B.C. SPRINKLER IRRIGATION MANUAL

Chapter 2

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LIMITATION OF LIABILITY AND USER'S RESPONSIBILITY

The primary purpose of this manual is to provide irrigation professionals and consultants with a methodology to properly design an agricultural irrigation system. This manual is also used as the reference material for the Irrigation Industry Association's agriculture sprinkler irrigation certification program.

While every effort has been made to ensure the accuracy and completeness of these materials, additional materials may be required to complete more advanced design for some systems. Advice of appropriate professionals and experts may assist in completing designs that are not adequately convered in this manual.

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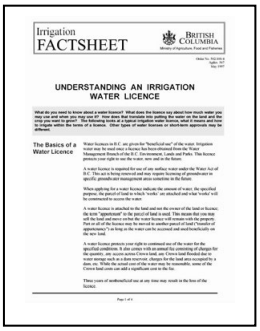
2 LEGISLATION AND GOVERNANCE

Water supply for agricultural irrigation in British Columbia is usually from surface water sources such as lakes, streams, rivers or reservoirs; groundwater wells; or from a municipality or other water purveyor. This chapter provides irrigation system designers with a number of licensing, bylaws, permits and guidelines that they must be aware of with respect to the withdrawal and use of water in British Columbia.

2.1 Water Withdrawal

Surface Water Licence


Irrigation FACTSHEET

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UNDERSTANDING AN IRRIGATION WATER LICENCE

The Basics of a Water Licence

An irrigation system drawing water from a surface water source will require a water licence issued by the Province of BC under the *Water Act*. Water licences specify various conditions, such as the purpose of water usage, the quantity that can be extracted on an annual basis, the area that can be irrigated, the peak withdrawal rate, the amount of storage (if any), the time period it can be used, and the location of withdrawal and usage.

Understanding an Irrigation Water Licence

Annual Water Use

Water licences permit the use of an annual volume of water that may be extracted from a surface water source. Groundwater licencing had not been implemented at the time of publishing but will likely be enacted sometime in the future. The annual water volume stated on a licence cannot be exceeded. Section 4.6 provides a method for determining the annual irrigation water demand for various crops.

Water Withdrawal Rates

Historically, water licences have not listed peak withdrawal rates (e.g., a pumping rate). However, more recent irrigation licences have started to list a

peak withdrawal rate in U.S. gallons per minute (US gpm). These rates are calculated using proper irrigation practices, the provincial region and the amount of area to be irrigated. The peak withdrawal rate stated on a licence cannot be exceeded. Irrigation designers must ensure that the irrigation system is designed not to exceed the licenced peak withdrawal rate stated on a licence. Section 4.5 provides a method for determining a peak irrigation system flow rate that can be used to estimate withdrawals from streams or wells if this information is not provided on a licence.

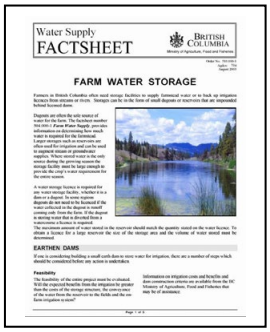
Clarification – Peak Withdrawal Rates

Tables 4.6 and 4.7 provide a simple methodology for determining the peak withdrawal rate for a water licence. The methodology uses the acreage to be irrigated and the peak ET rate for the location. The peak flow rate is determined in US gpm/acre and will then have to be converted to the appropriate units used on a water licence.

Tables 4.6 and 4.7 also takes into account a risk factor of 10%, meaning that using historical data the farm may be short of water one in ten years during the peak of the summer. The risks may go higher due to climate change. See section 4.7.

The design Examples 5.1, 6.2 use different methodologies for calculating the system flow rate. Using soils and climate information Example 5.1 does not include a 10% risk factor using historical climate. Example 6.2 uses table 4.6 and therefore a risk factor of 10% is included.

Water Storage


Water Supply
FACTSHEET
BRITISH COLUMBIA
FARM WATER STORAGE
EARTHEN DAMS

A water licence permits water storage, such as behind a dam or in a dugout to provide irrigation water, either as the sole source of water or to augment stream or groundwater supplies. Storage of water behind a dam must always be licensed.

In some regions, dugouts do not need to be licensed if the water stored is collected from on-farm runoff. If the dugout stores water coming from a watercourse, a water licence for storage and usage is required. The maximum amount of water stored and when it is stored must comply with the water licence according to the *Water Act*.

Farm Water Storage

Groundwater

At the present time, there is no groundwater legislation in British Columbia that requires a permit to extract water from a well. However, the peak flow rate and annual water use should follow the methodology as outlined in Chapter 4 of this Manual. This will ensure that the peak flow rates taken from a well are similar to what is authorized under a surface water licence. Therefore, should groundwater licencing be implemented in the future, the well, pump size and irrigation system peak flow rate established will be close to the licencing requirement.

