

Guidelines for the Construction of Waterworks

A Construction Permit must be obtained from a Public Health Engineer before construction, installation, alteration or extension of a water supply system is commenced (see the Drinking Water Protection Act, Section 7 and Section 6 of the Drinking Water Protection Regulation). The fundamental consideration in the issuance of a permit is whether the proposed system meets appropriate public health engineering standards for that type of system and whether that system will have sufficient ability to provide appropriate water to the intended user, having regard to the water source, quality and potential threats that the system may face from source to tap and the ultimate use of that water.

The role of the Public Health Engineer is to provide an assessment of the potential health risks in the design and a public health assessment of whether the design will meet health protection objectives. Public Health Engineers must consider the Drinking Water Officers Guide in their decisions to issue construction permits. The role of the design engineer is to provide the design for the proposed water supply system or infrastructure upgrades to industry standards and water quality objectives. The design is wholly the responsibility of the design engineer.

These guidelines provide application information for the construction of a waterworks permit. Sections include:

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1.0 New Drinking Water Sources

For new sources of water, a Request for a New Drinking Water Source Evaluation (820249) must be submitted to the local Environmental Health Officer (EHO) before the submission of the application for the Construction Permit. In response, the EHO will indicate if the water is appropriate for drinking. Once the works are constructed, an Operating Permit is required from the EHO prior to a new source being used.

2.0 Submission Requirements

2.1 Application Form

- (a) Applications may be made by the water supply system staff, consultants or owner, and should be of professional quality and prepared by a professional engineer registered to practice in British Columbia.
- (b) Applications should be made in writing at least 60 business days before approval is needed
- (c) For complex systems, or systems with advanced treatment processes, preliminary or pre-design discussions with the Public Health Engineer will assist in the application process.
- (d) Include:
 - A completed Application for a Water Supply System Approval (820102) (see Appendix A for an example)
 - Sufficient design information to allow a health risk assessment of the proposed works
 - For proposed water supply system that involves more extensive works, an explanatory letter which provides:
 - the name of the water system that the proposed works is part of,
 - the name and current address of the water supplier (owner/representative)
 - that the Construction Permit is to be sent to,
 - other information as noted in the various sections

2.2 Construction Plans

- (a) Submit one complete stamped and sealed set of construction plans and specifications for proposed treatment components and/or mechanical components
- (b) Specify who will be responsible for construction inspections and post construction certification of the water supply system to ensure that materials and construction standards meet current engineering standards such as American Water Works Association (AWWA). See Section 13.0 Resources
- (c) Include:
 - a key plan/map to show location of water supply system
 - all supply, transmission, storage, pumping, treatment and distribution works (see applicable sections)
 - a plan and profile to show high and low spots in the water system

- a plan and profile of sanitary and storm sewers that are crossed or are nearby. Health risks will be identified and will require mitigation where water mains are nearer than 3 m horizontally or have less than 0.45 m clearance vertically from any sanitary or storm sewer

3.0 Source and Protection

- 3.1 The water supply should be obtained from a source that could produce drinking water quality that meets the Drinking Water Protection Act, the Drinking Water Protection Regulation and the Guidelines for Canadian Drinking Water Quality.
- 3.2 The source and source location should be chosen to minimize the potential of municipal and industrial contamination, or other types of contamination, resulting from human or animal activities within the watershed or within the aquifer recharge zone. Every effort should be made to prevent contamination of the source.
- 3.3 The water system operator should conduct routine quality monitoring of the water source. The monitoring program should attempt to recognize all potential sources of contamination and assess their present and future importance. The monitoring program and any remedial action should be determined in consultation with the EHO.
- 3.4 Wells should, in general, follow the AWWA Standard for Water Wells (A100-97) and in accordance with the Water Act, Ground Water Protection Regulation.

4.0 Quantity

- 4.1 Water supplied must be of sufficient quantity for sanitary purposes and 680 litres (150 imperial gallons) per household per day may be adequate.
- 4.2 Water for firefighting, irrigation, or other purposes, is additional to that required for sanitary purposes. For details regarding fire protection requirements, the designer should refer to the most current Fire Underwriters Survey publication entitled Water Supply for Public Fire Protection
- 4.3 The supply to the distribution system must be adequate to meet reasonable peak demands without development of low pressures that could result in health hazards from cross-connections.
- 4.4 Where new servicing and an existing water supply system is involved, confirm that capacity of the existing or proposed expanded or improved water supply system, as applicable, are, or will be, adequate to accommodate existing, already committed and proposed new servicing.

