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Protocol for Centralised Drinking Water Systems in First Nations Communities

Standards for Design, Construction, Operation, Maintenance, and Monitoring of Centralised Drinking Water Systems

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This document will evolve based on feedback from users and other stakeholders. Comments on the document and questions on departmental policy on which this document is based may be forwarded to normes-standards@ainc-inac.gc.ca.

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Table of Contents

		Page
1.0	Introduction	1
2.0	Application	2
3.0	Multi-barrier Approach to Water Protection	4
3.1	Source Protection Requirements	4
3.2	Treatment Requirements	4
3.2.1	Minimum Treatment Requirements for Groundwater Sources	5
3.2.2	Surface Water and Groundwater under Direct Influence	6
3.2.3	Concentration - Time Requirements	6
3.3	Distribution System Requirements	7
3.3.1	Piped Water Systems	7
3.3.2	Trucked Water Systems	7
3.4	Monitoring Requirements	8
3.4.1	Monitoring of Small Community Systems	11
3.4.1.1	Groundwater	11
3.4.1.2	Surface Water or GUDI	12
3.4.2	Monitoring of Community Systems	12
3.4.2.1	Groundwater	12
3.4.2.2	Surface Water or GUDI	13
3.4.3	Monitoring of Trucked Water Systems	13
3.4.4	Procedure for Addressing DWAs	14
3.4.5	Reporting and Corrective Action for Adverse Results	15
3.5	Residuals Management Requirements	15
4.0	System Design	16
4.1	Treatment Plants	16
4.2	Distribution Systems	16
4.3	Trucked Water Systems	17
4.4	Code Requirements	17
4.5	Commissioning Plans	17
4.6	As-built documents	18
4.7	Operator's Manual	18
5.0	Quality Assurance	19
5.1	Maintenance Management Plans	19
5.2	Asset Condition Reporting System (ACRS) Inspections	19
5.3	Annual Performance Inspections	19
5.4	Documents Management and Record Keeping	20
5.4.1	Documents Management	20
5.4.2	Record Keeping	21
5.5	Compliance Assurance	21
6.0	Operator Certification Requirements	23
7.0	Emergency Response Plan Requirements	24

8.0 Public Reporting 25

Table of Appendices

		Page
Appendix A	Stakeholders Roles and Responsibilities	26
Appendix B	Summary of Guidelines for Canadian Drinking Water Quality	28
Appendix C	Definition of Groundwater under Direct Influence of Surface Water	29
Appendix D	Guidance on Concentration x Time (CT) Concept	30
Appendix E	Turbidity Requirements	31
Appendix F	Guidance on Provincial Operator Certification Requirements	33
Appendix G	Drinking Water Definitions	42
Appendix H	Summary of Material Changes between this Version and the Previous Version of this Document	47

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1.0 Introduction

The *Protocol for Centralised Drinking Water Systems in First Nations Communities* (Centralised Systems Protocol) contains standards for the design, construction, operation, maintenance, and monitoring of centralised drinking water systems in First Nations communities. A centralised system is a piped system with a centralised treatment plant.

This document is intended for use by First Nations staff responsible for drinking water systems. It is also intended for use by Indian and Northern Affairs Canada (INAC) staff and all others involved in providing advice or assistance to First Nations in the design, construction, operation, maintenance, and monitoring of drinking water systems in their communities.

As outlined in this Protocol, First Nations responsibilities as they relate to ensuring that residents are provided with clean, safe, and reliable drinking water are divided between two main groups on reserve: a) band councils, and b) water system operators:

a. Band Councils (chiefs, councillors, utility directors, infrastructure managers, and public works supervisors) are responsible for ensuring that drinking water systems are designed, constructed, and upgraded in accordance with this Protocol. They are also responsible for organising training to ensure that their system's primary and secondary operators are trained and certified to the classification level of the system.
b. Water system operators are responsible for operating and maintaining drinking water systems as well as for implementing effective sampling and testing to continuously monitor drinking water quality. They must also keep complete records to fully document maintenance activities, monitoring, and corrective action.

More information on stakeholders' responsibilities as they relate to the operation of water systems on reserve is outlined in Appendix A.

This protocol was developed with advice provided by First Nations representatives, regional and headquarters staff of Indian & Northern Affairs Canada, the First Nations and Inuit Health Branch (FNIHB) of Health Canada, and Environment Canada. This Protocol first came into effect March 21, 2006 under the name *Protocol for Safe Drinking Water in First Nations Communities*. This latest version reflects feedback from stakeholders including First Nations technical experts. The Protocol is a living document. In the future, it will continue to evolve and be amended as appropriate to reflect feedback provided from users of the document and changes in policy or regulation. The latest version of the Protocol is available on INAC's website:
http:www.ainc-inac.gc.ca/enr/wtr/pubs/sdw/sdw-eng.pdf

2.0 Application

Any centralised water system that produces drinking water destined for human consumption, is funded in whole or in part by INAC, and serves five or more household service connections, or that serves a public facility must comply with the requirements of this protocol. Specifically, this protocol and its requirements apply to the following types and sizes of drinking water systems:

- Small Community Systems - Small Community Systems are drinking water systems that serve between five and 100 service connections, or a public facility/building, or both.
- Community Systems - Community Systems are drinking water systems that serve more than 100 service connections, or a public facility/building, or both.
- Public Facilities – A Public Facility is a non-commercial, INAC-funded facility that is owned or operated by a First Nation band and serves a public function (such as a school, band office, or community centre).
- Trucked Systems – Trucked Systems are drinking water systems that use tank trucks to deliver potable water to consumers.

First Nations are responsible for the design, construction, operation, maintenance, and monitoring of their drinking water systems in accordance with industry best practices and INAC policies and Protocols. INAC staff will provide advice to First Nations regarding complying with INAC requirements.

Operators of First Nations water systems that are covered by this Protocol need to meet the more stringent of either:

- This Protocol's requirements; or
- Provincial requirements (standards, regulations, codes, or guidelines).

In the case where a particular element in a provincial standard, regulation, code, or guideline (ex: turbidity) is more stringent than the same element in the Protocol, then that higher objective should be adhered to for that element; the rest of the Protocol still applies; it is not possible for a First Nation to opt out of the Protocol.

This Protocol does not apply to drinking water systems that serve four or fewer service connections. Drinking water systems with four or fewer household service connections are covered in the *Protocol for Decentralised (On-Site) Water and Wastewater Systems in First Nations Communities*. More information on the Decentralised Systems Protocol is available at the INAC web site (http://www.ainc-inac.gc.ca/enr/wtr/index-eng.asp).

This Protocol does not apply to water supplied to a reserve via a municipal type agreement (MTA) unless otherwise stipulated in contracts or the terms and conditions of funding agreements between a First Nation and INAC related to the provision of the service.

This Protocol does not apply to facilities funded or operated by other government departments.

3.0 Multi-barrier Approach to Water Protection

This protocol is based on and organised according to the multiple barrier approach to drinking water protection, a strategy intended to prevent the presence of water-borne contaminants in drinking water by ensuring effective safeguards are in place at each stage of a drinking water system. The four main components of the multiple barrier approach (MBA) include:

- Protection of raw water sources;
- Effective treatment of drinking water;
- Maintenance of a clean distribution system; and
- Comprehensive testing to confirm water quality.

3.1 Source Protection Requirements

Source protection, the prevention of contaminants from entering water sources, is the first layer of defence in a multi-barrier approach to water protection. FN authorities responsible for drinking water systems covered by this Protocol shall participate where possible with local stakeholders (such as conservation authorities and neighbouring municipalities) in the development and implementation of a local watershed and aquifer protection plan. First Nations communities shall also develop and implement community-specific (on-reserve) source protection plans to prevent, minimise, or control potential sources of contaminants in or near the community's raw water sources.

3.2 Minimum Treatment Requirements

At the point where it is delivered to a user for human consumption, drinking water must meet the health-based water quality criteria set out in the latest edition of Health Canada's Guidelines for Canadian Drinking Water Quality (GCDWQ). A summary table entitled "Summary of Guidelines for Canadian Drinking Water Quality" is updated periodically and published by Health Canada. The current web link to Health Canada's Summary of Guidelines for Canadian Drinking Water Quality is listed in Appendix B.

The minimum level of treatment required to make drinking water microbiologically safe depends on the quality and type of water source as well as the size and type of the population served as defined in Section 2.0. The minimum level of treatment for drinking water is based on the type of raw water source:

- Groundwater source – minimum level of treatment is disinfection.
- Surface water source – minimum level of treatment is filtration combined with disinfection.

