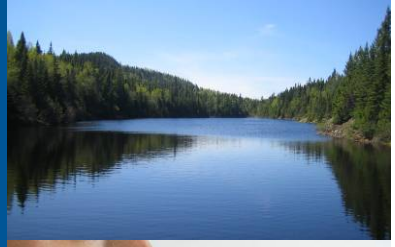
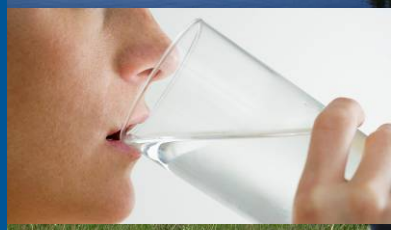
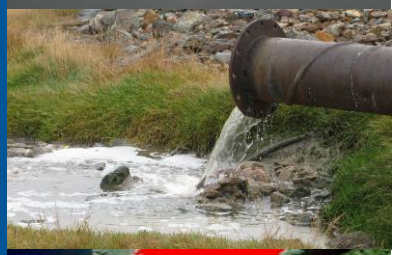
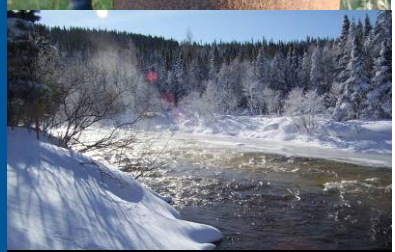
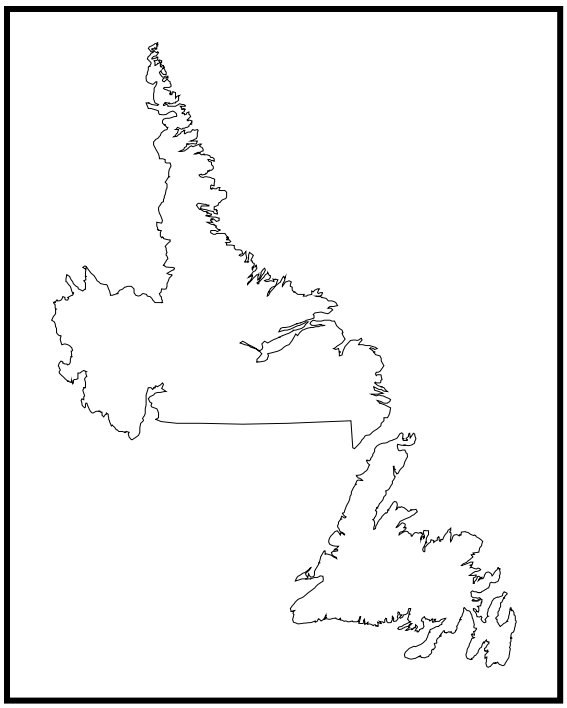







Protocols Manual for Water Quality Monitoring Agreement (WQMA) Sampling in Newfoundland and Labrador



December 2019

Newfoundland Labrador

Government of Newfoundland & Labrador
Department of Municipal Affairs and Environment
Water Resources Management Division

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Abbreviations and Acronyms

ALET	Atlantic Laboratory for Environmental Testing
ATV	All-Terrain Vehicle
AWS	Annual Work Schedule
BGA	Blue-Green Algae
BPA	Bisphenyl-A
BTX	Benzene, Toluene, Xylene
°C	Degree Celsius
CABIN	Canadian Aquatic Biomonitoring Network
CALA	Canadian Association for Laboratory Accreditation
CANAL	Canada-Newfoundland/Labrador AquaLink
CCG	Canadian Coast Guard
CCME	Canadian Council of Ministers of the Environment
CESI	Canadian Environmental Sustainability Indictors
cm	Centimeters
CMP	Chemical Management Plan
COC	Chain of Custody
CPR	Cardiopulmonary Resuscitation
DFO	Department of Fisheries and Oceans
DO	Dissolved Oxygen
ECCC	Environment and Climate Change Canada
ELEMENT	Laboratory database and sample management system
MAE	Department of Municipal Affairs and Environment
GPS	Global Positioning System
MDL	Method Detection Limit
mg/L	Milligrams per Liter
MSDS	Material Safety Data Sheets
ug/L	Microgram per Liter
NAQUA	ECCC Water Quality Database
NL	Newfoundland and Labrador
NLET	National Laboratory for Environmental Testing
NTU	Nephelometric Turbidity Unit
OHS	Occupational Health and Safety
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PFD	Personal Flotation Device
PFOS	Perfluorooctane Sulphonate
PPE	Personal Protective Equipment
QA	Quality Assurance
QAQC	Quality Assurance and Quality Control
QC	Quality Control
RCA	Reference Condition Approach
RTWQ	Real Time Water Quality
SDS	Safety Data Sheet
TDG	Transportation of Dangerous Goods
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
TN	Total Nitrogen
TP	Total Phosphorus
TDS	Total Dissolved Solids
µS/cm	MicroSiemens per Centimeter
WHMIS	Workplace Hazardous Materials Information System

WRMD	Water Resources Management Division
WQI	Water Quality Index
WQMA	Water Quality Monitoring Agreement

Appendices

Reference Materials

Several other documents are noted throughout this manual. The following documents will be useful for reference purposes:

Canadian Aquatic Biomonitoring Network Field Manual for Wadeable Streams (2012).

CCME Protocols Manual for Water Quality Sampling in Canada (2011).

Sampling Manual (Water, Sediment and Biological Sampling) Water Resource Management Division Surface Water Section Department of Environment and Labour (1999).

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1 Introduction

1.1 Purpose/Scope

This manual will provide Water Resources Management Division (WRMD) staff with the information required to conduct various types of field sampling in accordance with the Canada-Newfoundland and Labrador Water Quality Monitoring Agreement (WQMA). The protocols described in this manual are derived from the Canadian Council of Ministers of the Environment (CCME) Protocols Manual for Water Quality Sampling in Canada (2011). Though emphasis in this manual is placed upon collection of routine core ambient water samples, other sampling programs which fall under the mandate of the WQMA, or are conducted by WQMA staff, are also included.

Water quality monitoring programs are often designed to determine if water is of acceptable quality for drinking, swimming, irrigation, or to support aquatic life. Monitoring programs may also be designed to determine if water quality is improving or deteriorating over time, and to identify what is causing the impact and/or deterioration of a river, stream or lake.

One objective of this manual is to provide samplers with an understanding of the main principles of water quality monitoring of lakes, ponds and streams. In some cases it may not be possible or appropriate (due to logistics, use of certain laboratories, or where a program has different objectives, etc.) to follow all aspects of certain protocols.

Information is also provided regarding personal safety while collecting water samples. This manual provides basic direction for personal protective equipment (PPE) requirements, training and protocols that aim to keep staff safe in a variety of sampling environments.

Sampling locations and accredited laboratories have changed over time. Usually changes are made in relation to new information, better technology or safety. This manual presents the current protocols and laboratory requirements as of the date of revision.

When gathering ambient water quality samples, it is crucial that samples be collected in a standard and consistent manner with the appropriate equipment. This approach helps to ensure that data generated is representative of the environmental conditions at the sampling location. There is potential during any sampling effort to generate sampling errors. Though individual errors may not be substantial, several errors can combine to significantly affect data. Errors can lead to the collection of poor quality samples, funds misspent analyzing erroneous samples, inaccurate results generated and, ultimately, flawed conclusions derived. This manual provides guidance in standard operating procedures when sampling, handling and shipping water quality samples as well as instructions on data verification, validation and quality assurance (QA) and quality control (QC) procedures.

1.2 Canada-Newfoundland and Labrador Water Quality Monitoring Agreement

Environment and Climate Change Canada (ECCC) and WRMD are partners in the monitoring of ambient surface water quality of selected water bodies in the province. On April 29, 1986, the Canada-Newfoundland and Labrador Water Quality Monitoring Agreement (WQMA) was signed between the federal and provincial governments to establish a joint water quality monitoring network. The Agreement's purpose is the practical coordination and integration of federal and provincial water quality monitoring activities.

The work-shared arrangement requires the province (WRMD) to carry out the field work component of traditional grab sampling, while the sample analysis and data management is carried out by the federal counterparts at ECCC. Both parties are jointly responsible for report writing and product generation.

The WQMA provides for the regular monitoring of an index network of stations, as well as an annual intensive survey concentrating on water quality, sediment and biota in a selected watershed, when resources permit. Since its inception, water quality data has been collected at more than 120 core monitoring sites.

The purpose and goals of the Agreement are illustrated in Table 1:

Table 1: Canada-Newfoundland and Labrador Water Quality Monitoring Agreement Purpose and Goals

Time Frame	Long-term
Variable Type	Physical, chemical, limited biological
Frequency of Sampling	Seasonal to monthly
Hydrologic Type	Surface water- rivers, streams, lakes, estuaries
Sampling Media	Water, limited sediment, limited biota
Objective	Collect baseline water quality data
Main Information Goal	Detect trends in water quality
Main Management Goal	Ensure water quality is suitable for different beneficial water uses
Reporting	Annual Work Schedule, Intensive Survey Reports, Trends Analysis Report, Site Documentation, Fact Sheets, Specialized Studies, CANAL (Canada-Newfoundland/Labrador AquaLink) web page, technical support for stakeholders, CESI

Table 2: Core Responsibilities of the Canada-Newfoundland and Labrador Water Quality Monitoring Agreement

Management Activities		Lead Agency
Water Quality Sampling and Analysis	Collection of water samples	Province (WRMD)
	Entering field data into field sheets, field data spreadsheets and laboratory submissions	Province (WRMD)
	Laboratory analysis and quality control processes	Federal (ECCC)
Data Management	Processing and loading sample data to NAQUA database	Federal (ECCC)
	Providing access to NL WQMA Dataset	Federal (ECCC)
Data Management Special Projects	Laboratory comparison study	Province/Federal
	Data verification and validation of sample/ measurement data	Provincial/Federal
	Data extraction tool development and updates	Provincial/Federal

The collected information advises both the federal and provincial agencies in support of:

- Water resource management programs
- Pollution control regulations
- Water quality guidelines and objectives development
- Water quality modelling (simulation and prediction)
- Environmental assessment studies
- Legislative formulations
- Federal, provincial, and international agreements and commitments

All cost shared and work shared activities to be conducted as part of the agreement are detailed each fiscal year in an Annual Work Schedule (AWS) agreed to by both parties.

Annual Work Schedules can be accessed here:

\\Psnl.ca\mae\STJH\Shared\Env\WRMD\Agreements_Section\Admin\AWS_Progress\Annual_Work_Schedules

Under the WQMA there are several other sampling programs in addition to the core ambient surface water quality sampling program (Table 3).

Table 3: Water Quality Programs under the WQMA

Program		Lead Agency
Canadian Aquatic Biomonitoring Network (CABIN)	Monitoring of benthic invertebrates at selected water bodies (reference sites, core CESI sites and annual sites) for maintenance of the long-term reference network in support of the Atlantic Reference Approach Model.	Provincial (WRMD)
	Baseline Report on Reference Invertebrate Assemblages in NL	Provincial (WRMD)
	Share spatial data with ECCC, for use in the reference model	Provincial (WRMD)
	Develop CABIN reference model and associated tools	Federal (ECCC)
Canadian Environmental Sustainability Indicators (CESI)	Compile, analyze and interpret water quality data at core CESI stations according to CESI protocols	Provincial (WRMD)
	Produce an overview document indicating issues driving the rating and spatial trends	Provincial (WRMD)
Chemicals Management Plan (CMP)	Identifying and tracking environmental concerns and health risks of new substances and chemicals. Sample location and chemicals are determined by the Federal government.	Federal (ECCC)
	CMP sampling occurs in the Waterford River in St. John's. Perfluorooctane Sulphonate (PFOS), Bisphenyl-A (BPA), DY3, NP-NPE and Triclosan are sampled for at this location.	Federal (ECCC)
Intensive Survey Technical Reports	Intensive surveys are jointly discussed in annual planning and performed on an as needed basis in the province.	Provincial/Federal

1.3 Water Quality Monitoring Network Criteria

The criterion for designing a water quality monitoring network involves the following three components:

- **Location:** In order for the network to be representative, it must provide geographic coverage while accounting for geological, physiological, hydrological, demographic, anthropogenic and historical water quality factors. River basins are used as the basic sampling unit under the WQMA.
- **Parameters:** The specific water quality parameters to be measured as part of a monitoring network depend on the objectives of the monitoring network, the basin characteristics and the resources available. In NL, the same parameters are measured throughout the federal-provincial monitoring network.
- **Frequency:** The frequency of sampling is a reflection of the objectives of the monitoring network, data needs and capacity to perform the work. Highly variable water quality may require that more samples are collected to obtain results reflecting the natural variability.

Sampling Locations

Establishing suitable sample collection sites is the most critical aspect of a monitoring or sampling program. Before any sample collection can begin, the objectives of the program must be clearly defined and used to determine where samples will be collected. It is important that samples are collected from the same location each time so that temporal changes in water chemistry can be interpreted with confidence.

There are three levels of criteria used in reference to sampling locations. The ‘macrolocation’ defines the river reaches which will be sampled within a particular basin. Stations may be located at the headwaters (to define background conditions), mainstream or tributaries (to define spatial changes and pollutant sources), and at the mouth of the basin (to define how well the system is able to integrate inputs). The ‘microlocation’ defines the sampling location relative to point source inputs, tributary inflows, or other unique features within a river reach. Finally, the ‘representative location’ is a point in the river’s cross section from which a sample will provide a reasonable estimate of the average water quality at the cross section.

There are 122 active and inactive WQMA stations in the province of Newfoundland and Labrador:

- 38 in Eastern
- 28 in Central
- 27 in Western
- 29 in Labrador

In 2019-20, as documented in the AWS, there were 50 active sampling stations in Newfoundland and 25 in Labrador. Five of these stations are also continuous monitoring stations that are part of the Real-Time Water Quality (RTWQ) Network. Maps of active sampling locations can be found in ***Appendix A***.