5.0 Quality

- 5.1 Water supplies for human consumption, food preparation or sanitation and other domestic uses must be free of pathogenic micro-organisms, their indicators and any drinking water health hazards. In addition, the water should have acceptable colour, odour and taste.
- 5.2 The Drinking Water Protection Act, the Drinking Water Protection Regulation and the current edition of Guidelines for Canadian Drinking Water Quality should be used as a guideline for evaluation of water sources.
- 5.3 The raw water must be sampled and analyzed for the parameters listed in the handout Should I Get my Drinking Water Tested? (HP-WQ-9009). For new drinking water supply systems with groundwater sources the testing should also include iron and sulfur bacteria

and Heterotrophic Plate Counts. Initial samples from groundwater sources should be taken near the conclusion of the pump test and after disinfecting and flushing the well as per ANSI/AWWA Standard C654, when the water is visually clear of sediment.

- 5.4 Where new servicing and an existing water supply system is involved, confirm that water quality of the existing or proposed expanded or improved water supply system, as applicable, are, or will be, adequate to accommodate existing, already committed and proposed new servicing.

6.0 Treatment and Disinfection

6.1 Treatment Design

- (a) Treatment systems should be designed to have sufficient redundancy so if one unit is out of service the remaining unit or units are capable of meeting demand
- (b) All components, chemicals etc. in contact with potable water shall be certified for use with potable water, e.g. NSF 60, NSF 61, FDA, or equivalent for potable and edible liquid contact, etc.
- (c) For complex systems, or systems with advanced treatment processes, preliminary or predesign discussions with the Public Health Engineer will assist in the application process.

6.2 Treatment Levels

- (a) Water sources for new water supply systems or new sources for existing systems using surface water or groundwater at risk of containing pathogens must be disinfected. In accordance with provincial treatment objectives, treatment such as coagulation- flocculation, adsorption, sedimentation and filtration may be needed.
- (b) Deep well sources must be disinfected if deemed necessary by the EHO for reasons of either bacteriological quality or nuisance biological growths and may require other treatment to meet the Guidelines for Canadian Drinking Water Quality.
- (c) The level of treatment and disinfection for surface supplies or groundwater under the influence of surface water must ensure a minimum of:
 - 4 log (99.99%) removal or inactivation of viruses
 - 3 log (99.9%) removal or inactivation of Giardia Lamblia and Cryptosporidium
 - 2 refers to two treatment processes for all surface drinking water systems
 - 1 for less than 1 NTU of turbidity with a target of 0.1 NTU
 - 0 E. Coli
- (d) It is acceptable to phase in the improvements to an existing system over a specified timeframe to achieve the provincial treatment objectives.
- (e) Additional testing or pilot scale studies of treatment processes may be required. Disinfection must not create unacceptable levels of disinfection by-products (trihalomethanes, haloacetic acids, chlorite or bromate). It must be safe to drink without further treatment.

6.3 Treatment Equipment

When proposing water treatment equipment it is helpful for the health risk assessment to include the following information:

- (a) description and supporting data describing the proposed treatment credits the equipment may provide;

- (b) provision of the third party validation documents to support the treatment credits sought;
- (c) equipment specifications and water quality operating range, is it the right equipment for the water quality- i.e. what is the problem and will the proposed solution work;
- (d) control/ alarm logic (e.g. if a UV unit requires a warm up period the control alarm logic should clearly indicate that the water will not flow through the system until the appropriate UV dose is reached or if the UV dose is not met the flow through the system stops)

6.4 Treatment Exceptions

Exceptions to the disinfection and/or other treatment requirements will be considered upon application from the water supply system, based on information regarding that water system's source water characteristics. The application must demonstrate that the source is adequately protected from contamination and that the bacteriological and/or physical and chemical water quality of the source consistently meets the Drinking Water Protection Act, the Drinking Water Protection Regulation and the Guidelines for Canadian Drinking Water Quality. Exceptions are conditional upon continuance of the requirements and that provision is made for the installation and operation of disinfection and/or other treatment facilities should they be required at a later date. Note that the Guidelines indicate that secure confined aquifers should disinfect to achieve 4 log virus removal or inactivation.

7.0 Storage

7.1 Impounding Reservoirs

Any earth storage facility for raw water should be designed to minimize contact between the water and organic materials such as grass, peat, trees, etc.