This Protocol recognises that primary disinfection and secondary disinfection are separate treatment processes designed to provide different outcomes:

- Primary disinfection is a contiguous part of the treatment process and is intended to kill or inactivate (i.e.: render non-infectious) pathogenic microorganisms that may be present in the source water before secondary disinfection (if installed) takes place.
- Secondary disinfection (distribution system disinfection) is intended to protect the distribution system from re-contamination. It is the maintenance of a residual of disinfectant throughout the distribution system to prevent re-growth of microorganisms in the system as well as to kill or inactivate microorganisms that may enter the distribution system. Distribution system means a system of water mains, reservoirs, pumping stations, valves, and other appurtenances used to supply water for human consumption. Chlorine is the most commonly used water disinfectant for secondary (residual) disinfection.

Any drinking water system that provides disinfected water for human consumption must be equipped with standby chlorination equipment to ensure adequate disinfection in case of emergency, particularly if the main disinfection equipment ceases to function.

Although disinfecting agents other than chlorine are available, each has shortcomings when applied to a small-community water supply. Chlorine dioxide or chloramines may be used as disinfectants where appropriate. Proposals for disinfecting agents other than chlorine (such as when disinfection by-products are a concern) must be approved by the reviewing authority prior to preparation of final plans and specifications.

All chemical additives used for water treatment must be certified to NSF/ANSI Standard 60: *Drinking Water Treatment Chemicals – Health Effects*. A copy of this standard may be obtained from NSF International (www.nsf.org).

3.2.1 Minimum Treatment Requirements for Groundwater Sources

Groundwater is water located in subsurface soil aquifers where the overburden is sufficient to act as an effective filter to remove contaminants. For a groundwater source that supplies drinking water destined for human consumption to a distribution system serving five or more households or one or more public facilities, the minimum required treatment design is:

- Primary disinfection for inactivation of microbes and secondary disinfection with maintenance of a chlorine residual of 0.2 mg/L free chlorine (or 1.0 mg/L combined chlorine for disinfection processes that employ chloramination) throughout the distribution system [and at all times

provide at least 2-log (99 percent) removal or inactivation of *Giardia lamblia* cysts, *Cryptosporidium parvum* cysts, and viruses before water enters the distribution system].

Plants designed for disinfecting groundwater using a treatment process other than chlorine or chlorine dioxide disinfection (i.e. ultraviolet light, ozonation, membranes) must provide a treatment that achieves at least 4-log (99.99 percent) removal or inactivation of viruses. If a plant does not employ chlorination in its primary disinfection process, then it shall employ chlorination in a secondary disinfection step to provide a residual disinfectant after treatment.

3.2.2 Minimum Treatment Requirements for Surface Water and Groundwater under Direct Influence

Surface water, which is susceptible to microbiological contamination through various pathways, requires more treatment than groundwater. For a surface water source, or a groundwater source under direct influence of surface water (GUDI), that supplies drinking water for human consumption to a distribution system serving five or more households or one or more public facilities, the minimum required treatment design is:

- Filtration; and
- Primary disinfection for inactivation of microbes and secondary disinfection with maintenance of a chlorine residual of 0.2 mg/L free chlorine (or 1.0 mg/L combined chlorine for disinfection processes that employ chloramination) throughout the distribution system [and at all times provide 2-log (99 percent) removal or inactivation of *Giardia lamblia*, 3-log (99.9 percent) removal or inactivation of *Cryptosporidium parvum* cysts, and at 4-log (99.99 percent) removal or inactivation of viruses before water enters the distribution system].

At least 0.5-log removal or inactivation of Giardia cysts, and 2-log removal or inactivation of viruses, must be provided through the disinfection portion of the overall water treatment process.

A definition of groundwater that is under direct influence of surface water may be found in Appendix C. It is the responsibility of Chief and Council to obtain a determination of whether or not a groundwater supply is under the direct influence of surface water. Obtaining this determination may require the services of a licensed hydrogeologist.

3.2.3 Concentration - Time (CT) Requirements

The water system designer shall ensure that an appropriate contact time between drinking water and disinfectant(s) is provided to the water before it

reaches the first consumer on the distribution system during periods of peak flow (the period of contact time required calculated at peak flow rates is based on the type, temperature, and quality of source water). The water system operator, in turn, shall ensure that adequate disinfectant is added, as per water system design requirements, such that an adequate disinfectant residual is maintained in the system.

Design references for calculating required dose concentration and contact time for small community systems and community systems can be found in Appendix D. In addition, concentration-time (CT) tables for the inactivation of protozoan cysts and viruses by chlorine, chlorine dioxide, and chloramines at various temperatures and pH values may be found listed in the document entitled: "Procedure for Disinfection of Drinking Water in Ontario" (available from the Ontario Ministry of the Environment or at: http://www.ene.gov.on.ca/envision/gp/4448e01.pdf).

The tables identify the CT values for free chlorine and other chemical disinfectants required for specific values of log inactivation of protozoan cysts and target viruses at specific temperatures and pH levels.

3.3 Distribution System Requirements

To maintain drinking water quality after it leaves a treatment plant (whether by a piped distribution network or by a trucked water delivery system), it is the responsibility of the Water System Operator to ensure that a minimum chlorine residual is maintained in delivered water at all times to protect against bacteriological re-growth in the system and to kill or inactivate microbes that may enter at some point in the distribution system. It is recommended that secondary disinfection be achieved by applying chlorine or chloramines (unless prohibited by law) to provide a persistent residual disinfectant.

3.3.1 Piped Water Systems

In piped water systems, all water shall be chlorinated and shall have a free chlorine residual of no less than 0.2 mg/L at all points throughout the distribution system. Water that originates from a third party provider under a municipal type agreement (MTA) shall have a free chlorine residual of no less than 0.2 mg/L at all points throughout the distribution system.

3.3.2 Trucked Water Systems

In trucked water systems, all water shall be chlorinated and shall have a free chlorine residual of no less than 0.2 mg/L at the time of delivery.

No person shall operate a trucked drinking water distribution system without first obtaining adequate training including provincial bulk water delivery certification if available.

3.4 Monitoring Requirements

In general, the two primary health-related water quality parameters are: turbidity and bacteriological quality. The maximum acceptable concentration (MAC) for the bacteriological quality of small community systems, community systems, and systems serving one or more public facilities is no coliforms detectable per 100 mL. The maximum allowable turbidity in treated groundwater or treated surface water is 1.0 nephelometric turbidity units. More information on turbidity requirements can be found in Appendix E.

Three types of monitoring are required for First Nations drinking water systems:

1. Operational monitoring
2. Quality Assurance & Quality Control
3. Compliance & third party monitoring

Operational Monitoring

Operational monitoring is performed by an operator (or a qualified person supervised by an operator) using daily and weekly water quality tests of raw, treated, and distribution system water (as summarized in Table 1). The purpose of ongoing operational monitoring is to verify water quality and system performance and is conducted by the water system operator under the direction of the band council.

Sampling and testing methods and notification requirements for microbiological, chemical, physical, and radiological parameters are outlined in Health Canada's "Procedure Manual for Safe Drinking Water in First Nations Communities South of 60°", which can be obtained from the local Health Canada Environmental Health Officer or from an HC regional office.

The frequency and location of sampling in First Nations water systems should be as specified in Sections 3.4.1, 3.4.2, 3.4.3, and 3.4.4 of this Protocol and as summarised in Table 1.

Analyses of samples for microbiological parameters may be conducted by the trained operator onsite using appropriate analytical equipment and field kits (ex: Colilert). Analyses of samples for chlorine residual are to be undertaken

immediately after sampling by the Water System Operator using appropriate analytical equipment and field kits.

In the absence of appropriate onsite testing equipment, analyses of samples for microbiological parameters should be conducted by an accredited laboratory. First Nations water system operators must use a laboratory accredited by one of the following: Canadian Association for Environmental Analytical Laboratories (CAEAL), the Standards Council of Canada (SCC), or, in Quebec, the Programme d'accréditation de laboratoires d'analyse environnementale (PALAE). SCC/CAEAL defines accreditation as the formal recognition of the competence of a laboratory to carry out specific tests. Accreditation is awarded to a laboratory for each individual test (ex: the analysis of pesticides in drinking water).

The Water System Operator must keep an up-to-date log in which the dates and results of all required operational testing are recorded along with the name of the person who conducted the testing. The data collected for the log must be kept for a minimum of five (5) years.

Quality Assurance & Quality Control

For quality assurance/quality control (QA/QC) purposes, not less than ten percent of all samples for microbiological parameters will be submitted to an accredited laboratory (or equivalent) for comparison purposes.

