
SOP BEING FOLLOWED			
ANALYST HAS IDC			
MDL CURRENT			
MDL BELOW RL			
REAGENTS LABELED WITH DATES			
STANDARDS TRACEABLE			
STANDARDS NOT EXPIRED			
EQUIPMENT/INSTRUMENT OK			
Problems noted:			
Comments:			
Recommendations:			
Auditor signature:	date	::	
nalvst signature: date:			

#### Affirmation of Data Integrity:

The Nevada State Health Laboratory does not support improper manipulation of analytical data and/or falsification of data or data reports. Failure to comply may result in disciplinary action, including dismissal. Observation of such behavior anywhere in the laboratory should be immediately reported to management, either verbally or through the incident reporting system.

printed analyst name analyst signature

date

# **CHAPTER 12 - LABORATORY EVALUATION STUDIES**

Performance evaluations are used to provide a direct evaluation of the ability of the analytical systems to generate data that are consistent with the objective of accuracy and precision.

The Nevada State Health Laboratory, on a regular basis, is part of an ongoing QA program consisting of the analysis of blind samples. As part of the external QC the Supervisor submits a QC sample to the analysts with routine samples in such a way that the analysts do not know which of the sample is the QC sample. These external QC samples, test sample preparation as well as sample analysis. In addition, analysts are typically expected to run internal QC samples that will indicate to them whether the analytical procedures are in control. The external sample is a sample that has already been analyzed, and is re-analyzed, and the data are compared. This is a way of checking the ability to produce precise data.

When possible a past performance evaluation (PE) sample is analyzed with each analysis. The accuracy is checked by comparing the results with the previously set limits established statistically by EPA.

The Nevada State Health Laboratory participates biannually in the Water Pollution (WP) and the Water Supply (WS) evaluations. Quarterly the lab receives a set of samples for the analysis of water pollution and water supply parameters to provide interlaboratory evaluation of data results for reproducibility and comparability. Currently we purchase our studies from a private vendor. We are evaluated and then given certification based on the results achieved.

# **CHAPTER 13 - METHODS AND OPERATION**

#### STANDARD OPERATING PROCEDURES

Standard Operating Procedures (SOPs) describe step-by-step instructions for performing a method or specific job duty. The SOPs may outline the procedures, methods, corrective action requirements, documentation, review, and verification requirements. They are to be updated every year or sooner if the need arises. If there are changes made to the method they must be noted in the SOP.

#### ANALYTICAL METHODS

Methods used in sample preparation or analysis are selected to meet the specific needs and requirements of the client. The Nevada State Health Laboratory employs standard, officially approved analytical methods to quantify inorganic, organic, and radionuclide constituents in environmental media. The analytical methods performed are specific for drinking water, waste water, and groundwater. These methods are listed in the following Tables.

Table 13.1 - DRINKING WATER METHODS				
PRIMARY INORGANI	CS (40 CFR PAR	T 141.23 AND 141.74,	JULY 1 <i>,</i> 2000)	
<u>ANALYTE</u>	<u>REFERENCE</u>	<u>METHOD</u>	METHOD DESCRIPTION	
ANTIMONY	USEPA	200.8	ICP/MS	
ARSENIC	USEPA	200.8	ICP/MS	
BARIUM	USEPA	200.7	ICP	
	USEPA	200.8	ICP/MS	
BERYLLIUM	USEPA	200.8	ICP/MS	
CADMIUM	USEPA	200.8	ICP/MS	
CHROMIUM	USEPA	200.8	ICP/MS	
COPPER	USEPA	200.7	ICP	
	USEPA	200.8	ICP/MS	
LEAD	USEPA	200.8	ICP/MS	
MERCURY	EPA	245.2	AUTOMATED, COLD VAPOR	
NICKEL	USEPA	200.8	ICP/MS	
SELENIUM	USEPA	200.8	ICP/MS	

# THALLIUMUSEPA200.8ICP/MSDRINKING WATER METHODS (cont'd.)PRIMARY INORGANICS(40 CFR PART 141.23 AND 141.74, JULY 1, 2000)