7.2 Finished Water Storage

Finished water storage must be adequately protected from contamination, the following design features are recommended:

- (a) Storage structures should have a cover that is watertight, opaque and vermin proof.
- (b) Drains or overflows should not have a direct connection to a sewer or storm drain.
- (c) Venting of these structures should not be by open construction between the sidewall and the roof, but by special vent structures which will exclude birds, vermin, and dust.
- (d) Manholes to these structures should be curbed and raised at least 10 cm (4 inches) above the surface of the roof at the opening and the cover should be watertight and extend down around the frame at least 5 cm (2 inches). Access manholes shall have a locking device.
- (e) It is recommended that 455 L (100 gallons)/dwelling unit be provided for emergency standby storage. Additional storage may be required for pressure regulation and for fire protection.
- (f) Steel storage tanks, and paintings and coatings for steel storage tanks, should comply with the AWWA standards for steel tanks (D100, D102, D103 or D104). Hydropneumatic tanks should be constructed to comply with the B. C. Boiler and Pressure Vessels Code.

8.0 Pumping Stations

Pumping facilities must be designed to maintain the sanitary quality of the pumped water. Subsurface pits or pump rooms and inaccessible installations should be avoided. No pumping station should be subject to flooding. A standby pump should normally be provided. Standby power should be provided at least in situations where a power failure could produce complete pressure loss in high areas of the distribution system.

9.0 Transmission and Distribution

9.1 Transmission and Distribution Design

It is recommended that a watermain:

- (a) be 100 mm (4 inches) in diameter or greater
- (b) be looped wherever economically feasible to minimize contamination risks and service disruption during repair of breaks or watermain flushing
- (c) have flush outs or hydrants for flushing purposes on dead-ends and low points
- (d) have air relief valves or hydrants or services designed to provide air relief at high points
- (e) be laid at least 3 meters (10 feet) horizontally from any sanitary or storm sewer.

Where this horizontal separation is not possible, and/or where watermains and sewers must cross or share the same trench, the watermain should be at least 0.45 m (1.5 feet) above the sewer (measured between the bottom of the watermain and top of the sewer) and sufficiently to one side of the sewer to allow for sewer repairs without disturbing the watermain. If a variance is proposed, provide in writing reason why it is necessary (for example, bedrock, or existing utilities in limited space, etc.) Provide detail of the proposed mitigation (for example, higher pressure class pipe, joint and/or structural protection, casing, etc). If neither the horizontal or vertical separation is possible then the sewers should be of the same service capability as the watermain, and should be designed to withstand high groundwater table conditions without damage to joint seals. (This also applies to watermains when depressurized).

- (f) at the bottom portion of manholes, manhole connections to sewers, service connections to sewers and joints in service connections be designed to not leak where the normal separation distances are not possible. At crossings, the watermain joints should be as far as possible from the sewer and sewer joints.
- (g) *Where new and existing works are involved, construction practices should be applied to the new works and, with possible exceptions, the existing works may remain as is.
- (h) Where watermains must cross under sewers, at least 0.45 m clear vertical separation should be provided. Protection should be detailed wherever crossings have inadequate structural separation. Wherever possible these separation practices should also be applied to water service connections.
- (i) Watermain valves should be provided to isolate reasonably sized sections of the system for repair or maintenance. It is recommended that they be placed on property line projections if possible, to make them easier to locate.
- (j) Cross connections with any sanitary or storm sewer or other source of non-potable water is prohibited. Measures should be taken to prevent freezing of watermains and services. The system should be pressure tested before use.

9.2 Disinfection of tanks, watermains, and wells

The water supplier is responsible to ensure that all new and repaired tanks, watermains, wells, etc. are disinfected before use according to the AWWA Standards or an equivalent provided for such disinfection.

- (a) Disinfecting agents commonly used in water treatment are chlorine, chlorine compounds, ultraviolet light and ozone. Other methods of disinfection will be considered if an application provides sufficient evidence to support their use.
- (b) The water quality following any treatment and disinfection should normally produce a minimum chlorine residual of 0.2 mg/L or a chloramine residual of 1 mg/L (maximum 3.0 mg/L) throughout the distribution system.
- (c) The capacity of chlorination equipment must be such that an adequate residual can be maintained when maximum flow rates coincide with anticipated maximum chlorine demands. The equipment must be of such design that it will operate accurately over the entire anticipated flow, including low chlorine demand and low flows.
- (d) If gas chlorine is used, a separate room and operator protection must be provided including fan ventilation from floor level to an approved area, viewing window, exterior light and fan switches, chain secured storage for cylinders, chlorine container repair kit, breathing apparatus, emergency eye wash facilities, chlorine leak monitoring and alarm equipment. Additional guidelines for gas chlorine are available from the Work Safe BC.
- (e) If powdered chlorine is used, storage facilities should preclude contact with moisture or organic materials and should be mechanically vented to an approved area.
- (f) If needed, to ensure reliable, effective and continuous disinfection, additional facilities such as standby equipment, flow pacing, residual monitoring, automated recording and controlling equipment and alarms should be provided.
- (g) A chlorine test kit (DPD) suitable for measuring both free and total chlorine residual over a range of 0 to 2.0 mg/L, should be provided when chlorine is used. Test kits with either a scale or digital readout are preferable to those which rely on visual colour comparison, particularly for measurements below 0.5 mg/L, and should be provided.
- (h) If the distribution system does not have a chlorine residual, other methods of monitoring distribution system should be proposed.