Crop, Soil and Climate, Chapter 4

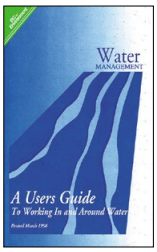
The Province of British Columbia passed the British Columbia Ground Water Protection Regulation on November 1, 2005. This new regulation protects ground water supplies by establishing new standards for well construction including surface seals, a secure well cap, minimum ground clearances as well as other requirements.

The new regulations require Qualified Well Drillers (QWD) to drill new wells in the province of British Columbia and Qualified Well Pump Installers (QWPI) for all pumps to be installed in wells. A full list of the new regulations can be found at the following website: http://www.env.gov.bc.ca/wsd/plan_protect_sustain/groundwater/index.html

2.2 Intake Installation and Maintenance

In B.C., it is a requirement to obtain a water licence through the Province to withdraw water from surface water sources for irrigation purposes.

Intake Construction



A water licence authorizing the withdrawal of water will also provide the authority required to install an intake at the location of the withdrawal point. If a different withdrawal point is chosen or authority is not given by the licence, the installation of an intake requires approval from the Province.

A Users Guide to Working In and Around Water

Intake Maintenance

Every irrigation diversion or intake that is taking water from a water source and is frequented by fish must be screened with an appropriate screen that will prevent the passage of fish into the intake or diversion.

Section 30 of the Fisheries Act requires that the maintenance of the intake screen authorized by a water licence must be conducted in a manner and during a period that minimizes impacts on water quality for existing licensed users and fish.

Fish Passage at Weirs and Dams

Water control structures, such as reservoir dams, weirs, flood boxes and pump stations on fish-bearing watercourses, may require fish passage structures. Such structures are specific to fish species requirements, and should be selected after consultation with the Province of B.C.

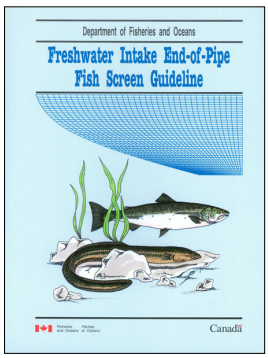
Habitat Disturbance during Intake Installation

Under the *Water Act*, changes in or about a stream require approval from the Province. Refer to the publication "A Users Guide to Working In and Around Water" for a complete listing of the types of work and the required approvals.

A Users Guide to Working In and Around Water

Fish Screening at Water Intakes

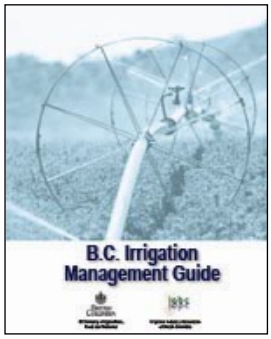
Irrigation intakes are often screened to prevent debris from entering the system. Screening is also required to protect fish from getting sucked into the pipes. Guidelines have been developed for intake screening on fish-bearing watercourses. The guidelines contain information on appropriate screen sizes for various intake flow rates. Chapter 10 provides additional information.

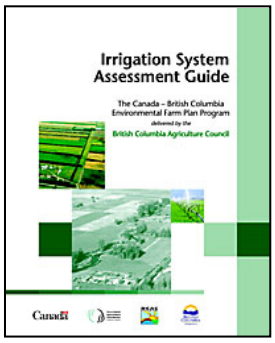


Freshwater Intake End of Pipe Fish Screen Guideline

Diversions and Intakes, Chapter 10

Irrigation System Assessment





The peak flow rate, annual water use and fish screen area as determined by various acts, bylaws or other legislation must be followed. If the irrigation system does not comply with the any of these, an irrigation assessment should be done to find out how these problems can be remediated. Information on conducting an irrigation assessment is available in the Irrigation System Assessment Guide for sprinkler and trickle systems under the B.C. Environmental Farm Plan Program, and in the B.C. Irrigation Management Guide for other system types.

B.C. Irrigation Management Guide

Irrigation System Assessment Guide

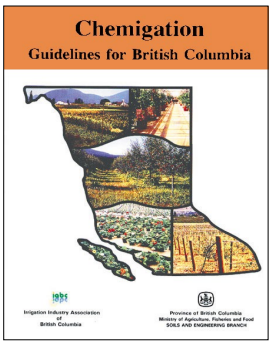
2.3 Chemigation and Reclaimed Water Use

Irrigation systems may be used to apply chemicals for disease and pest control or fertilizers to improve crop production. Reclaimed water is also seen as a viable source of irrigation water for agriculture. The injection of chemicals into an irrigation system or the use of reclaimed water by an irrigation system requires that certain bylaws, regulations or guidelines are met.