Water Quality Parameters

In measuring water quality, there is a wide array of potential analyses from which to choose, and many provide the same information. In order to fully understand the significance of one parameter it may be necessary to test a variety of parameters and this can maximize the interpretation of the data.

Parameters Measured in-situ

Some parameters are measured directly in the waterbody using a multi-parameter sonde, a handheld meter or other technology. These parameters typically include: temperature, dissolved oxygen, pH, specific conductivity and turbidity.

Parameters Measured in Laboratories

Laboratories provide various testing methods for water samples, allowing numerous parameters to be measured. Analysis may include conventional parameters (pH, specific conductivity, hardness, and turbidity), solids (total, suspended, dissolved, inorganic, and organic), nutrients (such as different forms of nitrogen, phosphorus, and carbon), metals (measured as total, dissolved, or extractable), pesticides, and more complex organic compounds such as PCBs, PAHs, dioxins and furans and many others.

Samples collected through the WQMA are analysed by the Atlantic Laboratory for Environmental Testing (ALET) and the National Laboratory for Environmental Testing (NLET), both which are Canadian Association for Laboratory Accreditation (CALA) certified.

Parameters measured and their Method Detection Limits (MDLs) have changed over the course of the WQMA. Detection limits change over time as technology improves or monitoring needs evolve. As a result, an individual parameter may have several different MDL values over the course of the agreement timeframe.

Table 4 lists the water quality parameters currently analysed at the ECCC laboratories as part of the WQMA, with their corresponding current MDL values.

Sampling Frequency

Frequency, or how often samples are collected, varies between WQMA stations. As a minimum, stations on the island must be collected quarterly (four times/year) while stations in Labrador are sampled only during the ice free season with a minimum of three times/year.

Sampling frequencies for WQMA stations are outlined each fiscal year in the AWS.

Table 4: WQMA Laboratory Parameters and Method Detection Limits (as of March 31, 2018)

Physical and Chemical			Major Ions			Nutrients			Trace Elements and Metals					
Parameters	**MDL**	**Units**	**Parameters**	**MDL**	**Units**	**Parameters**	**MDL**	**Units**	**Parameters**	**MDL**	**Units**	**Parameters**	**MDL**	**Units**
Colour	5	Colour Units	Alkalinity, gran	1.0	mg/L	Carbon, Total Organic (TOC)	0.25	mg/L	Aluminum, total	0.5	ug/L	Lead, total	0.005	ug/L
Conductivity	0.7	uS/cm	Alkalinity, total	1.0	mg/L	Nitrate, Dissolved	0.02	mg/L	Antimony, total	0.001	ug/L	Lithium, total	0.01	ug/L
pH	-	pH units	Calcium, total	0.01	mg/L	Nitrogen, Total	0.02	mg/L	Arsenic, total	0.01	ug/L	Manganese, total	0.05	ug/L
Turbidity	0.1	NTU	Chloride	0.1	mg/L	Phosphorus, Total	0.002	mg/L	Barium, total	0.05	ug/L	Molybdenum, total	0.005	ug/L
			Magnesium, total	0.05	mg/L				Beryllium, total	0.001	ug/L	Nickel, total	0.02	ug/L
			Potassium, total	0.4	mg/L				Bismuth, total	0.001	ug/L	Rubidium, total	0.001	ug/L
			Sodium, total	0.02	mg/L				Boron, total	0.5	ug/L	Selenium, total	0.01	ug/L
			Sulphate	0.1	mg/L				Cadmium, total	0.001	ug/L	Silver, total	0.001	ug/L
									Chromium, total	0.02	ug/L	Strontium, total	0.05	ug/L
									Cobalt, total	0.002	ug/L	Thallium, total	0.001	ug/L
									Copper, total	0.05	ug/L	Uranium, total	0.0005	ug/L
									Gallium, total	0.001	ug/L	Vanadium, total	0.01	ug/L
									Iron, total	0.5	ug/L	Zinc, total	0.2	ug/L
									Lanthanum, total	0.001	ug/L			

Additional metals analyzed but not required by WRMD:

Cerium, total	0.001	ug/L	Tin, total	0.005	ug/L
Cesium, total	0.001	ug/L	Titanium, total	0.05	ug/L
Niobium, total	0.001	ug/L	Tungsten, total	0.001	ug/L
Platinum, total	0.001	ug/L	Yttrium, total	0.001	ug/L

1.4 Metadata

Station Numbers

Every station sampled under WQMA is assigned a unique ten digit alpha-numeric station number by ECCC which conforms to a national scheme for consistency across Canada. This number will remain the same for a station even if there are different variations of the station name used.

To set up a new WQMA station, the *Station Identification Form* should be completed and sent to ECCC, who will then determine if a station number already exists for the location or if it is a new location in the database which requires generation of a new station number.

Format: **PPBBSSNNNN** where: PP = two character province code (NF, PE, NS, NB)

BB = two digit drainage basin

SS = two character sub-basin code

NNNN = four digit consecutive number within the sub-basin

Examples: NF02ZM0181 (Waterford River at Blackhead Road)

NF03QC0001 (Eagle River above Falls)

Site Documentation Database

The site documentation database or 'Site Doc' is WRMD's online metadata storage area. This is where all the descriptive information about a station is recorded so it can easily be stored and accessed as needed.

This information includes but is not limited to: station coordinates; sampling site access instructions; basin descriptions; and sources of anthropogenic influences on water quality at a station. Metadata is just as important as the chemical water quality data collected at a station as both are needed to accurately interpret what the data is 'saying' and what is influencing the water quality.

Anyone at WRMD may view the information in the database, but a password is required to edit the information. Select information from the database is then transferred to the WRMD website where it is publicly viewable.

To access the Site Doc via the WRMD intranet follow the link below:

http://www.wrmd.env.gov.nl.ca/SiteDoc/Default.aspx

Canada-Newfoundland/Labrador AquaLink (CANAL)

Initiated in 2002, the Canada-Newfoundland/Labrador AquaLink (CANAL) is a partnership project between ECCC and WRMD as part of the WQMA. CANAL is a central website which allows public access to ambient water quality data as well as site documentation metadata for all WQMA water quality monitoring stations throughout Newfoundland and Labrador.

The CANAL station profile pages (Figure 1) describe the water quality station using information pulled from the site documentation. It also provides other station relevant information, if available, such as links to real-time water quality data and water quality index (WQI) scores. Fact sheets for each station are in development. Currently, the 'Extract Data' function is not available.

Metadata for all core ambient sampling stations, real-time water quality stations and CABIN stations sampled by WRMD can be accessed via CANAL:

http://www.mae.gov.nl.ca/waterres/quality/background/canal.html

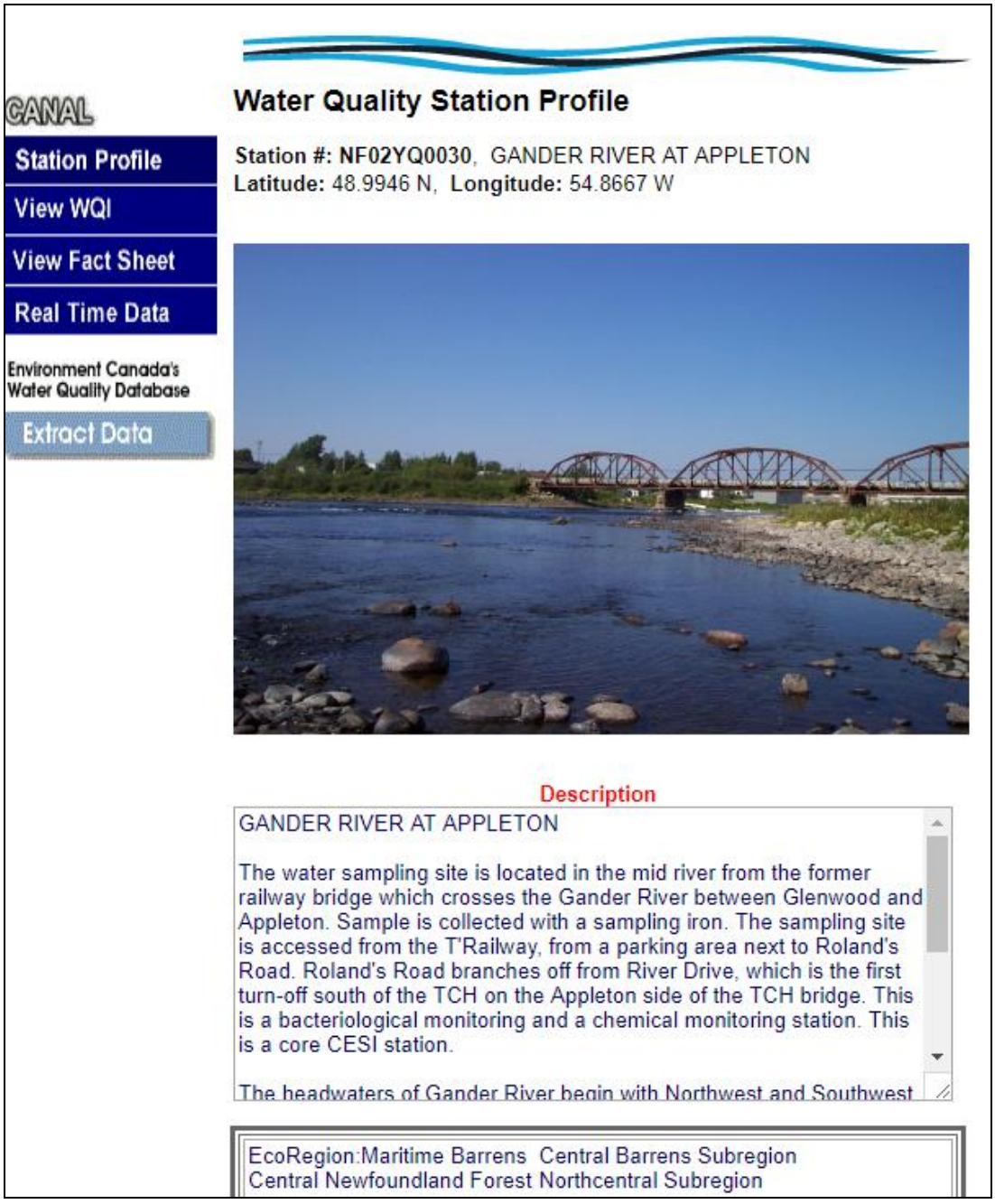


Figure 1: CANAL Station Profile for Gander River at Appleton WQMA Station

2 Occupational Health and Safety

Working safely is the most important component of any sampling program. Rivers and lakes are dynamic systems, constantly in a state of change. People collecting environmental samples must be trained and equipped to face any conditions which may exist at the time of sampling. No sample is worth risking personal health and safety and all employees have a **right to say no** to unsafe work. Applicable health and safety documents for performing WQMA sampling are included in the appendices of this document and are located on the server at the following link:

\\Psnl.ca\mae\STJH\Shared\Env\WRMD\OHS

2.1 Hazard Assessments, Safe Work Policies and Procedures

The Government of Newfoundland and Labrador has documented operating procedures and policies to keep employees safe while on the job. These documents provide employees with the information they need to perform their jobs safely and consistently and to ensure hazards are avoided. Before performing any WQMA related work, the corresponding Hazard Assessment Forms, Safe Work Procedures, and Standard Operating Procedures that address the planned field activity (surface water sampling, sediment sampling, CABIN sampling, intensive survey, etc.) must be reviewed and understood. These documents can be found in ***Appendix B***.

2.2 PPE (Personal Protective Equipment)

It is crucial to be prepared when heading out to collect samples. Samplers are required to have PPE in close range and to use specific equipment and clothing when sampling. These items can range from a Personal Floatation Device (PFD) to a first aid kit in your work vehicle. To ensure you are equipped with the appropriate items before sampling, refer to ***Appendix B*** which contains the *Hazard Assessment Forms* and *Safe Work Procedures for WQMA Sampling*. A sampling checklist is also provided in ***Appendix C*** to help you remember all safety equipment that is necessary to perform your field tasks.

2.3 Training

Training is required to collect environmental samples both safely and effectively. Some techniques are learned in the field as on-the-job training. Before performing any tasks, however, an employee must have current safety training and *Work Place Hazardous Materials Information System (WHMIS)* certification to ensure individual and crew safety. Training that is required for all staff as well as specialized training that is required for specific WQMA sampling tasks is contained in ***Appendix B,*** which contains the *Hazard Assessment Forms and Safe Work Procedures for WQMA sampling.* The province also has a *Travel and Work on Ice Cover Policy and Safe Work Procedure* that must be followed if you will be sampling through or travelling over ice.

2.4 Communication and Check- In Procedures

Working alone or in isolation may be required and effective, timely communication is critical to ensure employee safety. A local check-in procedure must be established with a supervisor or manager. Before performing any field work, review the *Working Alone or in Isolation Policy* and refer to ***Appendix B*** which contains the *Hazard Assessment Forms and Safe Work Procedures*.

Field Work Itinerary

Prior to undertaking any field work, preparing an itinerary is critical. The itinerary should list the stations to be sampled in the order that they will be visited and should be given to an accessible and reliable contact person. This is usually a supervisor or program lead. Figure 2 below is an example of an itinerary email sent before starting field work.