The Water System Operator must keep an up-to-date log in which the dates and results of all required QA/QC testing (including trucked water test results) are recorded along with the name of the person who conducted the testing. The data collected for the log must be kept for a minimum of five (5) years.

Compliance & Third-Party Monitoring

Any weekly testing of distribution system water by Health Canada (either by environmental health officers or community-based water monitors) is only for compliance and third party monitoring from a public health perspective and is not meant to replace INAC-mandated daily and weekly operational monitoring requirements outlined above (of the raw water, treated water, and distribution system water) that must be conducted by the trained First Nations Water System Operator. Nevertheless, if weekly Health Canada distribution system test results for chlorine residual and bacteria are reliably delivered weekly to the Water System Operator, then the WSO may use the HC test results in lieu of conducting required weekly tests for bacteria on water samples collected from the distribution system. However, if Health Canada distribution system test results for bacteria (which must be accompanied by the chlorine residual results for that time and location) are not reliably delivered weekly to the WSO, then the WSO must collect weekly water samples from the most remote part of the distribution system and test them for both chlorine residual and bacteria.

Note: Testing for quality parameters such as trihalomethanes (THMs) is not conducted under normal operational practice but must be done as per "Procedure Manual for Safe Drinking Water in First Nations Communities South of 60°" under circumstances where the parameter is identified as a potential risk. If after five years of testing THM concentrations never exceed 50% of the maximum allowable concentration, then the frequency of testing for THMs can be reduced to once every 3 years.

Table 1 – Monitoring Requirements of Drinking Water Systems

System Type	Source	Operational Monitoring by Water System Operator	QA/QC by First Nation	HC (Third Party) Monitoring
Small Community Systems and Public Facilities	Surface water or GUDI	Microbiological – One raw water sample per month (SW) or one raw water sample per well per month (GW) and one distribution sample per week. * Chlorine residual – One treated water sample per day and one distribution system sample per week. * Turbidity – one raw water sample per month (filtered surface water to have continuous monitoring equipment on each filter effluent line).	Of samples sent to be tested by an accredited laboratory, 10% must be sent to a second, accredited laboratory to verify quality of first lab.	Periodic testing (by Community-Based Water Monitors or Environmental Health Officers) of distribution system only.
	Groundwater	Microbiological – One raw water sample per well per month and one treated water sample per week and one distribution sample per week. ** Chlorine residual – One treated water sample per day and one distribution system sample per week. ** Turbidity – One raw water sample per month	As above	As above
Community Systems and Public Facilities	Surface water or GUDI	Microbiological – One raw water sample per week (SW) or one raw water sample per well per week (GW) , and one treated water sample per week, and eight distribution system samples per month (with at least one in each week). Chlorine residual – Treated water to have continuous monitoring equipment with alarm and one distribution system sample per week. Turbidity – one raw water sample per month, combined with continuous monitoring equipment on each filter effluent line.	As above	As above

	Groundwater	Microbiological – One raw water sample per well per week, one treated water sample per week, and eight distribution system samples per month (with at least one in each week). Chlorine residual – Continuous monitoring of treated water and at least one distribution system sample per week. Turbidity – One raw water sample per month	As above	As above
Trucked Water Systems	Water treatment plant	Chlorine residual – One sample per truck per delivery day.	As above	As above

* Samples that are to be tested for microbiological parameters and chlorine residual are to be collected at the same time and location at the most remote part of the distribution system. Chlorine residual should be tested immediately upon a sample being collected. For treated water obtained under a municipal type agreement (MTA), results of chlorine residual testing should be obtained from the treated water provider but samples must still be collected from the most remote point in the distribution system and tested for chlorine residual and bacteria.

3.4.1 Monitoring of Small Community Systems and Public Facilities

The types and frequency of water quality tests required for Small Community Systems (systems serving between five and 100 service connections), or any public facilities/buildings, or both are outlined in the following sections.

3.4.1.1 Groundwater

The following testing for ongoing operational parameters is required of the operator for Small Community Systems that obtain their raw water from a groundwater source:

- At least one raw water sample per month for each well is to be tested for microbiological parameters.
- At least one treated water sample per day to be tested for chlorine residual (equivalent to free chlorine residual) at a location where the minimum required chlorine contact time has been completed.
- At least one distribution system sample per week (collected from a location at the most remote point in the system) to be tested for microbiological parameters and one distribution system sample per week to be tested immediately for chlorine residual.
- The location and frequency at which distribution system samples are collected by the operator for chlorine residual testing must be the same as that for microbiological testing.
- Turbidity testing must include one raw water sample per month.

3.4.1.2 Surface Water or GUDI

The following testing is required of the operator for Small Community Systems that obtain raw water from a surface water source or from a groundwater source that is under the direct influence of surface water:

- At least one raw water sample (surface water) per month to be tested for microbiological parameters (if using a groundwater source, then one sample from each well to be tested for microbiological parameters weekly).
- At least one treated water sample per day to be tested for chlorine residual (equivalent to free chlorine residual) at a location where the required chlorine contact time has been completed.
- At least one distribution system sample per week (collected from a location at the most remote point in the system) to be tested for microbiological parameters and one distribution system sample per week to be tested immediately for chlorine residual.
- The location and frequency at which distribution system samples are collected for chlorine residual testing must be the same as that for microbiological testing.
- Turbidity testing must include one raw water sample per month, with the exception of filtered surface water, which will have continuous monitoring equipment on each filter effluent line.

3.4.2 Monitoring of Community Systems and Public Facilities

The types and frequency of water quality tests required for Community Systems (systems serving more than 100 private households), or any public facilities/buildings, or both are outlined in the following sections.

3.4.2.1 Groundwater

The following testing is required of the operator for Community Systems that obtain their raw water from a groundwater source:

- At least one raw water sample and one treated water sample per week per well to be tested for microbiological parameters.
- Testing for chlorine residual (equivalent to free chlorine residual) of treated water in community systems is to be carried out by continuous monitoring equipment equipped with an alarm in the treatment system at a location where the intended chlorine contact time has been completed. In the event that the system is offline, at least one treated water sample and at least one distribution system sample per day are to be taken and tested immediately for chlorine residual.

- At least eight distribution system samples per month (collected from a location at the most remote point in the system), with at least one of the samples being taken in each week, to be tested for microbiological parameters and at least eight distribution system samples per month tested immediately for chlorine residual, with at least one sample collected and tested per week.
- The location and frequency at which distribution system samples are collected for chlorine residual testing must be the same as that for microbiological testing.
- Turbidity testing will include one grab sample per month collected from the raw water source before treatment.

3.4.2.2 Surface Water or GUDI

The following testing is required of the operator for Community Systems that obtain their raw water from a surface water source or from a groundwater source under the influence of surface water:

- At least one raw water sample (for surface water) or one sample per well (for groundwater) and one treated water sample per week to be tested for microbiological parameters.
- Testing for chlorine residual (equivalent to free chlorine residual) of treated water in community systems is to be carried out by continuous monitoring equipment fitted with an alarm in the treatment system at a location where the intended chlorine contact time has been completed. In the event that the system is offline, at least one treated water sample and at least one distribution system sample per day are to be taken and tested immediately for chlorine residual.
- At least eight distribution system samples per month (collected from a location at the most remote point in the system), with at least one of the samples being taken in each week, to be tested for microbiological parameters and at least eight distribution system samples per month tested immediately for chlorine residual with at least one sample collected and tested per week.
- The location and frequency at which distribution system samples are collected for chlorine residual testing must be the same as that for microbiological testing.
- Turbidity testing for Community Systems will include one raw water sample per month combined with continuous monitoring equipment on each filter effluent line.

3.4.3 Monitoring of Trucked Water Systems

The operator of the delivery truck must have adequate training and certification, if available, in operating a bulk (trucked) water delivery system. The truck operator or person(s) in charge of a trucked water system must, at least once per delivery

day, measure the quantity of free residual chlorine present in a water sample collected at the outlet of the tank. In addition, the person(s) in charge of a trucked water system must keep an up-to-date log in which the dates and results of required testing are recorded along with the name of the person who conducted the testing. The data collected for the log must be kept for a minimum of five years.

3.4.4 Procedure for Addressing Drinking Water Advisories

To be effective, Drinking Water Advisories (DWAs) need to be fully understood by the community in which they are issued. In addition, DWAs must be dealt with quickly; a prolonged DWA can lose effectiveness over time and thus can become a threat to public health.