<u>ANALYTE</u>	<u>REFERENCE</u>	<u>METHOD</u>	METHOD DESCRIPTION
NITRATE-N	USEPA	300.0	ION CHROMATOGRAPH
NITRITE-N	SM	4500-N02-B	SPECTROPHOTOMETRIC
FLUORIDE	USEPA	300.0	ION CHROMATOGRAPH
TURBIDITY	USEPA	180.1	NEPHELOMETRIC
TOTAL CYANIDE	SM	4500-CN-F	DISTILLATION/ colorimetric
RES. CHLORINE	SM	4500-CL-G	COLORIMETRIC
# DRINKING WATER METHODS (cont'd.) SECONDARY INORGANICS (40 CFR PART 136 or PART 143, JULY 1, 2000)

<u>ANALYTE</u>	<u>REFERENCE</u>	METHOD	METHOD DESCRIPTION
рН	USEPA	150.1	ISE
SPEC. COND.	SM	2510B	DIRECT READING INST
TDS @ 180C	SM	2540C	GRAVIMETRIC
HARDNESS	USEPA	200.7	CALC FROM CA AND MG
CALCIUM	USEPA	200.7	ICP
MAGNESIUM	USEPA	200.7	ICP
SODIUM	USEPA	200.7	ICP
POTASSIUM	USEPA	200.7	ICP
ALKALINITY	SM	2320B	TITRATION
CHLORIDE	USEPA	300.0	ION CHROMATOGRAPHY
SULFATE	USEPA	300.0	ION CHROMATOGRAPHY
ALUMINUM	USEPA USEPA	200.8 200.7	ICP/MS ICP
IRON	USEPA	200.7	ICP
MANGANESE	USEPA USEPA	200.7 200.8	ICP ICP/MS
SILVER	USEPA	200.8	ICP/MS
ZINC	USEPA USEPA	200.7 200.8	ICP ICP/MS
COLOR	SM	2120B	VISUAL
MBAS	SM	5540C	DIRECT READING
CORROSIVITY	SM	203	CALCULATION

# DRINKING WATER METHODS (cont'd.) PRIMARY ORGANICS (40 CFR PART 141.24, JULY 1, 2000)

ANALYTE	<u>REFERENCE</u>	METHOD	METHOD DESCRIPTION
TRIHALOMETHANES	USEPA	524.2	P/T GC/MS
VOLATILE ORGANIC COMPOUNDS (INCLUDING VINYL CHLORIDE)	USEPA	524.2	P/T GC/MS

# RADIOCHEMISTRY (40 CFR PART 141.25, JULY 1, 2000)

ANALYTE	<u>REFERENCE</u>	<u>METHOD</u>	METH	OD DESCRIPTION
GROSS ALPHA	USEPA	900.0		Gross alpha/beta in water
GROSS BETA	USEPA	900.0		Gross alpha/beta in water
RADIUM-226	USEPA	903.0 precipitation/	Rn ingrowth	Radium in water by
RADIUM-228	-	-	-	-
RADON	-	-	-	-
URANIUM	USEPA	908	Note #1	Uranium in drinking water

(NSHL0797.SDW)

Note #1 - USEPA EMSL-LV and Region IX approval/certification letter.

# Table 13.2 - WASTEWATER AND GROUNDWATER METHODS TRACE METALS

<u>ANALYTE</u>	<u>REFERENCE</u>	<u>METHO</u> D	METHOD DESCRIPTION
ALUMINUM	USEPA	200.7	ICP
	USEPA	200.8	ICP/MS
ARSENIC	USEPA	200.8	ICP/MS
BARIUM	USEPA	200.7	ICP
	USEPA	200.8	ICP/MS
BERYLLIUM	USEPA	200.8	ICP/MS
BORON	USEPA	200.7	ICP
CADMIUM	USEPA	200.8	ICP/MS
COBALT	USEPA	200.8	ICP/MS
CHROMIUM	USEPA	200.8	ICP/MS
COPPER	USEPA	200.7	ICP
	USEPA	200.8	ICP/MS
IRON	USEPA	200.7	ICP
MERCURY	USEPA	245.2	AUTOMATED, COLD VAPOR
MANGANESE	USEPA	200.7	ICP
	USEPA	200.8	ICP/MS
NICKEL	USEPA	200.8	ICP/MS
LEAD	USEPA	200.8	ICP/MS
SELENIUM	USEPA	200.8	ICP/MS
VANADIUM	USEPA	200.8	ICP/MS
ZINC	USEPA	200.7	ICP
	USEPA	200.8	ICP/MS
ANTIMONY	USEPA	200.8	ICP/MS