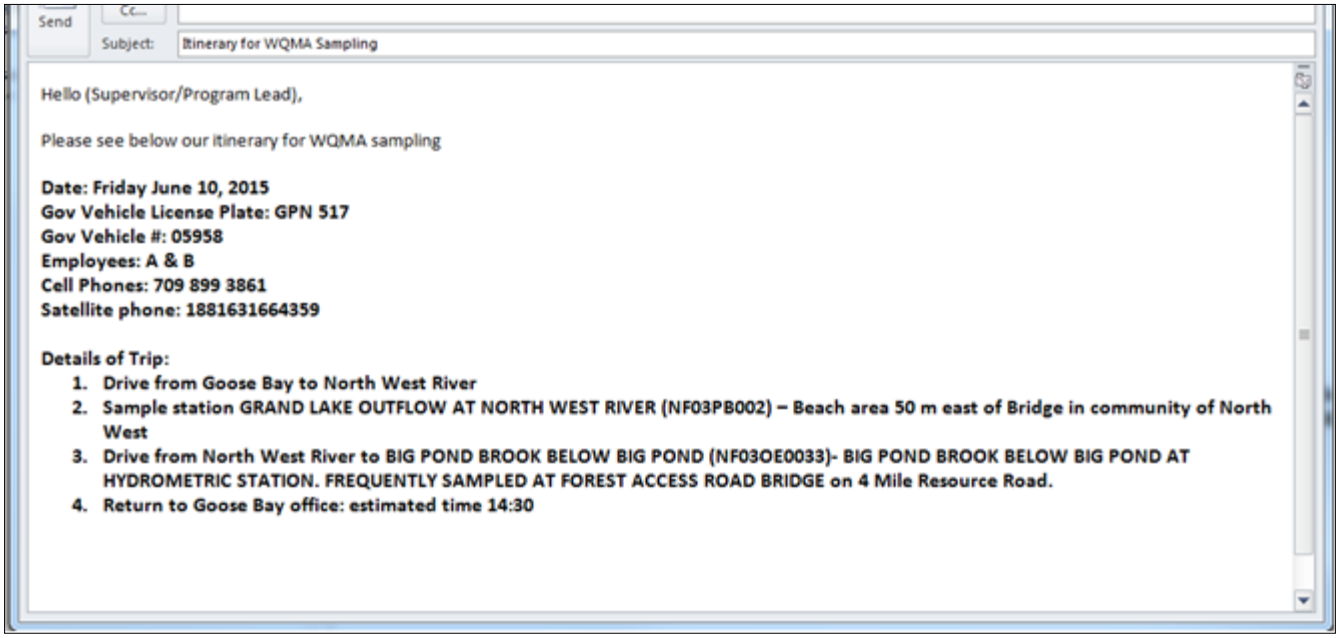


Figure 2: Example Email of Itinerary Sent to Supervisor/Program Lead Prior to Sampling

2.5 General Protocols for Sampling

Samples must be collected in a safe manner. Working safely in the field requires having first aid supplies, communication equipment and survival gear. It requires the use of appropriate footwear, gloves, PFD, reflective jackets, and personal safety devices for confined entry situations. It also means that two individuals may be required, with one acting as the support person to provide help should the sampler encounter an unsafe situation. The field crew must be trained for the situations to be encountered and experienced with the proposed program and the potential hazards. A detailed job safety analysis must be prepared. This should include specific emergency response plans and the crew must be aware of any special safety considerations. Basic safety information is provided here which has been derived from the *CCME, Protocols for Water Quality Sampling in Canada, 2011*.

General Safety in Sampling

The following is a list of *general* safety protocols which should be followed when performing WQMA field activities:

1. Samples should be collected using latex or plastic gloves in order to protect the sampler from contaminants in the ambient waters and from coming into contact with preservatives.
2. All field crew members must possess valid Standard First Aid (Level 1), CPR and Workplace Hazardous Materials Information System (WHMIS) certification to ensure individual and crew

safety. Additional required training could also include Transportation of Dangerous Goods (TDG), small boat safety (as required by the Coast Guard), chainsaw safety, swift water safety and awareness, electrical hazard safety and awareness, ice safety and awareness, defensive driving, all-terrain vehicle safety, snowmobile safety, bear awareness and wilderness first aid.

3. Provincial Workplace Hazardous Materials Information System (WHMIS) legislation requires that all workers be provided with information concerning the storage, handling and use of controlled products. This includes materials such as chemical preservatives. WHMIS requires that controlled products are labeled so that workers are alerted to the identity and dangers of products and to basic safety precautions. In addition, material safety data sheets (MSDS) are to be provided. These are technical bulletins that provide detailed hazard precautionary and first aid treatment information for controlled substances, as well as the hazardous ingredients, physical data, fire and explosion hazard, reactivity data, health effects, preventative measures, first aid measures and preparation information. All sample collectors should obtain copies of current MSDS sheets for each preservative that they are expected to use and become familiar with the provided information.
4. Individuals involved in sampling ambient waters should never become complacent about the potential dangers. At each site, the sampler or field team should do a site safety assessment prior to carrying out any work (i.e. assess site location and access hazards, potential upstream, in-stream, and downstream hazards, safety gear required, etc.)

Sampling by Wading

Wading is a common way to collect samples, but it can also be hazardous. Rubber boots or hip waders are standard equipment. If chest waders are worn a compression belt (or closely-fitted PFD) should be used. A wading rod or similar probing stick is often useful to gauge the current and to locate holes and unsafe footing.

1. When sampling by wading, a PFD must be worn (Figure 3).
2. If water is flowing swiftly at the site the sample collector must be tethered and a second crew member must remain on shore with a throw-bag prepared to deploy. The sampler and second crew member must participate in a *Swift-water Safety Awareness* training course provided by Rescue Canada or other certified agency.
3. Visually inspect the streambed for large obstacles or holes. Wade carefully into the stream with a wading stick and safety line. Once you are certain that it is safe, sampling can begin.
4. Be aware of floating ice that could knock you off balance or trap you. Also be aware of ice on rocks and other surfaces. If the river is too high and/or swift for wading, the samples should be collected from a safe shore location.
5. If you are not certain that conditions are safe, do not take a sample. Never take unnecessary risks.

Figure 3: Wading to collect a water sample

Sampling from Shore

Working from shore is usually the safest way to collect water samples, but it can also be dangerous. Always wear a PFD. Secure footing is essential and at swift water locations it is advisable to be tethered (to a tree or a second person) in case of a fall.

1. When sampling from shore, a PFD must be worn.
2. You should ensure safe footing and be well balanced as the current may pull hand-held sampling equipment sharply downstream. If rocky outcrops exist, ensure that these are not slippery before sampling.
3. If swift water safety is a regular concern at the site, samplers must complete a *Swiftwater Safety and Awareness* course provided by Rescue Canada or other certified agency.
4. If you are not certain that conditions are safe, do not take a sample. Never take unnecessary risks.

Sampling from a Bridge

When sampling from a bridge, space is confined and traffic may present serious hazards. If sampling from a bridge is required, avoid working in heavy traffic periods. Do not park on the bridge unless it is safe to do so. A reflective vest should be worn and pedestrian walkways should be used if available. The wind from large passing vehicles can make you lose your footing and also blow bottles and caps over the edge of the bridge. Dust stirred up by vehicles can also contaminate water samples before they are capped.

1. Special care must be taken when sampling from bridges over navigable water, as boat operators and water skiers may not be able to see ropes and sampling devices. It may be necessary to flag such equipment so that it is easily visible.
2. Power lines strung along or close to bridges should also be respected and avoided. At no time should ropes or cords be draped over a power or utility line.
3. Certain jurisdictions may require a permit if a person is working or parking on the side of a highway or street for more than 30 minutes.
4. If parking on the highway shoulder, hazard lights (and rotobeacon if available) and traffic cones must be used to alert oncoming traffic of your presence (Figure 4). If your vehicle encroaches onto the road, two ‘crew working’ signs, hazard lights, a circular light and three to six pylons should be used to alert oncoming traffic of your presence.
5. Whenever possible park your vehicle so as not to obstruct traffic. If you are encroaching into bridge traffic, a minimum of three traffic pylons must be used to mark out your work area on the bridge. A crew working sign must also be placed at both ends of the bridge to signal to oncoming traffic that you are working on the bridge.
6. Samplers must wear a reflective safety vest to be clearly visible to oncoming traffic.

7. Assess the bridge deck for slip/trip hazards and wear appropriate footwear. If sampling from a bridge with a wooden walkway, ensure that the boards have not begun to rot or that there are no missing planks or holes present. Ensure that the bridge railing is secure. Do not lean over the bridge railing.

Figure 4: Traffic Control Safety (CCME, Protocols Manual for Water Quality Sampling in Canada, 2011)

Sampling through Ice

When sampling on ice, always proceed with caution and do not jeopardize your safety. Test the ice thickness with a rod or ice chisels every few steps. Always wear a PFD and safety harness that is tethered to ice anchors or to something solid on shore. Ice thickness over moving water can vary, and the strength of the ice cannot be estimated from the apparent thickness near the shore (see Table 5). You should be aware that ice downstream from bridge supports and other structures may be thin as a result of modified flow patterns and de-icing agents. Honeycombed ice, areas over rapids, and confluences with other rivers and streams should be avoided as ice thickness in these areas will vary. Special care must be exercised during freeze-up and melt conditions (Figure 5).

1. Employees must have the required *Ice Safety Training* and recommended equipment prior to collecting water samples through ice.
2. Ideally, Rescue Canada will perform an ice safety station assessment at all sites to be sampled. This may require that some sites sampled at certain times of the year be attended by at least two people.
3. For safety reasons, any work on ice must be carried out by at least two people.
4. Wear an approved flotation or survival suit when working on ice.
5. Always proceed with caution over ice, and be attached to a tether. Use an ice bar to test the thickness and condition of the ice to make sure that it is safe. River ice can be thin even in the Arctic if there is a current or warm groundwater inflow (see Table 5). Carry ice safety picks to help in pulling yourself back onto the ice if you fall through.
6. Carry dry clothing with you in case you need to change.
7. Never drive a vehicle over the ice except where a winter ice road exists and then do so with caution.
8. If the ice is unsafe, do not take a sample.

Table 5: General guidelines for Ice Thickness [clear blue ice] (CCME, Protocols Manual for Water Quality Sampling in Canada, 2011)

Load	Required Ice Thickness (mm)[1]			
	Continuous Travel		Stationary Travel	
	Lake	River	Lake	River
1 person on foot	50	60	75	90
Group, single file	80	90	120	135
Passenger car (2000kg)	180	210	300	350
Light Truck (2500kg)	200	230	340	390
Medium Truck (3500kg)	260	300	425	500

[1] Effective thickness = Thickness (clear ice) + 1/2 Thickness (white ice)
Where water lies between layers, use only the depth of the top of layer of ice. Under thawing temperatures above average air temperatures exceeds zero degrees C, increas the required thickness by 20%
Source: EMNA-N (2005) from the Alberta Occupational Health and Safety Council 1990.

Figure 5: Staff member sampling near ice

Sampling from a Boat or Aircraft

When sampling from aircraft, the pilot has final say regarding operational details such as loading of equipment, weather conditions under which the trip can be performed safely, safety information and deplaning procedures. A PFD should always be used. When sampling from a boat or aircraft, you should perform a visual inspection of the surroundings, paying close attention to wave height and direction. Individuals in a boat should move using slow, calculated motions and should not stand in the boat to obtain the water sample. Boats must be maintained in a safe condition and aircraft safety and maintenance records should be inspected.

1. Before sampling, ensure the anchor is secure and the boat is pointed into the wind. For aircraft, ensure that the rotors and engines are still and the aircraft is pointed into the wind. Do not go forward of the red line on the float.
2. When sampling from a boat, be aware of other boat traffic and natural hazards. All power-driven vessels must yield the right-of-way to those not operating under power such as canoes. Two paddles, a bailer and an anchor must be on board. All Transport Canada regulations regarding equipment required relative to the type/size of boat should be adhered to.
3. Samplers should position themselves securely on the floor of the boat or on one of the seats. Prior to collecting a sample, others in the boat should be informed that a sample is going to be collected and they should counter balance the boat by positioning themselves on the opposite side to which the sample will be collected.
4. The rear door of fixed-wing aircraft (e.g., the Cessna 206, with its long, broad tail section) should be tied open. Direct or headphone communication with the pilot is essential. The pilot may need to communicate the difficulty of keeping the aircraft stable on the water, or the fact that wind, wave or fog conditions are making it too dangerous to continue. It is much safer to have a third person to help with communication between the sampler and the pilot. Relatively busy air traffic in popular lake areas may mean additional safety risks, forcing workers to work quickly and efficiently.
5. Ensure that footing is secure on aircraft if sampling from pontoons. Pontoons become wet and possibly slippery when landing. Samplers on pontoons should be tethered to the aircraft and should be wearing a PFD as well as rubber boots. The PFD should not be worn in the aircraft unless it is the manual inflation type.

6. For helicopters, never move toward the rear of the helicopter as the tail rotors are dangerous. If it is absolutely necessary to depart a helicopter with the engine running such as during winter sampling, leave the helicopter in a crouched position.
7. After samples have been collected, crew members should return to their regular positions in the boat or aircraft.

3 WQMA Core Ambient Water Quality Sampling

The core ambient water quality grab sampling schedule is described in the AWS for each fiscal year (April 1 to March 31). In the AWS, the fiscal year is divided into 4 sampling seasons or quarters:

- 1st Quarter: April 1 – June 30
- 2nd Quarter: July 1 – September 30
- 3rd Quarter: October 1 – December 31
- 4th Quarter: January 1 – March 31

There are three types of samples collected under the WQMA core ambient sampling:

- **Discrete sample -** an individual sample collected at a sampling station.
- **Duplicate sample** - the collection of two individual samples at a sampling station, approximately 5 minutes apart.
- **Blank sample -** an unopened, numbered and labelled set of empty sampling bottles**.**

3.1 Sample Numbers

Each sample collected under WQMA and submitted to ECCC for analysis must have a unique sample number. WQMA sample numbers follow the format: **YYYY- AT0215- ####,** where the #'s represent the number assigned sequentially to each sample in the order the samples are collected.