A procedure has been developed to help Chief and Council to co-ordinate efforts among all involved stakeholders to ensure that a drinking water advisory is lifted as quickly as possible. Entitled: *Procedure for Addressing Drinking Water Advisories in First Nations Communities South of 60°*, the Procedure provides guidance to Chief and Council and other involved stakeholders on how to efficiently address the underlying causes of a DWA.

The Procedure describes a team approach to help Chief and Council to co-ordinate efforts among all involved stakeholders to ensure that a DWA is lifted as quickly as possible. As some INAC regions may already have an effective process in place, this Procedure is meant to reinforce, not replace, these processes and to encourage communication between government departments and First Nations.

In order to facilitate communication among stakeholders following issuance of a DWA, the Procedure recommends the development of a Community-Based Water Team (CBWT) and identifies essential members of the CBWT. The roles and responsibilities of CBWT members with respect to actions following the issuance of a DWA are summarized in the Procedure. Three options that Chief and Council may follow to effectively address the DWA are also presented.

As each DWA deals first and foremost with the protection of public health, it is imperative that Chief and Council dedicate significant effort to addressing and removing the underlying causes of a DWA. However, in the event that the Chief is unavailable to take steps to address a DWA, he/she may choose to appoint a designate.

A printed copy of the Procedure can be obtained from Health Canada. A digital copy of the Procedure can be found at Health Canada's web site: http://www.hc-sc.gc.ca/fniah-spnia/pubs/promotion/_water-eau/2007_water-qualit-eau/index-eng.php

3.4.5 Reporting and Corrective Action for Adverse Results

Adverse water quality results (including inadequate chlorine residual) are to be reported immediately by the designated individual (e.g. plant operator or Environmental Health Officer) to Health Canada, INAC, band administration, and (where appropriate) the Provincial Medical Officer of Health so that corrective action by Chief and Council, including notification to consumers and follow-up sampling, can be performed promptly and in accordance with the community's emergency response plan. An adverse water quality result is defined here as any health-related parameter that does not meet the acceptable concentration set out in the latest edition of Health Canada's Guideline for Canadian Drinking Water Quality. Recommendations regarding corrective action may be provided to the Chief and Council (or chief administrative officer) by the Environmental Health Officer, as well as other qualified persons, water system operator, or facility inspectors. Similarly, corrective actions may be defined in the plant's Emergency Response Plan (see Section 7.0).

3.5 Residuals Management Requirements

All INAC-funded First Nations drinking water treatment plants must develop and use a functional system for the treatment and safe disposal of treatment process residuals and shall comply with the more stringent of applicable federal or provincial rules for the management and ultimate disposal of raw water rejects, backwash discharges, and process residuals.

4.0 System Design

Design requirements established under this Protocol are as stipulated in "Design Guidelines for First Nations Water Works" (Design Guidelines). A copy of the most current version of the Design Guidelines can be obtained from your INAC regional office.

4.1 Treatment Plants

Treatment systems must be designed and constructed based on the results of source water assessments in terms of quality and quantity of a source, as well as current and future water demands and they should be reviewed regularly during Asset Condition Reporting System (ACRS) inspections and updated as necessary. Items to consider in designing effective treatment systems include the treatment processes required, treatment components (including redundancies), equipment design, chemicals used, treatment efficiency, monitoring procedures, and local conditions. In assessing these components, potential hazards and their causes should be identified along with their associated health risks so priorities for risk management can be established.

Comprehensive, scientifically defensible, and achievable performance standards - based on industry-recognized principles - are essential to ensuring the effectiveness and reliability of treatment technologies. Decision makers must balance the desire to use the latest technologies against site-specific economic realities (including life-cycle costing analyses). Public health goals should be at the forefront of any treatment-related decision. Alternative approaches may be used if these have been demonstrated to the satisfaction of INAC to be equivalent or better ways of achieving the same objectives.

4.2 Distribution Systems

Piped distribution systems must be designed, constructed, and upgraded as necessary to eliminate dead-ends (where dead-ends cannot be avoided they must be designed to facilitate flushing), prevent cross-connections, prevent unauthorised access, allow for adequate disinfection (as outlined in sections 3.2.1, 3.2.2, and 3.2.3), and ensure that water system capacity is sufficient to meet domestic demand and fire protection flows when provided.

Because it has been shown that a significant number of waterborne disease outbreaks are caused by breakdowns in the distribution system, operators of on-reserve water systems should have in place active cross-connection control programs.

Treated water reservoirs and distribution systems will be designed, constructed, reviewed and upgraded as necessary, to take the following into account: best water management practices, and regulations; prevention of access by wildlife and unauthorized personnel; system capacity; emergency water storage; contact time required for disinfection; minimization or elimination of dead ends, and cross-connection potentials.

4.3 Trucked Water Systems

Tank trucks employed to deliver drinking water in a trucked water system are to be considered as an extension of the water distribution system.

Under this protocol, drinking water that is transported in delivery trucks shall be obtained only from a public drinking water system that meets fully the requirements of this protocol. Every delivery truck shall be equipped with a tank fabricated from stainless steel or another material that is suitable for transporting drinking water and meets the requirements of the current edition of NSF/ANSI Standard 61: Drinking Water System Components – Health Effects.

The tank must not be used to transport other materials, as these are likely to contaminate the water.

First Nations will operate trucked water systems in accordance with applicable federal or provincial requirements – whichever are the most stringent.

4.4 Code Requirements

Buildings and infrastructure should comply with the more stringent of either the applicable provincial or federal regulation or codes of practice for all building trades:

- Structures – Comply with the more stringent of applicable provincial or federal building codes and fire codes.
- Piping – Comply with the more stringent of either the applicable provincial plumbing code or the National Plumbing Code of Canada.
- Electrical and mechanical components - Comply with the more stringent of either the applicable provincial or national codes.

4.5 Commissioning Plans

Prior to any new or upgraded Small Community System or Community System being placed into service, it must undergo commissioning as set out in a

commissioning plan that meets the requirements of INAC-accepted generic commissioning guidelines. A generic commissioning guide is available through INAC regional offices. The terms and conditions of contract documents related to design and construction of the plant and distribution system shall state that:

- Using INAC's generic commissioning guide or an equivalent seed document, a commissioning plan will be created for the water system.
- The commissioning plan will include performance requirements to be met for a full year of continuous, uninterrupted operation after commissioning begins. Performance requirements will include ensuring that the system reliably produces at its design capacity and include ensuring that the water produced by the system meets quality requirements as set out in this Protocol.
- The warranty for the plant will cover the cost to remedy all deficiencies identified during the commissioning process and for one full year after successful completion of the commissioning process.
- A holdback for commissioning will be set aside to be paid upon successful completion of the commissioning process set out in the commissioning plan.

4.6 As-built Documents

The water system operator will be provided with as-built documents (as-built plans, design brief, etc.) to be kept permanently in the water treatment plant's records.

4.7 Operator's Manual

An operation and maintenance manual must be provided upon completion of the design phase of the project. The manual must include step by step procedures on how to safely operate and maintain the treatment process at all times.

5.0 Quality Assurance

To protect public health and safety and prolong the service life of water system assets, the water system must be inspected regularly to monitor its physical condition, identify maintenance deficiencies, and monitor ongoing system performance in providing safe drinking water.

5.1 Maintenance Management Plans

A functioning maintenance management plan (MMP) must be developed and implemented for the water system. In the context of this requirement, the term "functioning" means that the MMP is in continuous use, all regular maintenance is executed as per the MMP's schedule for maintenance, and records are kept for all maintenance work.

5.2 Asset Condition Reporting System (ACRS) Inspections

For Small Community Systems, Community Systems, and systems serving a Public Facility, an ACRS inspection of the water system is to be performed once every three (3) years by a qualified person (consulting engineer, Tribal Council engineer), who is not from the band involved, to assess condition of the asset, adequacy of maintenance efforts and needs for additional maintenance work. The ACRS inspection report will be discussed with and submitted to the band council and the INAC regional office. Inspections will be conducted in accordance with the ACRS Manual, the latest version of which can be obtained from the INAC office in your region.

5.3 Annual Performance Inspections

For systems defined in Section 2.0 (Small-Community Systems, Community Systems, and systems serving a Public Facility), a performance inspection shall be completed annually to verify the performance of the system and update some of the information provided by ACRS inspections. The Annual Inspection is a collaborative process between the Chief and Council, INAC. The purpose of an inspection is to ensure that:

- The water treatment process (as verified in terms of monitored water quality parameters) performs to meet design standards;
- Operator level of certification meets the complexity level of the treatment plant and distribution system;

- There is no potential for microbiological contamination of the water works and to identify operational and physical improvements to mitigate any potential; and
- The system is operated in conformity with this document.