SILVER	USEPA	200.8	ICP/MS
THALLIUM	USEPA	200.8	ICP/MS
MOLYBDENUM	USEPA	200.8	ICP/MS
STRONTIUM	USEPA	200.8	ICP/MS
TITANIUM	USEPA	200.8	ICP/MS

# WASTEWATER AND GROUNDWATER METHODS (cont'd.) NUTRIENTS

<u>ANALYTE</u>	<u>REFERENCE</u>	<u>METHOD</u>	METHOD DESCRIPTION
AMMONIA-N	SM	4500-NH3-F	ISE W/W/O DISTILLATION
NITRATE-N	USEPA	300.0	ION CHROMATOGRAPHY
ORTHO-P	SM	4500-P-E	ASCORBIC ACID
KJELDAHL-N	SM	4500-NH3-B	DIGESTION-ISE
TOTAL-P	SM	4500-P-E	PERSULFATE-ASCORBIC ACID

# WASTEWATER AND GROUNDWATER METHODS (con'd.) MINERALS

<u>ANALYTE</u>	<u>REFERENC</u>	<u>E METHOD</u>	METHOD DESCRIPTION
рН	USEPA	150.1	ISE
SPEC. COND.	SM	2510B	DIRECT READING INST
TDS @ 180C	SM	2540C	GRAVIMETRIC
HARDNESS	USEPA	200.7	CALC FROM CA AND MG
CALCIUM	USEPA	200.7	ICP
MAGNESIUM	USEPA	200.7	ICP
SODIUM	USEPA	200.7	ICP

POTASSIUM	USEPA	200.7	ICP
ALKALINITY	SM	2320B	TITRATION
CHLORIDE	USEPA	300.0	ION CHROMATOGRAPHY
FLUORIDE	SM	4500-F-C	ISE
SULFATE	USEPA	300.0	ION CHROMATOGRAPHY

# METHODS WASTEWATER AND GROUNDWATER(cont'd.) DEMANDS

<u>ANALYTE</u>	<u>REFERENCE N</u>	<u>IETHOD</u> <u>M</u>	1ETHOD DESCRIPTION
COD	SM	5220C	Closed reflux-Titrametric
тос	-	-	-
5-DAY BOD	SM	5210B	WINKLER-ISE
C-BOD	SM	5210B	WINKLER-ISE

# WASTEWATER AND GROUNDWATER METHODS (cont'd.) MISCELLANEOUS

ANALYTE	REFERENCE M	<u>1ETHOD</u>	METHO	DD DESCRIPTION
COLOR	SM	2120B		VISUAL
CYANIDE	SM	4500-CN-E	Distilla	tion/spectrophotometric
NON-FILTERABLE RESIDUE (TSS)	USEPA	160.2		GRAVIMETRIC
OIL & GREASE	USEPA	1664		GRAVIMETRIC
RES. CHLORINE	SM	4500-CL-F		DPD-FAS TITRITRIC
FIXED/VOLATILE SOL	IDS SM	2540 D,E		GRAVIMETRIC/IGNITION
CHLOROPHYLL	SM	10200		SPECTROPHOTOMETRIC

# **CHAPTER 14 - DATA REDUCTION, VALIDATION AND REPORTING**

# INTRODUCTION

The process of transforming raw analytical data into a finished report involves steps, which are generally grouped into the categories of data reduction, data validation, and reporting. It involves mathematical modeling of the standard calibration curves, statistical analysis of the acquired data, calculations to account for preparation steps and dilutions, verification of adherence to quality assurance procedures, and the generation of hard copy output. The method SOP for each analysis should detail these steps as they apply to that method.

# DATA REDUCTION

The analyst performing an analysis has the primary responsibility for reducing raw data. This process consists primarily of converting raw data values into final, reportable values by comparing individual sample results to those obtained for calibration purposes, then accounting for any dilutions made on individual samples.

For each method, all raw data results are recorded on method specific worksheets or in a standardized output from each of the various instruments. The SOP for each method provides more detail for how the raw data are handled.

# ANALYST DATA REVIEW

Upon completion of each analytical run, the analytical raw data and QC summary sheets are reviewed by the analyst. The analyst will place a hard copy of the raw data into the data sheet book and when there is sufficient raw data it will be bound into book format. The analyst makes sure that all QC passes and that nothing is out of the ordinary. The analyst also enters the processed data into the computer. If there is any question concerning the data in the data book the chemist will investigate the cause of the error and determine if there is need to re-run or confirm the data.