Sample numbers are allocated by region, remain the same each year, and are reset each January 1st:

0001 to 0200 – Labrador
0201 to 0400 – Western
0401 to 0600 – Central
0601 to 0800 - Eastern

3.2 Sample Frequency

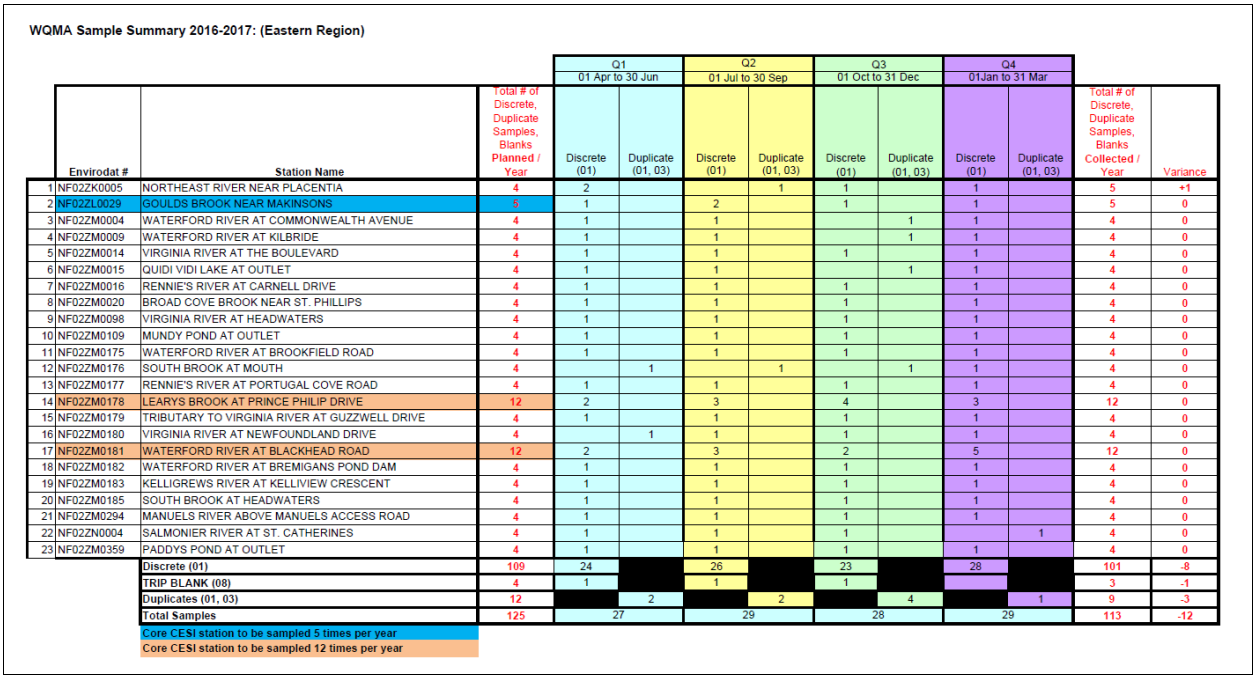
The AWS specifies the number of samples and frequency of sampling scheduled for each of the stations in the network in a fiscal year. Any deviations from this may affect data reporting programs such as the Canadian Environmental Sustainability Indictors (CESI) program, which requires a set number of samples each year. Any problems adhering to the AWS sampling schedule must be immediately discussed with the program lead to determine the appropriate path forward.

Sampling Summary Spreadsheet

Sampling frequency can be easily tracked and summarized each year using the *Sample Summary Spreadsheet*, which is used to document the samples completed each quarter, any extra samples collected and any samples which were not collected. The sample summary spreadsheet provides a variance (+/-) to quantify the differences in the number of samples planned and what was completed. The spreadsheet also includes an area where notes can be recorded regarding any sample that was missed, added, or for which there is incomplete information as well as any issues reported by the analyzing laboratory. Duplicate samples and sample blanks are also tracked in this spreadsheet.

Sample Summary Spreadsheets are located here:

M:\STJH\Shared\Env\WRMD\Agreements_Section\WQMA\Core\WQMA Summaries



WQMA Sample Summary 2016-2017: (Eastern Region)

				Q1 01 Apr to 30 Jun		Q2 01 Jul to 30 Sep		Q3 01 Oct to 31 Dec		Q4 01Jan to 31 Mar			
	Envirodat #	Station Name	Total # of Discrete, Duplicate Samples, Blanks Planned / Year	Discrete (01)	Duplicate (01, 03)	Discrete (01)	Duplicate (01, 03)	Discrete (01)	Duplicate (01, 03)	Discrete (01)	Duplicate (01, 03)	Total # of Discrete, Duplicate Samples, Blanks Collected / Year	Variance
1	NF02ZK0005	NORTHEAST RIVER NEAR PLACENTIA	4	2			1	1		1		5	+1
2	NF02ZL0029	GOULDS BROOK NEAR MAKINSONS	5	1		2		1		1		5	0
3	NF02ZM0004	WATERFORD RIVER AT COMMONWEALTH AVENUE	4	1		1			1	1		4	0
4	NF02ZM0009	WATERFORD RIVER AT KILBRIDE	4	1		1			1	1		4	0
5	NF02ZM0014	VIRGINIA RIVER AT THE BOULEVARD	4	1		1		1		1		4	0
6	NF02ZM0015	QUIDI VIDI LAKE AT OUTLET	4	1		1			1	1		4	0
7	NF02ZM0016	RENNIE'S RIVER AT CARNELL DRIVE	4	1		1		1		1		4	0
8	NF02ZM0020	BROAD COVE BROOK NEAR ST. PHILLIPS	4	1		1		1		1		4	0
9	NF02ZM0098	VIRGINIA RIVER AT HEADWATERS	4	1		1		1		1		4	0
10	NF02ZM0109	MUNDY POND AT OUTLET	4	1		1		1		1		4	0
11	NF02ZM0175	WATERFORD RIVER AT BROOKFIELD ROAD	4	1		1		1		1		4	0
12	NF02ZM0176	SOUTH BROOK AT MOUTH	4		1		1		1	1		4	0
13	NF02ZM0177	RENNIE'S RIVER AT PORTUGAL COVE ROAD	4	1		1		1		1		4	0
14	NF02ZM0178	LEARYS BROOK AT PRINCE PHILIP DRIVE	12	2		3		4		3		12	0
15	NF02ZM0179	TRIBUTARY TO VIRGINIA RIVER AT GUZZWELL DRIVE	4	1		1		1		1		4	0
16	NF02ZM0180	VIRGINIA RIVER AT NEWFOUNDLAND DRIVE	4		1	1		1		1		4	0
17	NF02ZM0181	WATERFORD RIVER AT BLACKHEAD ROAD	12	2		3		2		5		12	0
18	NF02ZM0182	WATERFORD RIVER AT BREMIGANS POND DAM	4	1		1		1		1		4	0
19	NF02ZM0183	KELLIGREWS RIVER AT KELLIVIEW CRESCENT	4	1		1		1		1		4	0
20	NF02ZM0185	SOUTH BROOK AT HEADWATERS	4	1		1		1		1		4	0
21	NF02ZM0294	MANUELS RIVER ABOVE MANUELS ACCESS ROAD	4	1		1		1		1		4	0
22	NF02ZN0004	SALMONIER RIVER AT ST. CATHERINES	4	1		1		1			1	4	0
23	NF02ZM0359	PADDYS POND AT OUTLET	4	1		1		1		1		4	0
		Discrete (01)	109	24		26		23		28		101	-8
		TRIP BLANK (08)	4	1		1		1				3	-1
		Duplicates (01, 03)	12		2		2		4		1	9	-3
		Total Samples	125	27		29		28		29		113	-12
		Core CESI station to be sampled 5 times per year											
		Core CESI station to be sampled 12 times per year											

Figure 6: WQMA Sample Summary Spreadsheet

3.3 Duplicates and Blanks

For quality control purposes at ECCC laboratories, approximately 10% of all samples collected should include a duplicate sample. The WQMA sample summary spreadsheet includes the number of duplicate samples required for each region. The required duplicates should be spread across each quarter.

The submission of blank samples is also required, four per year from each region on the island and three per year from Labrador. A blank consists of a set of unopened sample bottles, from the same bottle supply used to collect samples. The blank sample is assigned a sample number and labelled using the same protocol as other WQMA samples. The blank is not assigned a site number; instead 'NLL' is written on the Sample Submission Sheet where site numbers are recorded. The blank is referred to as a 'Trip Blank' with sample code 08 on the Sample Submission Sheet and is sent to the ECCC laboratory with a shipment of samples, to fulfill internal QA/QC protocols.

3.4 Sample Bottles

The AWS and the WQMA Sampling Summary Spreadsheet are used to determine the approximate number of bottles that will be required for sampling, including duplicates and blanks. Extras should be ordered to account for loss, breakage, special samples, etc. Bottle sets are identical for discrete, duplicate and blank samples. Regional staff are responsible for ordering sample bottles and maintaining an adequate supply throughout the year.

WQMA core sample bottles, along with shipping coolers and ice packs are obtained from:

Environment and Climate Change Canada **Atlantic Region** **Corner of University and Morton** **PO Box 23005** **Moncton, New Brunswick, E1A 6S8**	**Contact** **Julie Bourgeois** julie.bourgeois2@canada.ca ec.leea-alet.ec@canada.ca

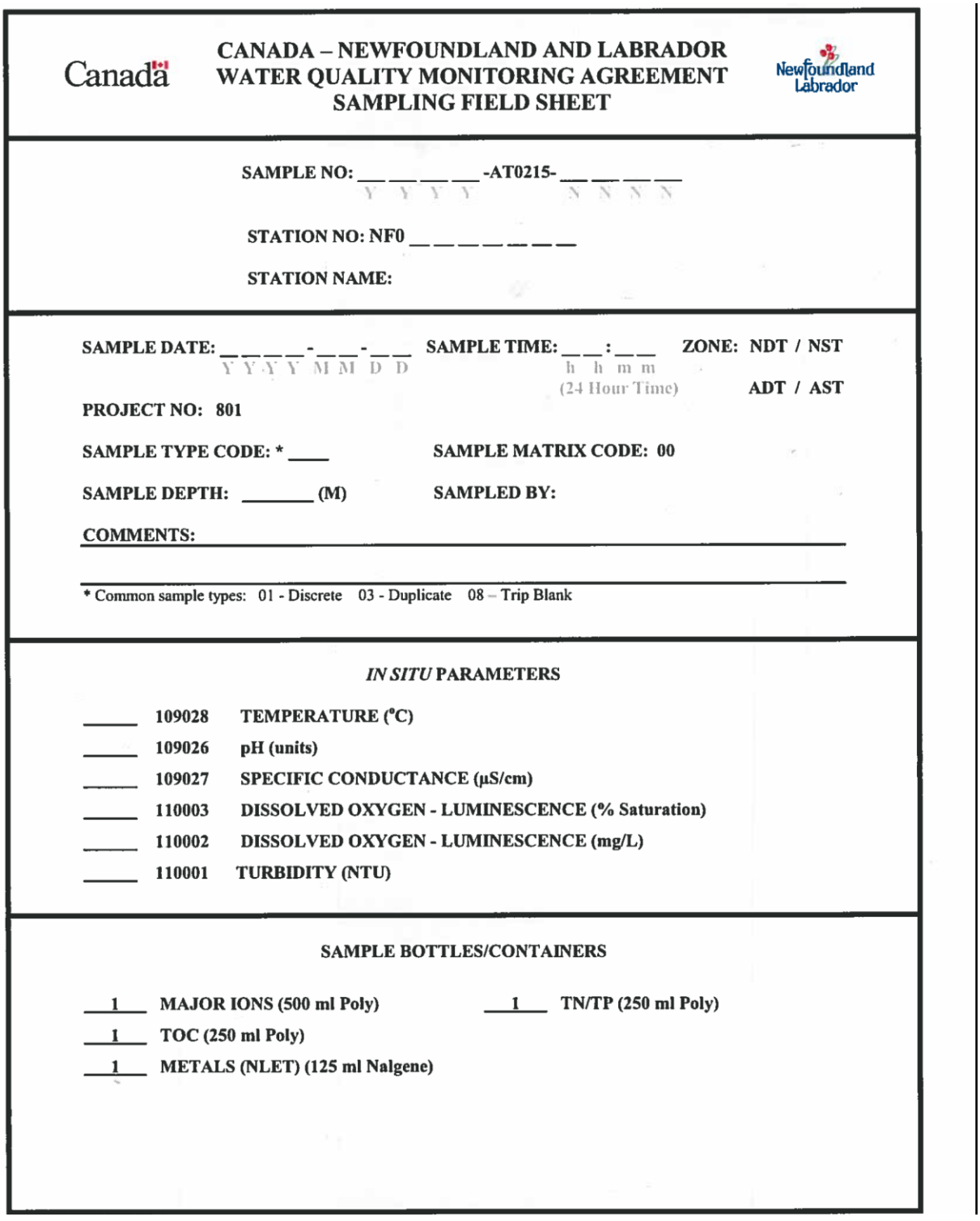
Table 6: WQMA Ambient Surface Water Bottles and Parameters

Parameter	Bottles
1 TOC	250ml Poly
1 TN/TP	250ml Poly
1 Major Ions and	500mL Poly
1 Metals	125 ml Nalgene (plastic bag)

Figure 7: Bottle set for WQMA Ambient Surface Water samples

3.5 Field Sheets

A WQMA *Sampling Field Sheet* (Figure 8) must be filled out each time a sample is collected. The field sheet notes current site observations including weather and in-situ water quality measurements at the time of sample collection. Field sheets are then saved to the WRMD shared drive so that the information is available to staff who require it for data interpretation:



Canada

CANADA – NEWFOUNDLAND AND LABRADOR
WATER QUALITY MONITORING AGREEMENT
SAMPLING FIELD SHEET

Newfoundland Labrador

SAMPLE NO: __ __ __ __ -AT0215- __ __ __ __
Y Y Y Y N N N N

STATION NO: NF0 __ __ __ __ __ __ __

STATION NAME:

SAMPLE DATE: __ __ __ __ - __ __ - __ __ (Y Y Y Y M M D D)

SAMPLE TIME: __ __ : __ __ (h h m m, 24 Hour Time)

ZONE: NDT / NST
ADT / AST

PROJECT NO: 801

SAMPLE TYPE CODE: * ____

SAMPLE MATRIX CODE: 00

SAMPLE DEPTH: _____ **(M)**

SAMPLED BY:

COMMENTS:

* Common sample types: 01 - Discrete 03 - Duplicate 08 – Trip Blank

***IN SITU* PARAMETERS**

_____ 109028 TEMPERATURE (°C)
_____ 109026 pH (units)
_____ 109027 SPECIFIC CONDUCTANCE (µS/cm)
_____ 110003 DISSOLVED OXYGEN - LUMINESCENCE (% Saturation)
_____ 110002 DISSOLVED OXYGEN - LUMINESCENCE (mg/L)
_____ 110001 TURBIDITY (NTU)

SAMPLE BOTTLES/CONTAINERS

__1__ MAJOR IONS (500 ml Poly)
__1__ TN/TP (250 ml Poly)
__1__ TOC (250 ml Poly)
__1__ METALS (NLET) (125 ml Nalgene)

Figure 8: WQMA Sampling Field Sheet

The Sample Codes on the field sheet refer to coding used by ECCC laboratories. Only a select few of these codes are used for WQMA ambient samples. These include Sample Type codes (discrete, duplicate, blank) and the Sample Matrix or medium being sampled (water, wastewater, rain, snow etc).