The annual inspections include site visits conducted by a qualified person (Circuit Rider, licensed consulting engineer, licensed Tribal Council engineer, provincial water system inspector; or a water system operator; none of whom cannot be a member of the band involved and must be certified or equivalent to the level of the system being inspected). Water quality testing results from the water system operator (operational results as defined in Section 3.4) and from Health Canada (third party monitoring results as defined in Section 3.4) for the previous year along with follow-up action reports will be given to the inspector for review and inclusion in the annual inspection report. The annual report will be discussed with and submitted to the band council and to the INAC regional office.

The list of data required to be collected during an annual inspection can be found in INAC's Integrated Capital Management Systems (ICMS). Inspection forms are generated from ICMS by INAC's regional offices. Data is then collected in the field to complete the inspection forms, which are returned to INAC regional offices for input into ICMS. For a copy of the Annual Inspection form or information on ICMS, contact the ICMS co-ordinator at the INAC office in your region.

5.4 Documents Management and Record Keeping

5.4.1 Documents Management

The band council will keep permanently on file the following documents:

- Feasibility studies
- Environmental assessments
- Design drawings
- Contract documents
- As-built drawings

The band council will maintain, revise, and keep up to date the following documents:

- Standard Operating procedures
- Maintenance Management Plan
- Emergency Response Plan

The water system operator will keep on hand copies of the following documents:

- Standard operating procedures
- Maintenance management plan
- Maintenance manuals for each piece of equipment in the plant and the distribution system
- Emergency response plan
- Commissioning manual
- As-built drawings
- WHMIS documentation (Material Safety Data Sheets)

5.4.2 Record Keeping

In addition to operator duties outlined in Section 5.3.1, the water system operator must keep an up-to-date register in which the dates and results of all required operational sampling and testing (as outlined in Section 3.4 of this document) are recorded along with the name of the person who conducted the sampling and testing. The data collected for the registers must be kept for a minimum of five years. In addition, water system managers must keep on file all records related to water quality monitoring, operations, and system maintenance (including laboratory analyses, ACRS reports, annual reports, and consultant reports) for a period of not less than five years. The water system operator's daily and weekly record keeping will include:

- Log book of daily plant checks
- Log book of daily and weekly water quality checks
- Log sheets for calibrating analyzers (chlorine, turbidity, pH)
- Log sheets for disinfectant volumes used (liquid or gas)
- Log sheets for sodium- or potassium chloride used for softeners
- Log sheets for coagulant volumes used
- Log sheets for chlorine delivered
- Sign-in sheet for visitors
- Maintenance performance logs for all equipment (pumps, compressors, valves, UV equipment, generators)

5.5 Compliance Assurance

The intention of compliance assurance is to ensure that appropriate remedial action and monitoring requirements are implemented to protect the quality of drinking water. The local authority (ex: Environmental Health Officer) and other stakeholders (ex: INAC) may, depending on jurisdiction, recommend to Chief and Council remedial actions when there is a suspected or known risk to public health and safety or, where necessary, closure of the system may be requested. Procedures related to issuing and lifting Boil Water Advisories and Orders are outlined in Sections 6.4 through 6.9 of Health Canada's *Procedure Manual for Safe Drinking Water in First Nations Communities South of 60°*, which can be

obtained from the local Health Canada Environmental Health Officer or from a Health Canada regional office.

Compliance with this Protocol is a part of the terms and conditions of ongoing funding agreements between the government of Canada and First Nations. As condition of funding, First Nations will agree that where public health is at risk and the First Nation lacks the ability to address the issue, INAC has the right to intervene and engage third-party service providers to temporarily take over control and operation of a water system that is not in compliance with this protocol. In such a case, the required funding of the operations under INAC's temporary control to operate and maintain the system will come from the First Nation's budget.

6.0 Operator Certification Requirements

Water System Operator certification requirements will match the requirements of the applicable provincial system. Thus, operators of water treatment plants and distribution systems must be certified to the level specified by provincial operator certification requirements for the classification of system they operate or their work must be overseen by an operator with the required level of certification.

Managers of trucked water systems shall ensure that each operator of the delivery truck possesses adequate training (or a provincial Operator Certificate for distribution systems where applicable).

Guidance on provincial requirements for certification of water treatment plant and distribution system operators is provided in Appendix I. Information provided in Appendix I is subject to change by the Provincial department/agency responsible. Updates of Appendix I will appear periodically at the INAC web site (http://www.ainc-inac.gc.ca/enr/wtr/index-eng.asp). But the latest information must be obtained directly from the respective Provincial department/agency.

7.0 Emergency Response Plan Requirements

It is required that the Chief and Council shall have in place an emergency response plan (ERP) in the event of any situation where there is a threat to the health of people drawing their potable water from a water system.

Chief and Council shall ensure that the ERP is developed in consultation with an emergency response consultant, if available, as well as the water system operator. In addition, the water system's ERP shall be incorporated into the band's community-wide ERP.

The emergency response plan should be reviewed annually. Reviewing the ERP and ensuring that emergency contact phone numbers are fully updated is the responsibility Chief and Council. A sample emergency response plan will be made available at INAC's web site.

8.0 Public Reporting

To help community members stay informed as to the quality of drinking water provided by their water system, it is strongly encouraged that all First Nations water system operating authorities make available to their customers a copy of the most recent Annual Inspection Report as well as copies of up-to-date annual summaries of water quality monitoring results. These records should be made available in printed format in an accessible on-reserve location such as the Band offices.

Appendix A

Stakeholders Roles and Responsibilities

Provision of water services to First Nations communities is a shared responsibility between three groups:

First Nations

As outlined in this Protocol, First Nations responsibilities as they relate to ensuring that residents are provided with clean, safe, and reliable drinking water are divided between two main groups on reserve: a.) band councils, and b.) water system operators:

a. Band Councils (chiefs, councillors, utility directors, infrastructure managers, and public works supervisors) are responsible for ensuring that drinking water systems are designed, constructed, and upgraded in accordance with this Protocol. They are also responsible for organising training to ensure that their systems primary and secondary operators are trained and certified to the classification level of the water system.
b. Water system operators are responsible for operating and maintaining drinking water systems as well as for implementing effective sampling and testing to continuously monitor drinking water quality. They must also keep complete records to fully document maintenance activities, monitoring, and corrective action.

Circuit Riders

Under the department's Circuit Rider Trainer Program (CRTP) INAC provides funds to engage circuit riders (third party water system experts who provide water system operators with on-site, mentoring, training, and emergency assistance). The third party service providers that provide circuit rider services also provide operators with a 24/7 emergency hotline. To participate in the Circuit Rider Training Program, bands should contact the CRTP co-ordinator at the INAC office in their region.

Tribal Councils

Tribal Councils are service organisations mandated to provide various services to member bands, including technical services. Bands that lack the required human resource capacity to manage and provide their own public works and technical services, including water services, should contact their Tribal Council for assistance.

Indian & Northern Affairs Canada

INAC provides First Nations with financial assistance and advice for designing, constructing, upgrading, operating, maintaining, and monitoring water facilities. INAC also provides funding and advice for the provision of training of operators and with the provision of services shared between reserves and municipalities through MTAs (municipal-type agreements). Compliance with this Protocol is monitored by INAC regional offices.

Health Canada

Health Canada works in partnership with First Nations communities to ensure that drinking water quality monitoring programs are in place in communities, South of 60^{o}, and that drinking water quality meets the *Guidelines for Canadian Drinking Water Quality*. These programs include testing drinking water quality and reviewing, interpreting, and disseminating results. In order to build community capacity in environmental health, Health Canada facilitates community-based drinking water quality sampling and testing through the support and training of community-based drinking water quality monitors (CBWMs). Health Canada, through Environmental Health Officers (EHOs) investigates potential problems, provides advice, and makes recommendations to First Nations communities and federal partners, such as Indian and Northern Affairs Canada on matters pertaining to drinking water. Health Canada also reviews water and wastewater infrastructure proposals from a public health perspective. Health Canada is also actively involved in the development of educational and awareness programs, tools, and materials on drinking water safety issues. In First Nations communities where Environmental Health Programs are transferred, the First Nations stakeholders are responsible for drinking water quality monitoring.

Environment Canada

Environment Canada is responsible for enforcing federal legislation related to wastewater, both on and off reserves. This mandate includes the enforcement of regulations related to the disposal of water treatment process residuals where applicable.