# DATA REVIEW POLICY

All analytical data produced for a report are reviewed by at least one chemist. The chemist is responsible for checking to make sure that the data passes all the QA/QC that is necessary to be valid data, and that there are no errors in transcribing the data from the raw data sheets to the computer, and that all the calculations are correct. Upon generation of the report the chemist will review and sign final report if deemed acceptable.

The first reviewers primary responsibility is to make sure that there are no transcription errors from the analyst's worksheet into the computer. They also review specific methods for calculation errors. The latter duty is shared between the two reviewers. For the analyses that use the *curvefit* program the data are entered again into the program and 10% of the samples are calculated again to check for errors. For analyses not requiring *curvefit* the reviewer looks at the data and checks for completeness and accuracy. For any manual calculations 10% are checked for error.

# DATA STORAGE

The data report files from all current and previous years, along with the supporting raw data, are stored either at the State Lab or in a locked medical school storage area. Currently, we are storing data for 12 years.

# **CHAPTER 15 - CONTRACTING SAMPLES TO ANOTHER LABORATORY**

# INTRODUCTION

The Nevada State Health Laboratory does not perform the Synthetic Organic Compound (SOC) analyses portion of the required criteria for a water system. Because of this we contract with a laboratory certified to perform the SOCs.

The sampling kits for SOCs are stored at the Nevada State Health Laboratory and then are distributed to the clients that request them. The sampling and holding procedures outlined in Table 7.1 are followed. Once the sample has been taken and the kit returned to the laboratory the accessioning department fills out a chain of custody for the contract laboratory and then the courier delivers the kit to the contract laboratory.

# **APPENDIX A**

# **ORGANIZATIONAL CHARTS**

# **CHEMISTRY DEPARTMENT**

29 December 2010





# NEVADA STATE HEALTH LABORATORY

March 11, 2009



# RESUMES

# Louis Dee Brown, MD MPH

Current Responsibilities:

Director, Nevada State Public Health Laboratory Associate Professor of Pathology and Laboratory Medicine, University of Nevada School of Medicine

Work Experience:

Nevada State Public Health Laboratory, Associate Director, & Associate Professor of Pathology and Laboratory Medicine, University of Nevada School of Medicine

Administrative Internship, Kaiser-Permanente, Northwest Headed project, which assessed electrocardiogram utilization within Kaiser Northwest, with development of evidence base for ideal utilization practices.

Oregon Health Division DOLPHIN Network Confidentiality and Privacy Task Force, Research Assistant, Interim Chair.

Developed a statutory and literature based framework for the Task Force, which developed Health-Division-wide guidelines for release of information maintained by the Division.

Methodist Hospitals of Dallas

Director, Clinical Chemistry Laboratories, and Associate Surgical Pathologist. Primary responsibility for consultation with clinical medical staff in areas of clinical chemistry and continual improvement services, Rotated responsibility with six anatomic pathology colleagues, signing out over 14,000 surgical cases and 4,000 cytology cases per year, Served as member of College of American Pathologists accreditation survey teams. Lectured to medical/surgical/ob-gyn and pathology residents on laboratory tests and theory; presented formal continuing education lectures to laboratory technical staff, taught pathology residents via one-on-one sessions. Served on Executive, Patient Care, Medical Staff Credentials, Institutional Safety and Radiation Safety Committees. Served as liaison with hospital administration, advising on analytical equipment and laboratory information systems.

Formal Education:

Masters of Public Health (1997), Portland State University. M.D. (1977), University of New Mexico. B.A. in Chemistry (1969), Texas Tech University.

### **Vernon Miller**

#### Current Responsibilities:

Chemist IV

Responsible for the day-to-day operation of the Nevada State Health Laboratory. These responsibilities include supervising the inorganic and organic chemistry sections of the laboratory, maintaining quality assurance and quality control of analyses, maintaining client relations, personnel assignment, staffing and training. Active contact with federal and state regulators. Prints and reviews reports as needed.

# Instruments and Equipment Experience:

GC/MS	Microwave Digestor
HPLC	XRF
AutoTrace	Leco C/S Analyzer
Flashpoint	DCP-AES
Viscosity	GC-OFID
GC-FID	IR-SPEC
GC-FPD	LC-MS
GC-TCD	IC
GC-AED	ICP/MS
UV/VIS SPEC	AA

Various Wet Chemistry Techniques and Instrumentation

Professional Experience:

- Senior Petroleum Chemist, Nevada Department of Agriculture
- Petroleum Chemist, Nevada Department of Agriculture
- Pesticide Chemist, Nevada Department of Agriculture
- Associate Scientist, Nevada Environmental Laboratories
- Laboratory Director and Quality Assurance Manager, Advanced Specialty Gases Inc.
- Chemist, Kennametal Inc.