The most commonly used Sample Codes are shown in Table 7:

Table 7: WQMA Sample Type and Matrix codes

Sample Type Code	Sample Matrix Code
01 Discrete Sample (one sample taken at a particular location, depth and time)	00 Water
03 Duplicate Sample (the second of two samples collected at the same location and depth, usually 5 minutes apart)	59 Soil
08 Trip Blank	50 Sediment
22 Field Blank	99 Biota

If a duplicate sample is collected, a separate sample number and field sheet are used for each of the sample sets. The first sample will be given Sample Type Code 01 and the second sample will be given Sample Type Code 03, marking it as a duplicate.

Space is provided on the field sheet to record weather and other pertinent conditions at the time of sampling, such as water level and clarity. The sampling field sheet is an important record of the sample and the conditions under which it was collected. In the absence of this information, interpretation of the analysis results is more difficult. Copies of standard WQMA forms can be found in ***Appendix D.***

All regional staff are responsible for printing their own WQMA sampling field sheets. Templates can be found at the following link on the server:

\\Psnl.ca\mae\STJH\Shared\Env\WRMD\Agreements_Section\WQMA\Core\WQMA Forms

Completed field sheets must be scanned and filed on the WRMD server under the appropriate region and fiscal year at the following link:

\\Psnl.ca\mae\STJH\Shared\Env\WRMD\Agreements_Section\WQMA\Core\WQMA Field Sheets

3.6 Labelling

All sample bottles must be clearly labelled. Regional staff are responsible for preparing and printing their own WQMA bottle labels for the year. Each sample set will have four labels, one for each bottle. Figure 9 below shows a sample set of labels. Label templates can be found at the following link:

\\Psnl.ca\mae\STJH\Shared\Env\WRMD\Agreements_Section\WQMA\Core\WQMA Forms

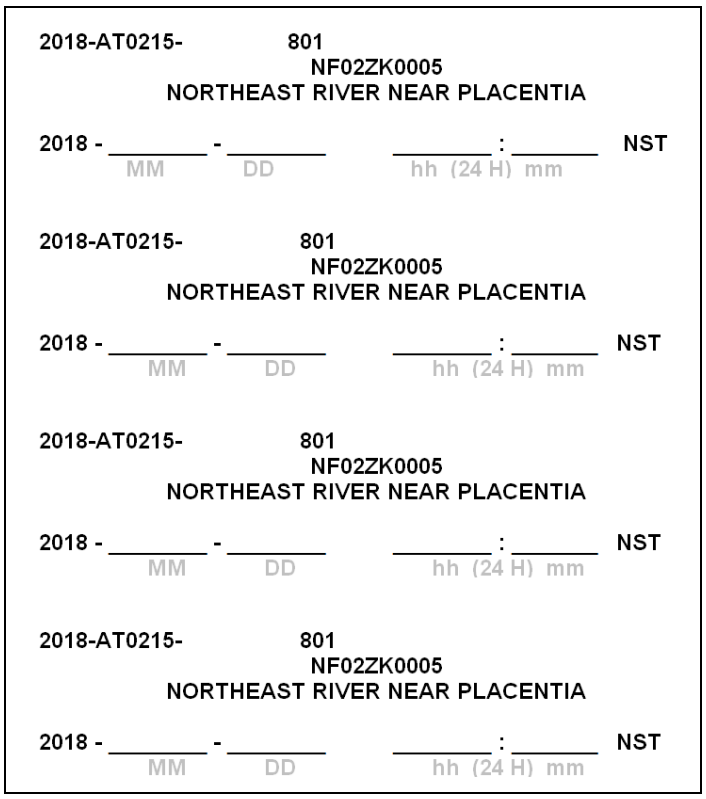


Figure 9: Sample Labels for Northeast River Near Placentia

Labels must be printed on water-proof label paper. Extra blank labels should also be printed in case they are needed.

Labels must be filled out with waterproof and quick drying permanent markers and affixed to the sample bottles *before* samples are collected.

3.7 Preparing to Sample

Preparation prior to any sampling trip is crucial in order to avoid lost time, added expenditures and the corruption of data if improper methods have to be used as a result of poor planning.

Equipment Checklist

Samplers should prepare a comprehensive checklist which is designed to help gather and prepare the equipment needed for each sampling trip. The checklist should, as a minimum, identify the following:

- Required bottles or containers (including extras)
- List of sample numbers to be used
- List of stations to be sampled with location descriptions
- Labels
- Waterproof markers
- Field book/ Field sheets
- Digital camera
- GPS device

- SPOT tracking device
- Calibrated multi-parameter sonde
- Pencils
- Sampling devices (pole, rope, etc)
- Coolers
- Ice packs
- PFD (personal flotation device)
- Hip or chest waders
- Sampling gloves
- Personal gear including rainwear, footwear

If shipping from the field, other required items include:

- Tape to seal coolers
- Shipping labels for coolers
- Sample Submission Forms (Chain of Custody)
- Waybills and tracking numbers

An example of a WQMA Surface Water Sampling Checklist can be found in ***Appendix C.***

Multi-Parameter Sonde

In-situ measurements are collected with each WQMA sample to provide information on water conditions when the sample is collected. Multi-parameter sondes are used to collect the in-situ data, which includes water temperature, dissolved oxygen, pH, specific conductance, turbidity and total dissolved solids (TDS). This information is then recorded on the WQMA Field Sheet.

The regular maintenance and calibration of water quality instruments such as these multi-paramter sondes is essential to ensure accurate data collection. Instruments should be calibrated just before WQMA samples are collected to ensure high quality data.

Please refer to the *Protocols Manual for Real-Time Water Quality Monitoring in NL Calibration and Maintenance Guide for Industry Partners* for detailed instructions on calibrating multi-parameter instruments used by the WRMD.

Items to include in your checklist when using a multi-parameter sonde:

- Sonde
- Cage for sonde
- Connection cable
- Handheld viewer
- Spare batteries for sonde

3.8 Assessing the Sampling Location

Upon arriving at a sampling location, assess the surroundings to determine whether conditions are safe enough to collect samples. No sample is ever worth putting yourself in danger! Is the water too high or too fast to sample safely? Is there ice or rafted ice? Are there animals or humans in the area that may pose risks to safety? Is the site otherwise unsafe for any reason? **If there is any question as to the**

safety of the site, DO NOT collect a sample. Refer to the health and safety protocols laid out by the Hazard Assessment process in ***Appendix B***.

If the site **is safe**, record notes on the following types of observations (Table 8) on the Field Sheet:

Table 8: Sampling Location Observations

Climate Conditions	Aquatic Conditions
air temperature (°C), % of cloud cover	water level (low, moderate high)
wind (light, moderate, high)	flow (low, moderate, fast)
any precipitation in previous 24 hrs	water clarity (clear, cloudy)
ice cover	algae growth (low, moderate, heavy)
snow on ground	aquatic plant growth (low, moderate, heavy)

3.9 Sampling Method

The sampling method for WQMA ambient surface water is broken down into a step by step guide below and in a checklist in Figure 14.

1. Using the next sequential sample number, complete sample bottle labels using permanent marker and affix to sample bottles (Figure 10).

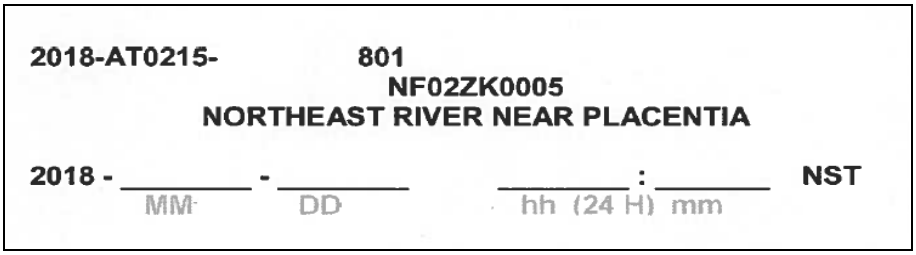


Figure 10: Example of a Sampling Label that is completed in the Field

2. When sampling by wading into streams or rivers, unless otherwise specified, aim for mid-stream. If water depth mid-stream is above the thigh, it will be safer to collect the sample closer to shore or to use a sampling pole.
3. Once the sampling location for the grab sample has been identified, deploy the multi-parameter sonde and allow it to become stable in the water environment (Figure 11). Ensure the sonde is placed upstream of your location so that it is not affected by your disturbance.
4. Record the readings from the multi-parameter sonde on the field sheet once they are relatively stable.

5. Wade to midstream with the labelled sample bottles. Ensure there is no disturbance of the substrate around you where you plan to fill your bottles. Rinse each sample bottle three times as described in the following procedure (Figure 12):
    a. Facing up stream, grasp the bottle well below the neck
    b. Remove the cap
    c. Invert the bottle and plunge it to a depth of 30 cm, taking care to minimize the disturbance in the water column
    d. Hold the bottle horizontal towards the current pointing up stream until it fills about ¼ full.
    e. Remove the bottle, replace the cap, shake to rinse, discard water downstream
    f. Repeat until the bottle is rinsed three times
    g. Wear clean laboratory gloves when handling the metals bottle

Figure 11: Multi-Parameter Instrument Upstream of Sampler

Figure 12: Rinsing of Bottle Prior to Sampling

6. After rinsing, fill the sample bottles beginning with the metals bottles.
    a. Completely fill each bottle and remove from the water by forcing forward into the current and upwards, avoiding collecting any surface scum and film (Figure 13).
    b. Cap each bottle immediately after filling and carefully place in a chilled cooler when you return to shore.

Figure 13: Example of Surface Water Sampling Technique

7. Do not touch the inner lining of the bottle cap or the opening of the bottle. Replace the metals bottle into its separate plastic bag immediately after filling to minimize potential contamination.
8. If the streambed is too shallow to reach a depth of 30 cm, immerse the bottle as deeply as possible without allowing it to touch the bottom of the stream.

9. If a duplicate sample is collected, it is assigned its own sample number and collected 5 minutes after the initial sample. A separate field sheet is also used.

WQMA Surface Water Sampling Checklist

Pre-Planning

- □ Transportation arrangements (boat, helicopter, truck, ATV, snowmobile)
- □ Appropriate transportation safety gear (see specific polices for transportation by ATV, snowmobile, etc.)
- □ Appropriate sample bottles, sample numbers, labels and field sheets for sampling locations
- □ Cooler filled with ice packs for sample preservation
- □ Multi-parameter instrument is ***fully charged*** to take in-situ water quality readings
- □ Appropriate GPS coordinates for sampling locations
- □ Appropriate health and safety equipment and **Personal Protective Equipment (PPE)**
- □ Refer to the ***WQMA Surface Water Sampling Checklist (Appendix C)*** to ensure you have all necessary supplies

Sampling Location

- □ Arrive at site location and assess the hazards (water level, weather ice conditions, etc) - reference ***WQMA Hazard Assessment Worksheet***

□ Is the site too hazardous to sample?

No - Continue sampling	Yes	
	□ Is there a safer location with in 20 m ?	
	Yes - Sample at new location	No
		□ Do not sample in hazardous conditions, return to the office or proceed to next sampling location

- □ Note obervations about the site - climate conditions, aquatic conditions (GPS coordinates if you moved 20 m from original location)
- □ Fill in ***sample number, date, time, time zone on each label for each corresponding bottle***
- □ Grab complete bottle set and place corresponding label on appropriate bottle.
- □ Identify a save sampling location and allow multi-parameter instrument to become stable in the water environment
- □ Put on appropriate gloves for sampling
- □ With pre-labelled bottles in hand, rinse each bottle three times
- □ Fill bottles by forcing forward into the current, cap each bottle immediately
- □ Record multi-parameter readings, complete the ***Sampling Field Sheet (Appendix A)***
- □ Store samples on ice in a cooler directly after sampling
- □ Return to the office once all safe sampling locations are completed
- □ Store samples on ice or in fridge in a secure location before preparing shipment

Figure 14: WQMA Surface Water Sampling Checklist

3.10 Sample Submission

It is the objective of the WQMA that all samples arrive at the analyzing laboratory within their holding times (Table 9). In some cases (remote regions) samples will not make it to the lab within the minimum holding time of 24 hours (nitrate). Pre-planning sampling activities and shipping options is very important to ensure samples arrive at the laboratory as soon as possible and stay cool during shipment.

Table 9: Water Sample Holding Times Recommended by ALET Lab Services

Parameter	Holding Time
Major Ions	
Alkalinity	14 days
Chloride	28 days
Sulphate	28 days
Calcium	180 days
Magnesium	180 days
Sodium	180 days
Potassium	180 days
Physical	
pH	48 hours
Conductivity	28 days
Colour	48 hours
Turbidity	48 hours
Nutrients	
Nitrate	24 hours
Total Nitrogen	28 days
Total Phosphorus	28 days
Total Organic Carbon (TOC)	28 days
Metals	
Total Metals-27 elements	6 months

All samples are transported from the field to the regional office in coolers with ice packs, making every effort to keep the samples in the dark and chilled. Samples must remain below 10°C for the laboratory to accept them for analysis. Do not allow the samples to freeze as this will compromise the sample integrity. Any samples stored at the regional office must be stored and refrigerated in a secure location (locked) until they are shipped, in coolers to the ECCC analyzing laboratory.