Appendix B

Summary of Guidelines for Canadian Drinking Water Quality

The Guidelines for Canadian Drinking Water Quality (GCDWQ) were published in booklet form by Health Canada in 1996. Since then, a number of changes have been made to various criterion values in the Guidelines but a new edition of the booklet has not been published.

To keep interested parties informed of changes to the Guidelines between publications of new editions of the booklet, a summary table called "Summary of Guidelines for Canadian Drinking Water Quality" (Summary Guidelines) is updated and published every spring on Health Canada's website:
http://www.hc-sc.gc.ca/ewh-semt/water-eau/index-eng.php

Each new summary supercedes all previous versions, including that contained in the published booklet mentioned above.

It is recommended that every six months the water system manager and the water system operator responsible for a water system obtain a printed copy of the most current version of the Summary Guidelines from a local Health Canada office or from the Health Canada web site (http://www.hc-sc.gc.ca/ewh-semt/water-eau/index-eng.php) and insert them in this document as Appendix B.

Appendix C

Definition of Groundwater under Direct Influence of Surface Water

The following drinking water systems will be deemed to be relying on groundwater under the direct influence of surface water:

1. A drinking water system that obtains water from a well that is not a drilled well or from a well that does not have a watertight casing that extends to a depth of 6 m below ground level.

2. A drinking-water system that obtains water from an infiltration gallery.

3. A drinking-water system that is not capable of supplying water at a rate greater than 0.58 L/s and that obtains water from a well, any part of which is within 15 m of surface water.

4. A drinking-water system that is capable of supplying water at a rate greater than 0.58 L/s and that obtains water from an overburden well, any part of which is within 100 m of surface water.

5. A drinking-water system that is capable of supplying water at a rate greater than 0.58 L/s and that obtains water from a bedrock well, any part of which is within 500 m of surface water.

6. A drinking-water system that exhibits evidence of contamination by surface water.

7. A drinking-water system in respect of which a written report has been prepared by a professional engineer or professional hydrogeologist that concludes that the system's raw water supply is ground water under the direct influence of surface water and that includes a statement of his or her reasons for reaching that conclusion.

A water system is not deemed to be under direct influence of surface water if a written report prepared after August 1, 2000 by a licensed professional engineer or professional hydrogeologist concludes that the raw water supply is not ground water under the direct influence of surface water and the report includes a statement of his or her reasons for reaching that conclusion.

Appendix D

Guidance on Concentration x Time (CT) Concept

The water system operator is responsible to ensure that an adequate contact time between drinking water and an appropriate concentration of chemical disinfectant is provided to the water before it reaches the first consumer on the distribution system during periods of peak flow.

Chlorine should be applied at a point that will provide optimum contact time after adequate mixing.

The actual period of contact time required (calculated at peak flow rates) varies based on the type of raw water source and temperature. As a rule of thumb, at least 15 minutes of contact time must be provided to the water before it reaches the first consumer on the distribution system during periods of peak flow.

References for calculating required dose concentration and contact time for community systems can be found below. In addition, concentration-time (CT) tables for the inactivation of protozoan cysts and viruses by chlorine, chlorine dioxide, and chloramines at various temperatures and pH values may be found listed in “Procedure for Disinfection of Drinking Water in Ontario” (available from the Ontario Ministry of the Environment or at:
http://www.ene.gov.on.ca/envision/gp/4448e01.pdf).

The tables identify the CT values for free chlorine and other chemical disinfectants required for specific values of log inactivation of protozoan cysts and target viruses at specific temperatures and pH levels.

References

- Ontario Ministry of Environment, 2003, Procedure for Disinfection of Drinking Water in Ontario
  Web site: http://www.ene.gov.on.ca/envision/gp/4448e01.pdf

- AWWA (American Water Works Association), 1991, Guidance Manual for Compliance with the Filtration and Disinfection Requirements for Public Water Systems Using Surface Water Sources.

- United States, EPA (Environmental Protection Agency), 1999b, Disinfection Profiling and Benchmarking Guidance Manual. Chapter 4.

- Small Systems Operation and Maintenance Practices, October 2005, National Guide to Sustainable Municipal Infrastructure
  Web site: http://www.infraguide.ca

Appendix E

Turbidity Requirements

Maximum allowable turbidity levels established under this protocol will be as required under Health Canada's Guidelines for Canadian Drinking Water Quality. Health Canada criteria for turbidity requirements in drinking water are outlined below. It is recommended that the operator obtain a printed copy of the most current version of health Canada's Turbidity Guideline, either from a local Health Canada office or from the Health Canada web site:
http://www.hc-sc.gc.ca/ewh-semt/water-eau/index-eng.php

Under proposed changes to Health Canada's turbidity guideline, systems that use a surface water source, or that use a groundwater source under the direct influence of surface water, should filter the source water to meet the following turbidity limits:

Chemically assisted filtration:

The treated water turbidity levels from individual filters should:

- Be less than or equal to 0.3 NTU in at least 95% of the measurements made, or at least 95% of the time each calendar month; and
- Not exceed 1.0 NTU at any time.

Where possible, the filtration system is to be designed and operated to reduce turbidity levels as low as possible, with a treated water turbidity target of less than 0.1 NTU at all times.

Slow sand or diatomaceous earth filtration:

The treated water turbidity levels from individual filters should:

- Be less than or equal to 1.0 NTU in at least 95% of the measurements made, or at least 95% of the time each calendar month; and
- Not exceed 3.0 NTU at any time.

Where possible, the filtration system should be designed and operated to reduce turbidity levels as low as possible; with treated water turbidity targets always less than 0.1 NTU.

Membrane filtration:

The treated water turbidity levels from individual filters should:

- Be less than or equal to 0.1 NTU in at least 99% of the measurements made, or at least 99% of the time each calendar month; and
- Not exceed 0.3 NTU at any time.

If membrane filtration is the sole treatment technology employed, secondary disinfection using chlorine or chloramines should follow the filter process. Where possible, the filtration system should be designed and operated to reduce turbidity levels as much as possible, with a treated water turbidity target of less than 0.1 NTU at all times.

Appendix F

Guidance on Provincial Operator Certification Requirements

Operator certification requirements for First Nations water systems will match applicable provincial requirements. Thus, operators of water treatment plants and distribution systems must be certified to the level required for their respective drinking water system as specified by the appropriate provincial operator certification program. Managers of trucked water systems shall ensure that the operators of the delivery truck possess adequate training (or a provincial operator certificate for distribution systems where applicable).

British Columbia

Pre-requisites: Grade 12 or combination of experience and training (see tables below)
Length of program: Varies by level
Method of delivery: In-class or self-directed
Certifications provided: Small System, OIT, and Levels 1, 2, 3, and 4

For the most current information, please go to:
http://www.eocp.org/docs/guide.pdf

Pre-requisites: Operator-in-training and Small Systems

Category	Education	Experience
Operator-in-training (OIT)	12 years of education	3 months experience or completion of an approved course
Small water system (SWS)	10 years of education + 1.2 CEUs	6 month of experience/50 hours(min) hands-on
Small wastewater system (SWWS)	10 years of education + 1.2 CEUs	6 month of experience/50 hours(min) hands-on

Pre-requisites: Levels 1, 2, 3, and 4

Category	Level 1		Level 2		Level 3			Level 4		
	Educ.	Exp.	Educ.	Exp.	Educ.	Exp.	DRC	Educ.	Exp.	DRC
Water treatment (WT)	12	1	12	3	14	4	2	16	4	2
Water distribution (WD)	12	1	12	3	14	4		16	4	
Municipal wastewater	12	1	12	3	14	4	2	16	4	2

treatment (MWWT)										
Wastewater collection (WC)	12	1	12	3	14	4		16	4	
Industrial wastewater treatment (IWWT)	12	1	12	3	14	4	2	16	4	2

British Columbia notes:

- Education of 14 years means Grade 12 or GED 12 plus 2 additional years of education.
- DRC = Direct responsible charge

Alberta

Pre-requisites: Grade 12 or combination of experience and training (see tables)
Length of program: SSO starts at 6 h
Method of delivery: In-class from AWWOA or other applicable approved training
Certifications provided: Small Systems Operations, Operator Levels 1, 2, 3, and 4

For the most current information, please go to:
http://environment.alberta.ca/1698.html

Pre-requisites

Category	Education	Experience
Small water systems (SWS)	0.6 CEUs small water system course	Minimum 6 months experience in municipal facility
Small wastewater systems (SWWS)	0.6 CEUs small wastewater system course	Minimum 6 months operating experience in municipal facility
Level 1	High school diploma, GED Transcript, or high school equivalency diploma plus: -1.2 CEUs	1 year operating experience in a municipal facility
Level 2	High school diploma, GED Transcript, or high school equivalency diploma	3 years operating experience in a Class 1 or higher
Level 3	High school diploma, GED Transcript, or high school equivalency diploma plus: - Two years **or** 90 CEUs of approved post secondary education	4 years of acceptable operating experience, at least two of which must be in a Class II or higher facility including at least 2 years of DRC
Level 4	High school diploma, GED Transcript, or high school equivalency diploma plus: -Four years or 180 CEUs	4 years of acceptable operating experience, at least two of which must be in a Class III or IV facility including at least 2 years of DRC in Class III or IV

Alberta notes:

- Each level has four categories: water treatment, wastewater treatment, water distribution, and wastewater collection.
- It is possible to work in more than one category in the same year.