Formal Education: Bachelor of Science, Biochemistry & Molecular Biology

# Stacey A. Rice

# Current Responsibilities:

Chemist III

Quality Assurance Manager. Perform ICP/MS and VOC analysis. Responsible for printing the data reports and reviewing before they are sent out. Review the SOC and Radiochemistry reports that are contracted to other laboratories.

Instruments and Equipment:

GC/MS - Hewlett Packard 5972 GC - HP 5890, ECD/NPD ICP - Varian ICP/MS - Varian Other instruments and equipment include - Ion Chromatograph, UV/VIS Spectrophotometers, pH Meters, Kjeldahl Digester, Kjeldahl distillation, Balance.

Work Experience:

Over a decade of experience in environmental testing for drinking water, wastewater, and petroleum samples.

Formal Education:

B.S. in Chemistry (1988), Southern Utah University

# Angie Bobadilla

Current Responsibilities:

Chemist III

Responsible for the analysis of mercury, BOD, CBOD, COD, Residual Chlorine and oil and grease. Prints and reviews reports as needed, checks-in samples, and disposes samples as necessary.

Instruments and Equipment:

FIMS

BOD meter

Other instruments and equipment include - Ion Chromatograph,UV/VISSpectrophotometers, Turbidity Meter, ConductivityMeter, KjeldahlDigester, Kjeldahl Distillation, TennelecMeter, Kjeldahl

Work Experience:

Sierra Environmental Monitoring Performed water and soil analyses. Interscience Research, Inc. Performed water, petroleum and asbestos analysis. International Textile Mills, Philippines Trained and supervised OC staff to maintain quality pro

Trained and supervised QC staff to maintain quality product.

Formal Education: Chemical Engineer (1976), Mapua Institute of Technology

# Vacant

Current Responsibilities:

Chemist III

Responsible for the analysis of oil and grease and the radiochemistry program. Prints and reviews reports as needed.

Instruments and Equipment:

Gas Flow Proportional Counter Other instruments and equipment include - Balance, pH meter, UV/VIS Spectrophotometers.

Work Experience:

Formal Education:

# Vacant

Current Responsibilities:

Chemist III

Quality Assurance Manager. Responsible for the analysis of metals by ICP-MS. Prints and reviews reports as needed. Chemistry department computer support specialist maintaining networks, instruments, instrument data, and ancillary equipment

Instruments and Equipment:

Work Experience:

Formal Education:

Current Responsibilities:

Laboratory Technician

Responsible for the analysis of total suspended solids, total phosphorous, orthophosphate, nitrite and IC. Preparing sample bottles for laboratory and clients. Washing and storing of glassware.

Instruments and Equipment: pH Meter Conductivity Meter Analytical Balance Spectrophotometer Tennelec Gas Flow Proportional Counter

Formal Education:

B.S. in Health Science (1994), University of Nevada, Reno

# **Chantelle Etcheverry**

Current Responsibilities:

Laboratory Technician

Responsible for the analysis of ammonia, cyanide, and total Kjeldahl nitrogen.

Responsible for sample management, operating the pH/conductivity/alkalinity auto-titrator, TDS, color, turbidity, MBAS, and other benchtop analyses.

Instruments and equipment:

Kjeldhal digester Kjeldahl distillation unit Cyanide Digester Spectrophotometer Thermo Orion pH/ISE meter pH/conductivity/alkalinity auto-titrator Analytical Balance Turbidimeter

# **Formal Education**

Bachelor of Science, University of Idaho, Moscow, Biology 2004

### John Fenn

Current Responsibilities:

Laboratory Technician

Responsible for sample management, operating the pH/conductivity/alkalinity auto-titrator, TDS, color, turbidity, MBAS, and other benchtop analyses.

Instruments and Equipment

Kjeldhal digester Kjeldahl distillation unit Cyanide Digester Spectrophotometer Thermo Orion pH/ISE meter pH/conductivity/alkalinity auto-titrator Analytical Balance Turbidimeter

**Formal Education** 

Bachelor of Science, University of Nevada, Reno, Physics