Before sending the samples to the ECCC lab a *Sample Submission Form* (Figure 15) must be filled out, identifying all samples in the submission and the analysis being requested. The form must be filled out accurately and it must accompany the samples in the cooler. This allows the person receiving the samples at the laboratory reception to know what they are receiving. The form should be placed in a plastic bag to protect the information from moisture during transport.

EOALRSD MONITORING and RESEARCH SAMPLE SUBMISSION FORM
FORMULAIRE DE DEMANDE D'ANALYSES DU ULAOSR

Laboratory / Laboratoire: ALET

ELEMENT Project No. - No du Projet dans ELEMENT (NNN)	Work Order No. (Internal Use) - Numéro de commande de travail (Usage interne)	Date/Time Rec'd - Date/Heure de réçu	Temperature on Arrival - Température à l'arrivée (°C)	ENVRODAT submitter ID - Identification ENVRODAT du client	Page __ of __
801					

Sampled by - Échantillonné par (F-Name, L-Name / surnom, prenom)	Project Lead - Chargé de projet (F-Name, L-Name / surnom, prenom)	Submitter- Expéditeur (F-Name, L-Name / surnom, prenom)	Submitter Email -Courriel d'expéditeur	Submitter Tel. No - No de Tel
ENVC Employee ("Melissa McComiskey")	EC Contact - Christine Garron	ENVC Submitter ("Melissa McComiskey")	ENVC email address "melissamccomiskey@gov.nl.ca"	ENVC Contact #

Lab Sample No. / No du laboratoire	# Bottles / #	Client/Field Sample No / No d'échantillon du client	Client/Field Sample No. Alias / No d'échantillon alias du Client	Analyses Requested / Analyses Demandées	ENVRODAT Station ID / No de station ENVRODAT	Collected- Collecté: Date	Collected- Collecté: Time/Heure	Collected- Collecté: Time Zone	Sample depth in metres / Sample Depth in metres	Sample Type / Type d'échantillon	Matrix / Matrice	Preservative / Preservatif	Remarks, Site Description, Sample Descriptions, Preservation Comments, etc. / Remarques, description du site, description de l'échantillon, commentaires sur le conservation etc.
	(1 - N)	(YYYY-LL0000-0000) <<auto generated>>	(Optional / Optional)	TM2/4/T2/W (X); M_Metals_TR ICP OES (X); M_TP (X); M_Hardness (X); M_Turbidity (X); M_TN (X); M_Anions_PKG (X); M_TOC (X); M_pH Auto (X); M_Anions (X); M_Alkalinity (X); M_Colour (X); M_Conductivity (X)	(LLNNLLNNNN)	(YYYY-MM-DD)	hh:mm	e.g. (EST)	(m)	NN	NN	Yes/No	(Optional / Optional)
	4	Your Sample Number	Your Site Name	x x x x x x x x x x x x x	Your Site Number	Date Sample Collected	Time sample taken	Time Zone	Sample Depth in metres	See codes below	See codes below	Yes or No	Notes

Metals Extraction/Extraction des métaux: Metals in water/Métaux dans l'eau: Dissolved/Dissous ( ) Total/Totaux ( ) ; Metals in solid/Métaux dans solide: Extractable ( ) Total/Totaux ( )

Sample Return/Retour d'échantillon: ( ) Will pick up sample after analysis complete/Collectera l'échantillon après l'analyse complétée ; (x) Samples are non-hazardous and may be disposed after analysis completed / Les échantillons sont non-dangereux et peuvent -être disposés une fois l'analyse complétée.

Figure 15: WQMA Sample Submission Form for ECCC Laboratory

The sample submission form has been partially completed with information common to all NL WQMA sample submissions. The following information is the same for all the regions:

- Project No: 801
- Project Lead: Christine Garron
- Analyses Requested
- Number of Bottles (4)

The following is an example of a completed sample submission form (Figure 16):

EOALRSD MONITORING and RESEARCH SAMPLE SUBMISSION FORM
FORMULAIRE DE DEMANDE D'ANALYSES DU ULAOSR

Laboratory / Laboratoire: ALET

LEMENT Project No. - No du Projet dans ELEMENT (NNN	Work Order No. (Internal Use) - Numéro de commande de travail (Usage interne)	Date/Time Rec'd - Date/Heure de réçu	Temperature on Arrival - Température à l'arrivée (°C)	ENVIRODAT submitter ID - Identification ENVIRODAT du client	Page 1 of 1
801					

Sampled by - Échantillonné par (F.Name, L.Name / surnom, prenom)	Project Lead - Chargé de projet (F.Name, L.Name / surnom, prenom)	Submitter- Expéditeur (F.Name, L.Name / surnom, prenom)	Submitter Email -Courriel d'expéditeur	Submitter Tel. No - No de Tel	Remarks, Site Description, Sample Descriptions, Preservation Comments, etc. / Remarques, description du site, description de l'échantillon, commentaires sur le conservation etc.
Paul Rideout	Christine Garron	Paul Rideout	paulrideout@gov.nl.ca	(709) 729 - 0351	

Lab Sample No. / No du laboratoire	# Bottles / t	Client/Field Sample No / No d'échantillon du client	Client/Field Sample No. Alias / No d'échantillon alias du Client	Analyses Requested / Analyses Demandées														ENVIRODAT Station ID / No de station ENVIRODAT	Collected- Collecté			Sample depth in stated units / Type / Type d'échantillon	Matrix / Matrice	Preservative Present? Y/N Oui/Non
				B_Metals_TR_ICP-MS	M_Metals_TR ICP-OES	M_TP	M_Hardness	M_Turbidity	M_TN	M_Anions_PKG	M_TOC	M_pH Auto	M_Anions	M_Alkalinity	M_Colour	M_Conductivity			Date	Time/Heure	Time Zone				
	(1 - N)	(YYYY-LL0000-0000) <<auto generated>>	(Optional / Optionel)	(X)	(X)	(X)	(X)	(X)	(X)	(X)	(X)	(X)	(X)	(X)	(X)	(X)	(LLNNLLNNNN)	(YYYY-MM-DD)	hh:mm	e.g. (EST)	(m)	NN	NN	Yes/No
	4	2018-AT0215-0654	KELLIGREWS RIVER AT KELLIGREWS CRESCENT	X	X	X	X	X	X	X	X	X	X	X	X	X	NF02ZM0183	2018-06-13	10:20	NDT	###	01	00	No
	4	2018-AT0215-0655	MANUALS RIVER ABOVE MANUALS ACCESS ROAD	X	X	X	X	X	X	X	X	X	X	X	X	X	NF02ZM0294	2018-06-13	10:50	NDT	###	01	00	No
	4	2018-AT0215-0656	PADDY'S POND OUTLET	X	X	X	X	X	X	X	X	X	X	X	X	X	NF02ZM0359	2018-06-13	11:20	NDT	###	01	00	No
	4	2018-AT0215-0657	WATERFORD RIVER AT BREMIGANS POND DAM	X	X	X	X	X	X	X	X	X	X	X	X	X	NF02ZM0182	2018-06-13	12:05	NDT	###	01	00	No
	4	2018-AT0215-0658	SOUTH BROOK AT HEADWATERS	X	X	X	X	X	X	X	X	X	X	X	X	X	NF02ZM0185	2018-06-13	12:40	NDT	###	01	00	No

Figure 16: Completed WQMA Sample Submission Form for ECCC Laboratory

The completed sample submission form is saved on the server with the submission date as the file name *'Sample Submission dd-mm-yyyy.xls'* at the following location.

\\Psnl.ca\mae\STJH\Shared\Env\WRMD\Agreements_Section\WQMA\Core\WQMA Sample Submission Forms

Two copies of the sample submission form are printed. One form accompanies the samples to the laboratory and the second is filed in a binder with the sampling field sheet.

Samples are sent to the analyzing laboratory via bonded courier. Samples from Newfoundland are shipped using Purolator, by air, for next day or two day delivery. Samples from Labrador are shipped using Purolator via Blizzard Express. Shipping times and service are limited and shipments should be planned ahead of time when working in remote locations. Depending upon courier service, shipping samples on Friday is not advisable due to unavailability of weekend transport. It is better to store samples awaiting shipment in a refrigerator rather than in a cooler stored in a vehicle, warehouse or hanger where it may be subject to extreme changes in temperature.

The ECCC ALET lab in Moncton currently receives all NL WQMA samples. As this laboratory is not open on Saturdays, shipping of samples should only occur Monday to Thursday, keeping in mind that the laboratory is closed holidays and weekends. Lab contact numbers and shipping address are:

Hélène Harper

ALET, 443 University Ave.

Moncton, NB E1A 6S8

Phone: 506-851-7208

Fax: 506-851-6608

Pad coolers so that bottles will not break or shift during transport, using bubble wrap or shredded paper. The samples must be shipped in coolers with adequate ice packs, making every effort to keep the temperature inside the cooler below 10°C.

Before the samples are shipped, make sure:

- The *Sample Submission Form* is filled out and placed inside a plastic bag in the cooler
- The cooler contains enough ice packs to keep samples below 10°C
- A tracking or waybill number is available for the shipment
- The sampler's contact information, phone numbers, etc are included.

Samplers should then update the sample summary spreadsheet with the samples they have completed.

Figure 17 below presents a sample handling flowchart.

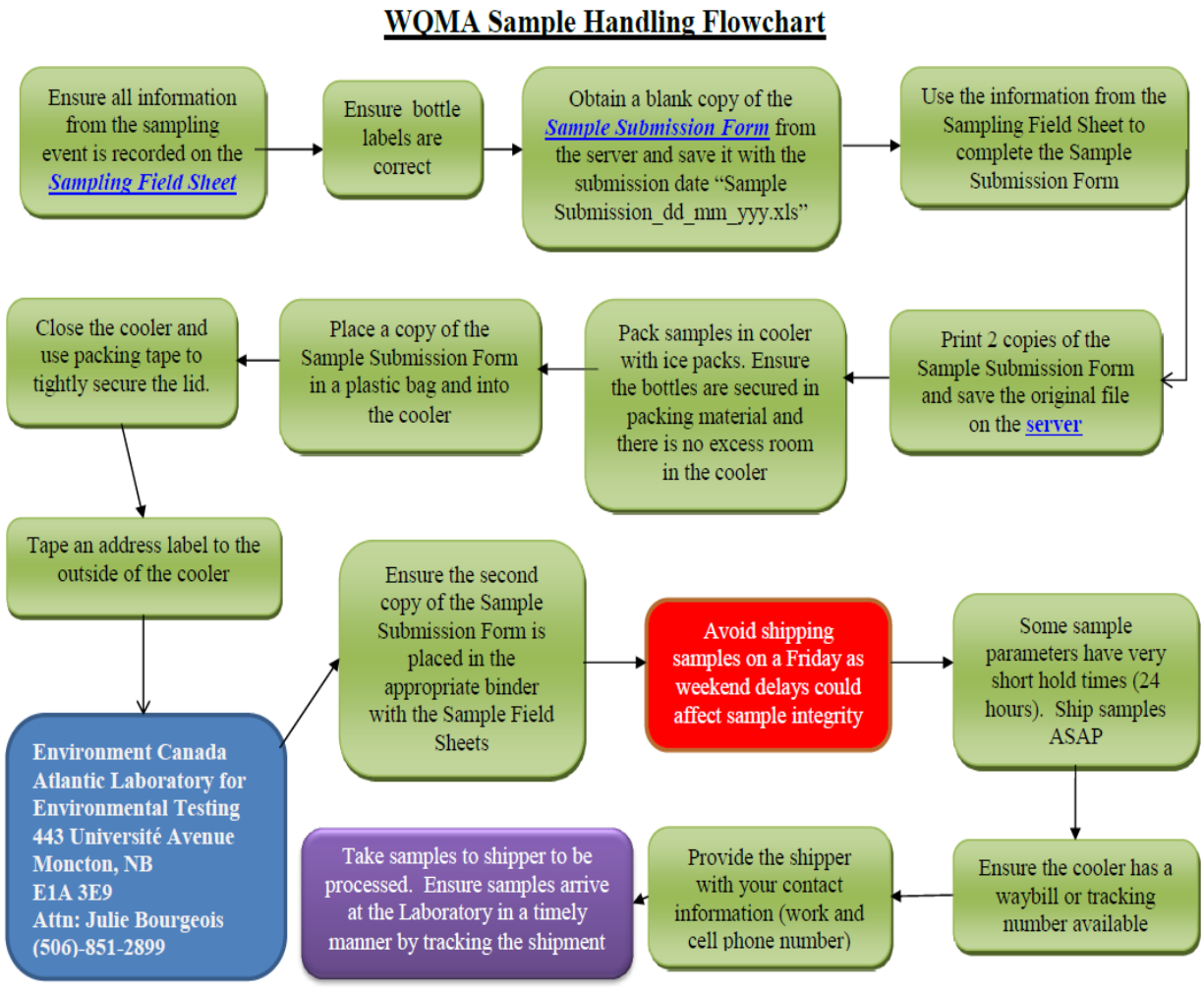


Figure 17: Sampling Handling Flowchart

3.11 Field Data Submission

The *Field Data Spreadsheet* (Figure 18) is an Excel file used to submit collected field data to ECCC. Most of the information collected and recorded on the field sheet at the time of sampling is entered into the field data spreadsheet which is then sent electronically to ECCC at the end of each sampling season. Field data spreadsheets are accessed and stored on the server at the following link:

\\Psnl.ca\mae\STJH\Shared\Env\WRMD\Agreements_Section\WQMA\Core\WQMA Field Data Spreadsheets

Currently, field data submission forms are emailed to Christine Garron and Denis Parent at ECCC.