Saskatchewan

Pre-requisites: Grade 10 (or GED 10), or Grade 12 (or GED 12), or combination of experience and training (see tables below).
Length of program: Varies by level
Method of delivery: Accredited college
Certifications provided: Small Systems, Classes 1, 2, 3, and 4

For the most current information, go to:
http://www.environment.gov.sk.ca/Default.aspx?DN=6c1f5725-6a82-42d8-a06d-5e227612c4f5

Pre-requisites: Operator-in-training and Small Systems

Category	Education	Experience
Small water system (SWS)	Grade 10 or GED 10	6 month of experience
Small wastewater system (SWWS)	Grade 10 or GED 10	6 month of experience

Pre-requisites: Classes 1, 2, 3, and 4

Category	Class 1		Class 2		Class 3			Class 4		
	Educ.	Exp.	Educ.	Exp.	Educ.	Exp.	DRC	Educ.	Exp.	DRC
Water treatment (WT)	12	1	12	3	14	4	2	16	4	2
Water distribution (WD)	12	1	12	3	14	4	2	16	4	2
Wastewater treatment (WWT)	12	1	12	3	14	4	2	16	4	2
Wastewater collection (WWC)	12	1	12	3	14	4	2	16	4	2

Saskatchewan notes:

- Education of 14 years means Grade 12 or GED 12 plus 2 additional years of education.
- In cases where an operator is required to have four years of operational experience, two of those years must be in a direct responsible charge (DRC) position.

Manitoba

Pre-requisites: Grade 10 (or GED 10) or Grade 12 (or GED 12) (see tables)
Length of program: Varies by level
Method of delivery: Accredited provincial college
Certifications provided: Small Systems, Classes 1, 2, 3, and 4

For the most current information, please go to:
http://web2.gov.mb.ca/laws/regs/pdf/e125-077.03.pdf

Pre-requisites: Small Systems

Category	Education	Experience
Small water system (SWS)	Grade 10 or GED 10	6 month of experience
Small wastewater system (SWWS)	Grade 10 or GED 10	6 month of experience

Pre-requisites: Classes 1, 2, 3, and 4

Category	Class 1		Class 2		Class 3			Class 4		
	Educ.	Exp.	Educ.	Exp.	Educ.	Exp.	DRC	Educ.	Exp.	DRC
Water treatment (WT)	12	1	12	3	14	4	2	16	4	2
Water distribution (WD)	12	1	12	3	14	4	2	16	4	2
Wastewater treatment (WWT)	12	1	12	3	14	4	2	16	4	2
Wastewater collection (WWC)	12	1	12	3	14	4	2	16	4	2

Manitoba notes:

- Education of 14 years means Grade 12 or GED 12 plus 2 additional years of education.

Ontario

Pre-requisites: Grade 12, GED 12, or combination of experience and training (see table)
Length of program: Varies by level
Method of delivery: Private training companies and community colleges
Certifications provided: Operator Classes 1, 2, 3, and 4

Pre-requisites for Classes 1, 2, 3, and 4

Category	Education	Experience
Operator-in-Training	Grade 12 or GED 12	N/A
Class 1	Grade 12 or GED 12	1 year operating experience at Class 1
Class 2	Grade 12 or GED 12	Three years operating experience at Class 1 or higher
Class 3	Grade 12 or GED 12 plus 2 years of relevant education or training	Four years of experience as an operator including at least 2 years as operator-in-charge at a Class 2, 3, or 4 facility.
Class 4	Grade 12 or GED 12 plus 4 years of relevant education or training	Four years of experience as an operator including at least 2 years as operator-in-charge at a Class 3 or 4 facility.

Ontario notes:

- Each level has four categories: water treatment, wastewater treatment, water distribution, and wastewater collection.

Quebec

Pre-requisites: High school graduation or combination of experience and training.
Length of program: Varies from 3 days to 8 days based on complexity of facility for which the training is designed.
Method of delivery: Centre de formation professionnel Paul-Gérin Lajoie (UQAM)
Certifications provided: Training is for existing operators. Certification is not by standardised level (OIT, 1, 2, 3, 4) but instead is tailored to operator's particular facility.

For more information:
http://www.mddep.gouv.qc.ca/eau/potable/brochure/operateur.htm

Atlantic Canada

(Comprised of Nova Scotia, New Brunswick, Prince Edward Island, and Newfoundland and Labrador)

Pre-requisites: Grade 12, GED 12, or combination of experience and training (see table)
Length of program: Varies by level
Certifications provided: Operator Classes 1, 2, 3, and 4

Pre-requisites for Classes 1, 2, 3, and 4

Category	Education	Experience
Class 1	Grade 12 or GED 12	Minimum1 year operating experience at Class 1
Class 2	Grade 12 or GED 12	Three years operating experience at Class 1 or higher
Class 3	Grade 12 or GED 12 plus 2 years or 90 CEUs of post-secondary education	Four years operating experience of which 2 years must be in Class 2 or higher. Half of the experience must be in DRC
Class 4	Grade 12 or GED 12 plus 4 years or 180 CEUs of post-secondary education	Four years operating experience of which 2 years must be in Class 3 or higher. Half of the experience must be in DRC

Atlantic notes:

- Each level has four categories: water treatment, wastewater treatment, water distribution, and wastewater collection.
- DRC = direct responsible charge

Appendix G

Drinking Water Definitions

Aesthetic objective (AO): Aesthetic objectives are set for drinking water quality parameters such as colour or odour, where an exceedance may make the water less pleasant, but not unsafe.

Alkalinity: Alkalinity is a measure of the capacity of water to resist changes in pH. Alkalinity is usually expressed as the equivalent concentration (mg/L) of calcium carbonate (CaCO3).

Aquifer: A natural an underground geological formation or group of formations, often of sand or gravel, which contain water. An aquifer is a source of groundwater for wells and springs.

Aquifer (confined): A confined aquifer is a layer of soil or rock below the land surface that is saturated with water. There are layers of impermeable material both above and below it and it is under pressure so that when the aquifer is penetrated by a well, the water will rise above the top of the aquifer.

Aquifer (unconfined): An unconfined aquifer is one whose upper water surface (water table) is at atmospheric pressure, and thus is able to rise and fall.

Bacteria (plural) bacterium (singular): bacteria are microscopic living organisms usually consisting of a single cell. Bacteria can aid in pollution control by consuming or breaking down organic matter in sewage and or other water pollutants. Some bacteria may also cause human, animal and plant health problems. Bacteria are predominantly found in the intestines and feces of humans and animals. The presence of *coliform* bacteria in water indicates the contamination of water by raw or partially treated sewage.

Centralized Water System: The term centralized water system refers to a water system employing a central treatment plant from which potable water is distributed to users via a network of distribution pipes.

Coliform: A group of related bacteria whose presence in drinking water may indicate contamination by disease-causing microorganisms.

Contaminant: A contaminant is anything found in water (including microorganisms, minerals, chemicals, radionuclides, etc.) that may be harmful to human health.

Cryptosporidium: *Cryptosporidium* are protozoic microorganisms commonly found in lakes and rivers. It is highly resistant to disinfection processes and can cause diarrhoea, nausea, and/or stomach cramps.

Disinfectant: A disinfectant is a chemical (commonly chlorine, chloramines, or ozone) or physical process (e.g., ultraviolet light) that inactivates or kills microorganisms such as bacteria, viruses, and protozoa.

Distribution System: A distribution system is a network of pipes leading from a drinking water treatment plant that delivers finished drinking water to customers' plumbing systems.

Escherichia coli: *Escherichia coli* (E. coli) are commonly found in the lower intestine of warm-blooded animals. E. coli are not always confined to the intestine, and their ability to survive for brief periods outside the body makes them an ideal indicator organism to test environmental samples for fecal contamination.