10.0 Manuals, Guidelines and Written Plans

- 10.1 Where applicable provide an equipment maintenance manual, operating guidelines and a written Emergency Response Plan (as required by the Drinking Water Protection Act, Section 10; Drinking Water Protection Regulation, Section 13). The submission may be in draft form for review. Comments may be provided to the DWO for consideration with respect to the Operating Permit.
- 10.2 An Emergency Response Plan is a requirement for all water supply systems with Operating Permits.
- 10.3 Where applicable, provide a description of the planned physical, chemical and bacteriological water quality monitoring program including parameters, frequency and duration. This is important for new systems and systems that are upgrading a treatment system or adding reservoir storage. Comments may be provided to the EHO for consideration with respect to the Operating Permit.

11.0 Small Systems

For a small water supply system serving fewer than 50 people or the equivalent (14 or less service connections) resolving existing water problems the procedures outlined above will generally apply. The submission may be modified at the discretion of the Public Health Engineer, as follows:

- 11.1 Include recent bacteriological, physical and chemical analysis of the proposed source and, if warranted, contamination protection plans.
- 11.2 Be of reasonable quality, with an explanatory letter and plans preferably prepared by a Professional Engineer. It should indicate the steps, and phasing if necessary, for the water system to achieve the provincial treatment objectives.
- 11.3 Include the name and address of the water supplier or person responsible for the water system operation and include documentation outlining the legal basis for operation - Municipality, Regional District, Improvement District, Water Utility under the Water Utility Act, Water Users Community under the Water Act, Strata Corporation, Privately Owned (mobile home parks, campsites), etc.
- 11.4 Have enough information to allow a health risk assessment.
- 11.5 Be robust in design and not overly complex to allow for sustainable operations.
- 11.6 In recognition of the nature and often remote location of these small/rural systems, written operating and maintenance instructions, a written Emergency Response Plan and a written sampling/water quality-monitoring plan. A draft copy may be submitted to the EHO with comments for the Operating Permit.
- 11.7 An Operating Permit must be obtained from the EHO before a new source is used. New works (e.g. treatment components) may require amendments to the existing operating permit, operating plans and emergency response plans.

Notes: The publication Design Guidelines for Rural Residential Community Water Systems is available from the Water Stewardship Division, Ministry of Forests, Lands, and Natural Resource Operations, in Victoria, and can be used as a design guideline. Another industry standard is the [Recommended Standards for Water Works](http://www.10statesstandards.com/waterstandards.html)(<http://www.10statesstandards.com/waterstandards.html>)

12.0 Other Agencies

Where applicable, confirm that the water system meets all local government bylaws. Some regional districts may choose to avoid the creation of several small water supplies in proximity and offer incentives for amalgamation. Identify any other drinking water supply systems that might be affected by proposed works. Provide any other relevant approvals from other agencies.

12.1 Comptroller of Water Rights

Where a water utility is involved, confirm that the design incorporates the wishes of the Comptroller of Water Rights, via the Water Stewardship Division, Ministry of Forests, Lands, and Natural Resource Operations, in Victoria.

12.2 Ministry of Transportation

Where water supply systems are to be installed on road easements under the jurisdiction of the Ministry of Transportation, confirm that an approval has been received for the specific proposal and state any conditions specified.