Site Code	Naqua Sample No.	Sample Alias (Client sample #)	Measurement Date and Time (yyyy-mm-	Variable Name	National VMV Code	Unit	Measurement Value	Data Release Code	Measurement Comment	Sample Comment
NF02YJ0004	2017-AT02015-0201	Pinchgut Brook at TCH	2018-01-30T09:30	Dissolved Oxygen Saturation	110003	% Sat	94.6	PUB		10/10 cloud cover, light SE wind, snow<24hrs, Air -10, moderate flow
NF02YJ0004	2017-AT02015-0201	Pinchgut Brook at TCH	2018-01-30T09:30	Dissolved Oxygen/L'oxygène dissous	110002	mg/L	13.49	PUB		10/10 cloud cover, light SE wind, snow<24hrs, Air -10, moderate flow
NF02YJ0004	2017-AT02015-0201	Pinchgut Brook at TCH	2018-01-30T09:30	pH	109026	pH units	7.57	PUB		10/10 cloud cover, light SE wind, snow<24hrs, Air -10, moderate flow
NF02YJ0004	2017-AT02015-0201	Pinchgut Brook at TCH	2018-01-30T09:30	Specific Conductance/Conductivité spécifique	109027	uS/cm	186.7	PUB		10/10 cloud cover, light SE wind, snow<24hrs, Air -10, moderate flow
NF02YJ0004	2017-AT02015-0201	Pinchgut Brook at TCH	2018-01-30T09:30	Temperature/Température	109028	Celsius	0.63	PUB		10/10 cloud cover, light SE wind, snow<24hrs, Air -10, moderate flow
NF02YJ0004	2017-AT02015-0201	Pinchgut Brook at TCH	2018-01-30T09:30	Turbidity/Turbidité	110001	NTU	0	PUB		10/10 cloud cover, light SE wind, snow<24hrs, Air -10, moderate flow
NF02YL0012	2017-AT02015-0202	Humber Village	2018-01-30T10:40	Dissolved Oxygen Saturation	110003	% Sat	93.0	PUB		10/10 cloud cover, light NE wind, snow<24hrs, Air -11, moderate flow
NF02YL0012	2017-AT02015-0202	Humber Village	2018-01-30T10:40	Dissolved Oxygen/L'oxygène dissous	110002	mg/L	13.26	PUB		10/10 cloud cover, light NE wind, snow<24hrs, Air -11, moderate flow
NF02YL0012	2017-AT02015-0202	Humber Village	2018-01-30T10:40	pH	109026	pH units	6.87	PUB		10/10 cloud cover, light NE wind, snow<24hrs, Air -11, moderate flow
NF02YL0012	2017-AT02015-0202	Humber Village	2018-01-30T10:40	Specific Conductance/Conductivité spécifique	109027	uS/cm	42.4	PUB		10/10 cloud cover, light NE wind, snow<24hrs, Air -11, moderate flow
NF02YL0012	2017-AT02015-0202	Humber Village	2018-01-30T10:40	Temperature/Température	109028	Celsius	0.66	PUB		10/10 cloud cover, light NE wind, snow<24hrs, Air -11, moderate flow
NF02YL0012	2017-AT02015-0202	Humber Village	2018-01-30T10:40	Turbidity/Turbidité	110001	NTU	1.9	PUB		10/10 cloud cover, light NE wind, snow<24hrs, Air -11, moderate flow

Figure 18: Example of a Field Data Spreadsheet for Submission to ECCC

4 Chemicals Management Plan (CMP)

In 2006, ECCC launched the Chemicals Management Plan (CMP) with the focus of protecting human health and the environment by assessing approximately 500 chemical substances used in Canada and taking action on chemicals found to be harmful. WRMD has participated in the CMP program since 2009 by collecting water and sediment samples from Waterford River at Kilbride.

ECCC develops a Chemicals Management Plan sampling schedule each fiscal year and sends it to WRMD. Any changes in the sampling frequency or the analysis required are also included. Targeted chemicals and contract labs may change year-to-year.

Currently under the CMP, grab samples are collected from the Waterford River downstream of Bowring Park in St. John's four times per fiscal year: April, July, October and January. These samples are analyzed for triclosan (antibacterial), bisphenol A (BPA, found in plastics and resins), DY3 (an Azo disperse dye used in textile manufacturing), perfluorooctane sulfonate (PFOS, most often used as a water, soil and grease repellent) and NP-NPE (nonylphenol and its ethoxylates, commonly used as a surfactant or defoamer).

The ECCC contact for CMP is Christine Garron. Sample bottles (three for each quarterly sample) and sample submission forms are provided by ECCC. Copies of blank forms are available at:

\\Psnl.ca\mae\STJH\Shared\Env\WRMD\Agreements_Section\WQMA\CMP\Forms

- Bottles must be labelled before samples are collected.
- Disposable nitrile gloves must be worn when sampling.
- Prior to filling, all bottles must be rinsed twice with water from the location to be sampled.
- To collect the sample, invert the rinsed bottle and plunge it to a depth of 30 cm, taking care to minimize the disturbance in the water column. Allow the bottle to fill by pointing the mouth towards the current. Repeat for the other two samples.

The sample to be analyzed for PFOS is collected in a 1L wide-mouth plastic bottle and the sample to be analyzed for NP-NPE is collected in a 1L amber glass bottle. These two bottles are sent to AXYS Analytical in Sidney, British Columbia:

AXYS Analytical Services, 2045 Mills Road West, Sidney, British Columbia, Canada, V8L 5X2

The third sample, to be analyzed for triclosan, BPA and DY3 is collected in a 1L amber glass bottle and sent to ECCC in Burlington, Ontario:

ECCC Water Quality Monitoring and Surveillance Office, 867 Lakeshore Road, Burlington, Ontario, L7R 4A6

As with all samples collected under the WQMA, field notes must be recorded when a sample is collected. The information is recorded on the Chemicals Management Plan Submission Sheet which must accompany all samples that are sent to ECCC in Burlington. A separate Chain of Custody form is sent with the samples that are shipped to AXYS Analytical.

5 Canadian Aquatic Biomonitoring Network (CABIN)

The Canadian Aquatic Biomonitoring Network (CABIN) is the national biomonitoring program developed by ECCC. This program has a standardized sampling protocol and uses the recommended assessment approach, called the Reference Condition Approach (RCA), for assessing aquatic ecosystem conditions.

Since 2008, WRMD has conducted sampling of benthic macroinvertebrates at stream sites across the province in accordance with the sampling and processing protocols established by CABIN. These invertebrates are collected and identified to provide valuable biological water quality information on streams across Newfoundland and Labrador. The biological data is complementary to the physical and chemical data collected at the core ambient surface water quality sites.

To perform CABIN sampling you must receive the in-class and practical field training provided by a qualified ECCC trainer. Please refer to the *Canadian Aquatic Biomonitoring Network Field Manual for Wadeable Streams (2012)* (Figure 19) for specific sampling protocols.

Some of the protocols are summarized here so that the information is readily available should WRMD staff require information on the methodology.

5.1 Protocol for Sampling Invertebrates in Streams

Sampling is conducted during late summer and early fall, typically late August to late October, depending on weather and flow conditions. A team of 2-3 CABIN trained samplers is required.

Rivers should be sampled at or near their lowest flow, when possible, so that the sampled area is the portion of the river which is always underwater and the primary habitat of the invertebrates living in the river.

Sampling must be conducted in a section of the river which contains at least a portion of a riffle environment. This ensures that sampled habitats are as consistent as possible at each location, and that the community assemblages are comparable.

A CABIN sample consists of several components:

1. Site description/reach characteristics
2. Chemical/physical water data sample
3. Biological macroinvertebrate sample
4. Channel Measurements
5. Substrate Measurements

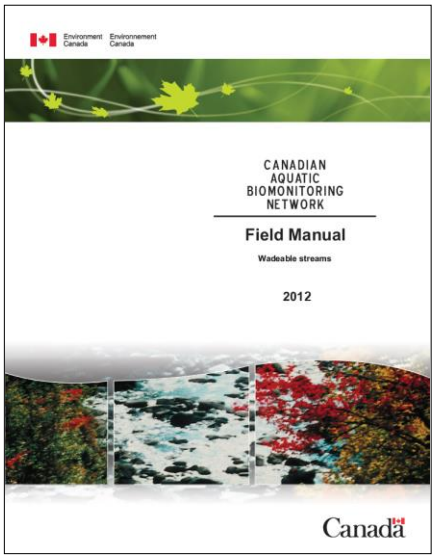


Figure 19: CABIN Field Protocols Manual (2012)

The following is a brief summary of the processes involved in collecting a CABIN benthic macroinvertebrate sample. For more information and further details, please refer to the *Canadian Aquatic Biomonitoring Network Field Manual for Wadeable Streams (2012)* (Figure 19).

1. **DO NOT GO IN THE RIVER** until you are ready to take a sample. This interferes with the benthic macroinvertebrates and the water quality sample.
2. Inspect the site for safety issues or concerns, and determine the area of the river in which each sampling component will be completed and in what order.
3. Fill in field sheets with site descriptive data (latitude/longitude/access description/local landmarks, reach characteristics, etc) and take photos of river area (as per field sheets).

Photos
☐ Field Sheet ☐ Upstream ☐ Downstream ☐ Across Site ☐ Aerial View
☐ Substrate (exposed) ☐ Substrate (aquatic) ☐ Other _____

4. **Chemical/Physical Water Quality Sample**: If water quality data is to be collected first, it should be collected downstream of the intended kick area to avoid disturbance to the invertebrates. If water quality samples are taken after the invertebrate sampling, they should be taken upstream of all activity in the river to prevent contamination by substrate disturbance. Physical parameters should be measured with a multi-parameter sonde. Chemical samples are taken in bottles provided by the analysing lab, and must be clearly marked with sample site code, name and sampling time, and kept cold until they are shipped to the laboratory. Record all information on the field sheets.
5. **Benthic Macroinvertebrates Sample**: One person acts as the timer, counting down 3 minutes for the kick net sampler, stopping the clock when the kicker needs a break or to reposition themselves, and starting the clock again when kicking continues. The timer should also watch the kicker to ensure they do not encounter any safety issues and warn them of any obstacles in the river. The kick net sampler should only enter the river, net first, when the timer begins counting down. The kicker will walk through the riffle area of the river in a zigzag pattern against the flow, from downstream to upstream, keeping the net downstream of their feet as they twist and kick the substrate. This releases invertebrates from the riverbed, allowing the flow to carry them into the net. When large rocks or other debris are encountered, the kicker may scrape the side of the object with their gloves, thus releasing any invertebrates that may be attached to the object. Crossing the width of the river in several transects is ideal, but in larger rivers, try to get at least one transect across the river, from bank to bank (Figure 20).

Figure 20: WRMD staff CABIN sampling in NL

6. **Sample Preservation**: The contents of the net/cup are transferred to the sample jar. If large objects or sand particles are present, empty the contents of the net into a bucket. Wash the net several times with spray bottles and transfer all contents to the bucket. The bucket contents is then decanted into the sieve. Remove all 'green' or fresh leaves and twigs after washing them thoroughly as these can interfere with preservative. Transfer all contents from sieve into labelled wide mouth plastic jars. Samples are preserved with 10% buffered formalin, in a 1:3 ratio (formalin:sample) to ensure adequate tissue preservation. Label all sample jars. Seal the jars in a plastic ziplock bag, with only jars from the same sample in each bag. This ensures that the sample is recoverable and still identifiable should the jar leak or break during transport to the taxonomy laboratory (Figure 21).

Figure 21: Processing of CABIN kicknet samples

7. **Channel Measurements:** Record measurements of the channel across the kick area, as per the Field Sheets. Take velocity and depth measurements at regular intervals across this transect using a flow meter, as per the field sheets (Figure 22).

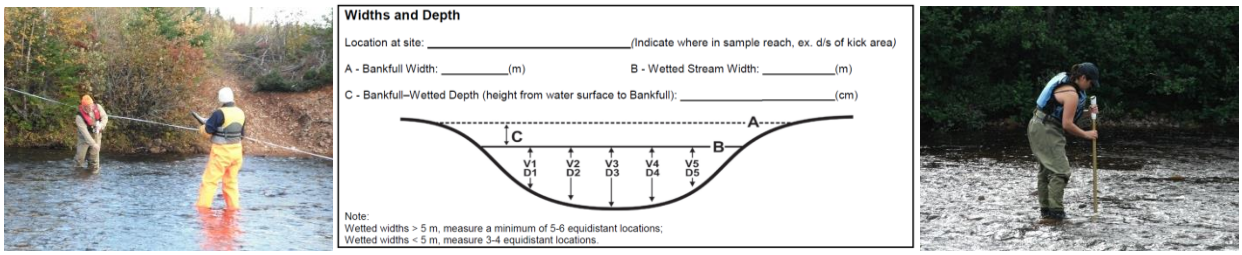


Figure 22: CABIN Sampling Channel and Flow Measurements

8. **Slope**: Slope measurements are meant to reflect a 'rough' estimate of the gradient of the surface of the river. This is calculated using a hand level, measuring tape and survey pole. When conditions in the river necessitate (eg. obstacles, high flow, depth, etc), slope measurements can be adapted for safety reasons, as long as an estimate of the general vertical change (rise) and horizontal change (run) are calculated. This can be done by taking either one or two measurements within the sampling reach, as in Figure 23 below. The survey pole and the feet of the person using the eye level should be as close to the surface of the water as possible as we are measuring the slope of the water's surface, not the substrate. The level user must ensure the hand level is level (bubble is balanced) then determine an approximate value (on the survey pole) at which their eye is level. Instruct the person stabilizing the survey pole to move their finger up or down the pole measurements until it is at a value which appears 'level' to or directly across from your eye. Measure the distance between the survey pole and the leveler's eye to determine the 'run' distance. If two portions of the river are measured (upstream and

downstream) the vertical distance (rise) is the difference in the eye height measurements. If only one portion (upstream or downstream, or a small river) is surveyed, measure the eye height of the person using the eye level and compare it to the height measured on the survey pole. This will give you the vertical (rise) distance for the single survey point (Figure 23).