Fecal coliforms: Fecal coliforms include the genera that originate in feces; Escherichia as well as genera that are not of fecal origin; *Enterobacter*, *Klebsiella*, and *Citrobacter*. In general, increased levels of fecal coliforms (fecal bacteria) provide a warning of failure in water treatment, a break in the integrity of the distribution system, or possible contamination with pathogens. When levels are high there may be an elevated risk of waterborne gastroenteritis.

Giardia lamblia: *Giardia lamblia* are protozoic microorganisms frequently found in rivers and lakes, which, if not treated properly, may cause diarrhoea, fatigue, and cramps after ingestion.

Groundwater: Groundwater is any water that is obtained from a subsurface water-bearing soil unit (called an aquifer). 1) Water that flows or seeps downward and saturates soil or rock, supplying springs and wells. The upper surface of the saturate zone is called the water table. 2) Water stored underground in rock crevices and in the pores of geologic materials that make up the Earth's crust.

Groundwater, confined: Groundwater that is under pressure significantly greater than atmospheric, with its upper limit the bottom of a bed with hydraulic conductivity distinctly lower than that of the material in which the confined water occurs.

Groundwater, unconfined--water in an aquifer that has a water table that is exposed to the atmosphere.

Hardness: Hardness is a measure of calcium and magnesium in water. These elements precipitate with carbonate in boilers and pots to form scale. Hardness

also makes it difficult to form lather, requires more soap, and creates a soap scum.

Inactivate: Inactivate, a term used in water disinfection, refers to the process by which a disinfectant renders pathogenic microorganisms harmless by damaging them enough that they can no longer reproduce and are, thus, no longer infectious.

Microorganisms: Microorganisms, also known as microbes, are tiny living organisms that can be seen only with the aid of a microscope. Some microbes can cause acute health problems when consumed in drinking water.

Pathogen: Pathogen is a term applied to any disease-causing organism.

Potable water: Potable water is water that is destined for human consumption. For the purposes of this Protocol, water destined for human consumption is water that is consumed directly as drinking water, water that is used in cooking, water that is used to wash food, and water that is used for bathing infants (individuals under 1 year in age).

pH: pH is a measure of water's acidity or alkalinity. Water with a pH of 0 to less than 7 is acidic. A pH of 7 is neutral, neither acidic nor alkaline. Water with a pH greater than 7 to 14 is termed alkaline. In Canada, recommended pH for drinking water is between 6.5 and 8.5.

Public Facility: A public facility is a non-commercial facility that is owned or operated by Chief and Council and serves a public function, such as a school, band office, or community centre. Facilities funded by other government departments are not covered by this Protocol.

Qualified Band Employee: A qualified band employee is a band employee (a person on the band's pay roll), or a third party operating under contract to the band, who is fully licensed to perform the work in the province in which the work will be performed.

Radionuclides: Any man-made or natural element that emits radiation.

Raw Water: The term raw water refers to water that is in its natural state, prior to any treatment for drinking.

Runoff: The term runoff refers to: (1) That part of the precipitation, snow melt, or irrigation water that appears in uncontrolled surface streams, rivers, drains or sewers. Runoff may be classified according to speed of appearance after rainfall or melting snow as direct runoff or base runoff, and according to source as surface runoff, storm interflow, or ground-water runoff. (2) The total discharge described in (1), above, during a specified period of time. (3) Also defined as the

depth to which a drainage area would be covered if all of the runoff for a given period of time were uniformly distributed over it.

Source Water: Water in its natural state, prior to any treatment for drinking.

Surface Water: Surface water is any water that is obtained from sources, such as lakes, rivers, and reservoirs that are open to the atmosphere.

System Designer: A system designer is a person, such as an engineer, who is qualified to design a water or wastewater systems.

System Operator: A system operator is a band employee or a third party under contract to a band who is tasked with the operation and maintenance of a water or wastewater system.

System Manager: A system manager is a band employee or a third party under contract to a band who is tasked with managing a water or wastewater system.

Trihalomethanes: Trihalomethanes (THMs) are formed when chlorine (or chlorine-based disinfectants) used to control microbial contaminants in drinking water react with naturally occurring organic and inorganic matter in water. They have been shown to cause negative effects in lab animals but their effect on human health is unknown.

Turbidity: Turbidity is the cloudy appearance of water caused by the presence of suspended matter or particles in the water. High levels of turbidity may interfere with proper water treatment and monitoring. In Canada, the maximum acceptable concentration (MAC) for turbidity in drinking water entering a distribution system is 1 NTU (Nephelometric Turbidity Unit). An aesthetic objective of 5 NTU has been set for samples taken in the distribution system. Turbidity levels higher than 5 NTU in samples collected in the distribution system can indicate severe local corrosion of the water pipes.

Water destined for human consumption: Water destined for human consumption is water that is consumed directly as drinking water, water that is used in cooking, water that is used to wash food, and water that is used for bathing infants (individuals under 1 year in age).

Watershed: The land area from which water drains into a stream, river, or reservoir.

Water quality: The term used to describe the chemical, physical, and biological characteristics of water, usually in respect to its suitability for a particular purpose.

Water use: The term water use refers to water that is used for a specific purpose, such as for domestic use, irrigation, or industrial processing. Water use pertains to human's interaction with and influence on the hydrologic cycle, and includes elements, such as water withdrawal from surface- and ground-water sources, water delivery to homes and businesses, consumptive use of water, water released from wastewater-treatment plants, water returned to the environment, and in-stream uses, such as using water to produce hydroelectric power.

Appendix H

Summary of Material Changes between this Version and the Previous Version of this Document

This document will evolve over time based to reflect feedback from users and other stakeholders as well as operational or policy changes at Indian and Northern Affairs Canada. This appendix lists material changes between this release of this document and the first version released March 21, 2006. The numerous minor edits that were made to improve clarity and organisation of the document are not listed.

1. The title of the document (formerly entitled: *Protocol for Safe Drinking Water in First Nations Communities*) was changed to: *Protocol for Centralized Drinking Water Systems in First Nations Communities* to better reflect its content and purpose.
2. Various textual changes were made
3. The text in Section 1 was revised to elaborate and clarify roles and responsibilities of stakeholders.
4. Section 3.2.1 was revised to set the disinfection log removal requirement for groundwater at 2-log (99 percent) removal or inactivation of *Giardia lamblia* cysts, *Cryptosporidium parvum* cysts, and viruses.
5. Section 3.2.2 was revised to set the disinfection log removal requirement for surface water and GUDI at 2-log (99 percent) removal or inactivation of *Giardia lamblia*, 3-log (99.9 percent) removal or inactivation of *Cryptosporidium parvum* cysts, and at 4-log (99.99 percent) removal or inactivation of viruses before water enters the distribution system].
6. A new section was added (Section 3.4.4 in this version) to outline the requirement that DWAs be dealt with quickly.
7. A new section was added (Section 3.5 in this version) to set out a requirement for residuals management.
8. A new section was added (Section 4.6 in this version) to set out a requirement for retention of as-built drawings.
9. A new section was added (Section 4.7 in this version) to set out a requirement for keeping of an operations and maintenance manual.
10. A new section was added (Section 5.1 in this version) to elaborate on a requirement for functioning maintenance management plans.
11. Section 5.3 in this document (formerly called Section 5.2 in the previous version) was redrafted to introduce changes to annual inspection requirements arising from the department's implementation if the Integrated Capital Management System.
12. A new section was added (Section 5.4 in this version) to elaborate document management and record keeping requirements.
13. The section entitled Appendix A in previous version was re-titled as Appendix B.

14. The section entitled Appendix B in the previous version of this document was superseded by new text added in Section 3.1 of the new version of this document.
15. The section entitled Appendix E in the previous version of this document was superseded by new text added in Section 7 of the new version of this document.
16. The section entitled Appendix F in the previous version of this document was re-titled Appendix E in this version.
17. The section entitled Appendix G in the previous version of this document was superseded by new text added in Section 4 of the new version.
18. The section entitled Appendix H in the previous version of this document was superseded by new text added in Section 5.3 of the new version.
19. The section entitled Appendix J in the previous version of this document was superseded by new text added in Section 7 of the new version.
20. The section entitled Appendix K in the previous version of this document was revised re-titled Appendix A in this version.
21. A new appendix was added (Appendix G in this version) to provide definitions for water terminology employed in this document.
22. A new appendix was added (Appendix H in this version) to list changes between this version of the document and the previous version.