13.0 Resources

AWWA Standards for Disinfection
BC Drinking Water Officers Guide
BC Drinking Water Protection Act & Regulation
Guidelines for Canadian Drinking Water Quality
Recommended Standards for Water Works (10 State Standards)

APPENDIX A-EXAMPLE APPLICATION FOR A WATERWORKS CONSTRUCTION PERMIT



Application for a Water Supply System Approval

Water Supply System Name <i>Somewhere Improvement District</i>		Date (dd/mm/yyyy) <i>01/06/2014</i>
System Site Address <i>123 Main Street</i>		City <i>Nowhere</i>
<p>Note: Construction permits are required by the Drinking Water Protection Act and must be obtained before the construction, installation, alteration or extension of a water supply system. A construction permit will be issued if it is found to meet appropriate public health engineering standards for that type of system. Operating Permits are required prior to operating as per the Drinking Water Protection Act. This applies to systems supplying water to more than one single residence.</p>		
<p>What are you applying for? <i>Check all that apply:</i></p> <p><input checked="" type="checkbox"/> Construction Permit</p> <p><input type="checkbox"/> Operating Permit</p>	<p>Why are you applying?</p> <p><input type="checkbox"/> New Water Supply System</p> <p><input type="checkbox"/> Existing Water Supply System needing approval</p> <p><input type="checkbox"/> Replacement Alteration Work</p> <p><input checked="" type="checkbox"/> System Extension</p> <p><input type="checkbox"/> New Source (<i>Complete this prior to construction permit phase</i>)</p> <p><input type="checkbox"/> I need to change the name of the Legal Owner</p> <p><input type="checkbox"/> I need to change the name of the water supply system. What was the previous name of the water system:</p>	
<p>If this application is being submitted less than 60 working days in advance of the requirement for approval, please indicate the anticipated construction or tender date: <i>August 2014</i></p>		
How can we contact you?		
Owner(s) or Proposed Owner(s) <i>Somewhere Improvement District</i>		
Owner Contact <i>Joe Brown</i>		
Type of Ownership	<input type="checkbox"/> Private <input type="checkbox"/> Society <input type="checkbox"/> Water Users Community <input type="checkbox"/> Partnership	<input checked="" type="checkbox"/> Improvement District <input type="checkbox"/> Regional District <input type="checkbox"/> Strata Corporation <input type="checkbox"/> Sole Proprietorship
<input type="checkbox"/> Government Are you a <input checked="" type="checkbox"/> Corporation	<input type="checkbox"/> Municipality <input type="checkbox"/> School District <input type="checkbox"/> Utility (Utility Act) <input type="checkbox"/> Society	
Mailing Address <i>Box 4567</i>	City <i>Nowhere</i>	
Email <i>joe.brown@sid.ca</i>	Postal Code <i>V2A 9A9</i>	
Phone <i>250-123-4567</i>	Cell <i>250-345-6789</i>	Fax <i>250-123-7890</i>
Engineer of Record		
Mailing Address <i>987 Back Street</i>		City <i>Nowhere</i>
Email <i>mac@nonameengineering.ca</i>		Postal Code <i>V2A 1B2</i>
Phone <i>250-123-7777</i>	Cell <i>250-123-9999</i>	Fax <i>250-123-8888</i>
Water System Operator		
Mailing Address <i>Box 4567</i>		City <i>Nowhere</i>
Email <i>joe.brown@sid.ca</i>		Postal Code <i>V2A 1B2</i>
Phone <i>250-123-4567</i>	Cell <i>250-345-6789</i>	Fax <i>250-123-7890</i>

820102 Aug 07-13

Water System Details

Choose the number of connections
 Note: If this is an existing system, choose the total number of connections once the work is complete.

14 or less connections
 301 - 10,000 connections
 > 20,000 connections
 15 - 300 connections
 10,001 - 20,000 connections
 Bulk Water Hauler, name source of water

What is the population served by this water system?

If this is an existing system, is the water on a water notification such as Boil Water Notice?
 Yes No *if YES what type of notification?*

Months of Operation: All Year or Seasonal
 Open from _____(month) to _____(month)

Construction Information

Application must be complete – incomplete applications will be returned. An example of a completed application is provided in the HP-WQ-9021 Guideline for Construction of Waterworks.

Description of proposed works (source, treatment, reservoir size, number of pressure reducing valves, etc.)
 Watermain extension

Location of proposed works (with enough information for the Public Health Engineer to locate site)
 9999 Whatever Street, Nowhere, BC

If a water main extension/replacement is proposed, provide description:
 Extension of existing system to service new subdivision

Length (m)	Size (mm)	Pressure Rating (Class)	Material
1222m	300m		PVC

How many new lots or dwelling units will be serviced? 10

Does the design show that the existing system has adequate capacity to serve existing, committed and proposed new lots? Yes No

Are you attaching a drinking water evaluation form 820249 Request for New DW Source Evaluation? Yes No