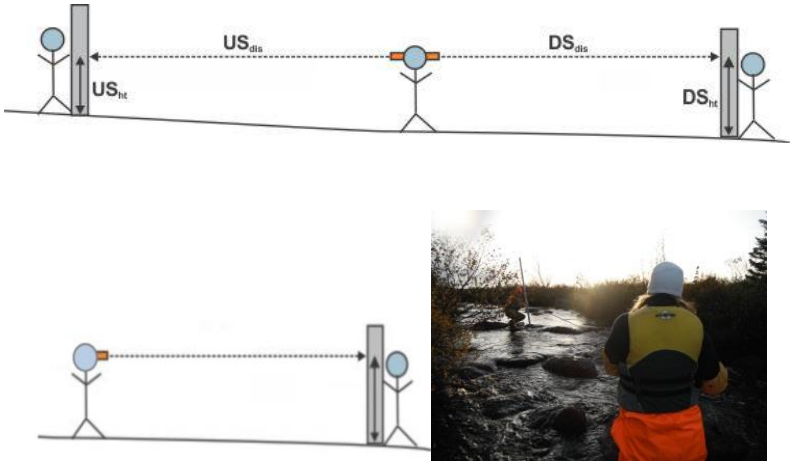
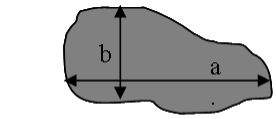


Figure 23: Calculating Slope During CABIN Sampling

9. **Rock Measurements**: Randomly select 100 rocks throughout the sampled area. This task can be shared or split amongst samplers. Measure the intermediate axis of the rock as in the diagram below. Ten of the rocks will also require an estimate of 'embeddedness' or how surrounded the rock is by others or sediment, given as a percentage (see figure 24 below).



The intermediate axis of a substrate (b).

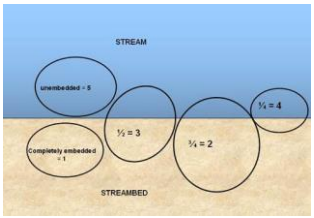


Figure 24: CABIN Sampling Substrate Measurements

10. **Review of Field Sheets**: Review all components of the field sheets, including photos, to ensure that all measurements have been taken and the sample is complete. Incomplete datasets may make the sample unusable.
11. **Final Check**: Scan area to ensure that no equipment has been left behind and the area was disturbed as little as possible during sampling.

5.2 Protocol for Invertebrate Sample Processing

Due to the high level of expertise and time required to accurately process samples, WRMD contracts a taxonomic laboratory for invertebrate processing.

Under the CABIN program, taxonomy laboratories should provide the following services:

1. Receive samples and maintain chain of custody
2. Transfer samples from field preservative to 70% ethanol upon receipt if required
3. Subsample using a Marchant box (Marchant 1989) to a minimum 300
4. Identify specimens to the lowest taxonomic level according to the specified taxonomic effort
5. Implement QC protocols for sample sorting and identification
6. Create a reference collection if required
7. Enter taxonomic data into the CABIN database if required
8. Provide a voucher specimen to the National CABIN Laboratory in a timely fashion, if required
9. Return identified samples, reference collection and debris to the project authority

For more information, please refer to the *CABIN Laboratory Methods Manual: Processing, Taxonomy, and Quality Control of Benthic Macroinvertebrate Samples (April 2012).*

In addition, taxonomic laboratories contracted to perform identifications for WRMD must meet the following criteria to process CABIN samples:

1. Taxonomist must have certification from the Society for Freshwater Science, previously known as the North American Benthological Society.
2. Taxonomist must have CABIN certification and process the samples using the processes and procedures approved by CABIN, including entering benthic macroinvertebrates data into the CABIN database on behalf of WRMD.
3. The taxonomic laboratory must be able to accept the benthic macroinvertebrate samples in 10% formalin and perform the necessary transfer to ethanol for storage.

The National CABIN Laboratory operated by Environment Canada provides QA/QC services for all CABIN samples. The laboratory will perform sorting efficiency QA/QC on all samples submitted to the database (each sample must have $\geq$ 95% sorting efficiency). The laboratory also performs QA/QC of submitted identifications to ensure samples are being accurately identified. These processes ensure that all samples submitted to the CABIN Database have been stringently QA/QCed and the data is of the highest quality.

6 Intensive Surveys

Intensive surveys are conducted jointly by WRMD and ECCC when detailed information on water quality in a particular area is required. In addition to water quality samples, intensive surveys may include sampling and analysis of sediment, biota (fish) and bacteria. Possible impacts on the water quality in the area of interest are also analyzed to provide a complete picture of what is going on in an ecosystem.

Intensive surveys require significant resources in terms of manpower and funding. For this reason, they are conducted on an as needed basis. Recent intensive surveys include Bonne Bay Big Pond and Bonne Bay Little Pond in 2009 and the Churchill River near Happy Valley-Goose Bay in 2008.

For more information on sampling protocols used for the collection of sediment samples and biological samples of fish and bacteria, please see ***Appendix E***:

7 Blue Green Algae (Cyanobacteria)

Though sampling of Blue Green Algae (BGA) is not a part of the WQMA program, staff are often called upon to sample for BGA when the need arises.

Cyanobacteria, commonly referred to as blue-green algae (BGA), are microscopic, plant-like bacteria that occur naturally in mainly aquatic environments throughout the world. They are not normally visible in water but populations can increase rapidly to form a large mass or scum called a bloom, when conditions are favourable. Blooms usually occur in late spring through early fall, when surface waters are the warmest.

Many species of BGA can produce toxins that are potentially harmful to humans and animals. These include neurotoxins, hepatotoxins, cytotoxins and endotoxins. The most common toxin encountered and monitored in Canadian waters is called microcystin, a hepatotoxin. Health Canada has established guidelines for the cyanobacterial toxin “microcystin-LR”. The CCME sets the maximum acceptable concentration for total microcystins in drinking water at 1.5µg/L and in recreational waters at 20µg/L.

BGA specific sampling is usually conducted when a suspected bloom has been noted or reported to WRMD. If, upon visual inspection, a bloom is believed to be occurring, grab samples are collected to analyse for total microcystins, bloom density (cell counts) and identification to genus.

Arrangements, including the establishment of a Purchase Order are made with an accredited environmental laboratory every spring to analyse for microcystin. The bottles used to collect samples may vary year to year as they are dependent on what laboratory is contracted for analysis.

For cell counts and identification, a 500 ml clear, wide-mouth plastic bottle is typically used to collect a grab sample. Lugol’s iodine is added to the sample to preserve and stain the collected material and help the analyst differentiate between diatoms, green algae and blue-green algae. The Lugol’s iodine is added, drop by drop, until the sample is ‘the colour of weak tea’.

For total microcystins, a grab sample is collected in a small amber glass bottle or vial.

In some cases a 250 ml plastic bottle may be used to collect a grab sample to be analysed for nutrients.

The samples are appropriately labelled (sampler name, sample location, time and date) and kept cool and dark (refrigerated) before shipping to the designated lab(s) as soon as possible.

BGA Sampling Process

1. Notification received or BGA observed

- Are photos available of the suspected bloom and is a site visit warranted?
- Can the person who observed the suspected bloom determine from the 'Weird Stuff in Water' website whether or not what they observed was in fact BGA?

  (http://www.mae.gov.nl.ca/waterres/outreach/water_weird.html)
- Upon visiting the site, is a BGA bloom occurring? Take photos. If a bloom is suspected, collect samples.

2. First Sampling Round

- Bottles are labelled before samples are collected.
- Disposable plastic gloves should be worn when sampling.
- Field values are obtained with a multi-parameter sonde and recorded.

BGA (500 ml plastic bottle)

- A grab sample is collected from an area where BGA is evident. No rinsing is required.
- Lugol's Solution is added drop wise to the sample until the water resembles 'weak tea'.

Microcystin (amber glass bottle or vial)

- A grab sample is obtained from the same area. No rinsing is required.

Nutrients (250 ml plastic bottle)

- If analyses for nutrients is required, the bottle is rinsed twice and a grab sample is collected from the same area.

3. After Sampling

- Ship samples to the contract lab(s) overnight, via courier, in appropriately sealed coolers and with sufficient ice to allow samples to remain below 10°C.
- Send an Email to the person who reported the suspected bloom and to the affected municipality advising that BGA may be blooming and samples have been taken.

4. After Results are Received

- If lab results indicate that BGA is found in large enough quantities to continue to suspect a bloom, follow-up sampling for microcystin is advised.
- Advise public and & municipality regarding results and whether or not more sampling will occur.

All paperwork associated with BGA complaints and/or sampling, including laboratory submission forms and reported results must be saved in the appropriate annual folder at:

\\Psnl.ca\mae\STJH\Shared\Env\WRMD\Agreements_Section\WQMA\BGA

8 Data Management

8.1 NAQUA Database

All field and laboratory water quality data collected under the WQMA program is stored at ECCC in the NAQUA database. The data undergoes quality analysis and quality control checks through ECCC to ensure its validity. As the database is not currently available for easy access via the web, ECCC provides an updated version of NAQUA to WRMD twice per year, usually in March and September. Data can then be pulled by station for validation and analysis.

8.2 Envirotrend

Envirotrend is an application developed by WRMD for use by staff to export and statistically analyze water quality data collected under the WQMA. The Envirotrend application can be used by staff to obtain water quality data, basic statistical measurements, graphical analysis as well as trend analysis of water quality parameters at WQMA stations. Further information on Envirotrend can be found at: \\Psnl.ca\mae\STJH\Shared\Env\WRMD\Agreements_Section\WQMA\EnviroTrend

8.3 Work Order

Upon receipt of a WQMA sample shipment at ALET, the samples in the cooler are compared to the Sample Submission Form to ensure everything is in order. After the samples are entered into the Laboratory tracking system, a *Work Order* is generated, summarizing the samples received and the analyses requested. The work order is e-mailed to the person named on the sample submission form.

When a work order is received, it should be reviewed to ensure that the listed contents are accurate based on what the sampler sent to the laboratory. Any errors can be addressed directly with ALET. If an error is not reported promptly, it could lead to incorrect analyses or mislabeled data in the system.

Once work orders are verified, they must be filed in the same location as the corresponding sample submission forms: M:\STJH\Shared\Env\WRMD\WQMA\WQMA_Sample_Submission_Forms. This ensures that all information regarding WQMA sample submissions can be easily accessed.

Section 9.1 contains additional information regarding data verification.

8.4 Report of Analysis

After samples have been analyzed, ALET will e-mail the program lead and the sample submitter a *Report of Analysis* containing the water quality results. The batch number on a report of analysis matches the corresponding work order. The report of analysis should be checked against the work orders, field notes and the sample submission form to ensure accuracy. Errors or discrepancies can be addressed directly with the analyzing lab.

Another way to ensure that the analysis is accurate is to compare the values for pH, specific conductance, and turbidity in the Report of Analysis with the values collected in-situ with the multi-

parameter sonde at the time of sampling. If significant discrepancies are seen between field values and laboratory values, the Report of Analysis should be flagged for further investigation and the laboratory should be informed.

WQMA reports of analyses are archived at:

\\Psnl.ca\mae\STJH\Shared\Env\WRMD\Agreements_Section\WQMA\Core\Data\Report of Analysis

It is advisable for each sampler to save a second copy of these reports in their working files.

9 Quality Assurance and Quality Control

Implementation of Quality Assurance/Quality Control (QA/QC) protocols is essential to ensure data derived from the WQMA program is accurate and representative of the state of the Province's water resources:

- Quality Assurance is a set of processes and procedures which are followed in an effort to **prevent** errors in, or losses of data.
- Quality Control is a set of processes and procedures which are followed in an effort to **verify** that there are no errors in, or losses of data.

QA/QC of data collected under the WQMA relies on a feedback mechanism between WRMD and ECCC to identify and correct erroneous data or metadata as ECCC is the custodian of the main NAQUA database where WQMA data is stored.

The QA/QC protocols require verification and validation of data and metadata by WRMD.

9.1 Data Verification

Verification is the process of ensuring that each sample collected and its associated information appear in the NAQUA database correctly. Errors can easily occur while transferring data from field sheets to sample submission forms and field data spreadsheets, as well as when sample data is input into the sample tracking system at ECCC laboratories. Verifying that information in NAQUA is accurate is the responsibility of the person who collected the samples as only they would have access to all the correct information.

1. Ensure that information recorded on the field sheet is entered accurately into the sample submission form.
2. Ensure that information recorded on the field data submission spreadsheet is entered accurately before sending it to ECCC.
3. Compare sample metadata on sample submission form to work order received from the ECCC laboratory. Ensure samples are accounted for accurately and errors are reported to the laboratory for correction in NAQUA. Copies of all such correspondence must also be sent to the program lead.
4. Once the work order has been verified as accurate, it should be filed on the shared drive with its corresponding sample submission form.

9.2 Data Validation

All water quality data within NAQUA must be validated to maximize accuracy. No system is perfect, and there is potential for error at many steps in the process between a sample being collected and data being downloaded for analysis.

WQMA data must be validated at least once every sampling year.

Region specific data from NAQUA containing laboratory and field data will be provided to each WQMA sampler, in the form of an Excel spreadsheet, twice per year.

The following are the steps in the data validation process:

1. Confirm that the number of samples collected each year at each station matches the data provided in the dataset.
2. Ensure that in-situ data associated with each sample is accurate by comparing database values to field sheets and field data spreadsheets. If there is a discrepancy, highlight the cell containing the incorrect value in yellow and insert a comment (right click on cell and click 'Insert Comment') indicating the correct value.
3. In order to validate laboratory data (whether or not the data 'makes sense' for a particular station), some knowledge of the water quality at each station is required. A separate spreadsheet ('Stat Measures') highlighting statistical analysis of historical data from each station can be used to help determine whether or not a reported value is reasonable. If a reported value is suspect, the cell containing the suspect value is highlighted in yellow and a comment added.
4. Once all the data in the spreadsheet has been validated and errors noted, email the file back to the Envirotrend administrator.
5. The administrator will flag all suspect values and enter them into a CSV file format which can be read directly by the ECCC data validation tool, "Egrapher". All corrections are sent to ECCC for incorporation into the NAQUA database.

Frequently found data errors:

- Erroneous inputs: eg. 345.642.5223.5533
- Values that don't make sense. eg. pH=18
- DO % in the DO mg/L field and vice versa
- Incorrect units (eg. values typically range 0.3-0.5, but one value showing up as 0.0005 would be a suspected unit issue).