Chemigation

Chemigation is the practice of injecting chemicals into an irrigation system. Chemicals may be injected to improve the performance of the irrigation system, such as chlorine or acids in drip systems, or applied to the crop or field to treat pests, such as fertilizers, herbicides, insecticides, fungicides, nematocides and growth regulators.

There are Federal and Provincial Legislations as well as municipal bylaws that govern the use of pesticides and fertilizers with chemigation. Users must be aware of the legislation. The Manual "Chemigation Guidelines for British Columbia" provides guidelines on the laws and regulations regarding chemigation use as well as information on how to operate irrigation systems for chemigation.

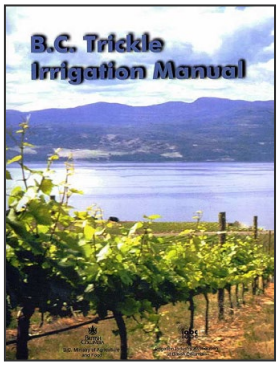


Safety considerations include personal safety and protection of drinking water supplies. Many of the water sources used for agricultural irrigation purposes are also potable water supplies. Proper cross-connection control procedures should be used to prevent contaminated water from entering a potable water source. Before applying herbicides or insecticides through an irrigation system, check to ensure that the product label specifies:

- the chemical is registered for the pest to be controlled
- the chemical can be used for the crop to be treated
- the irrigation system used is an acceptable method of application

Chemigation Guidelines for British Columbia

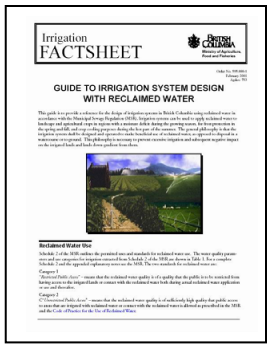
Irrigation System Cross Connection Control

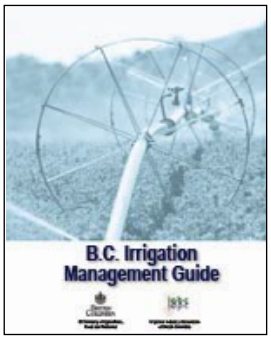


If planning a new irrigation system that will be applying chemicals, a Certified Irrigation Designer (CID) should be retained to design and provide a certified irrigation plan. This Manual and the BC Trickle Irrigation Manual provide the standards Certified Irrigation Designers are required to follow in British Columbia.

B.C. Trickle Irrigation Manual

Reclaimed Water





The Municipal Sewage Regulation (MSR) of the Waste Management Act (WMA) allows for the use of reclaimed water on agricultural crops. Water purveyors that wish to supply reclaimed water to agricultural areas must ensure that the reclaimed water meets the quality standards outlined in Schedule 2 of the Regulation. The permitted agricultural uses are provided in the factsheet "Guide to Irrigation System Design with Reclaimed Water" and in Table 10.1 of the "B.C. Irrigation Management Guide".

Guide to Irrigation System Design with Reclaimed Water

B.C. Irrigation Management Guide, Table 10.1

The two water quality standards outlined in the regulation allow reclaimed water to be used in areas with restricted public access and unrestricted public access.

Category 1: Restricted Public Access

Category 1 reclaimed water requirements are at a level more stringent than most discharge effluent standards, though the resulting quality still requires that the public be restricted from contact with it, including access to land irrigated with the reclaimed water.

Category 1 reclaimed water uses are limited to activities where:

- The public will not likely come into contact with the reclaimed water.
- Sufficient time has elapsed since treatment or use prior to public contact.
- In the case of agricultural products, a commercial process has been applied to make the product safe for distribution.

Considerations for the irrigated use of Category 1 reclaimed water are:

- Irrigation through sprinkler systems may only be applied to forage, fibre, nursery and turf, or food crops that are commercially processed.
- Trickle/drip irrigation systems may be used on orchard and vineyard crops provided that the reclaimed water does not contact the fruit.
- Spring frost protection is allowed but crop cooling and autumn frost protection are not.
- Category 1 reclaimed water must not be applied to crops that will be eaten raw, except for orchard and vineyard crops as qualified above.

Category 2: Unrestricted Public Access

Category 2 reclaimed water is of sufficient quality that the MSR and the code allow public contact with it, e.g., public access to land irrigated with the reclaimed water. The restricted public access category is of lower quality and has restrictions on public access.

Category 2 reclaimed water may be applied:

- by sprinkler irrigation systems to forage, fibre and nursery crops
- by sprinkler systems to food crops that are commercially processed
- to crops that will be eaten raw, provided that the water does not contact the fruit or vegetable directly

Drip and trickle systems must be used for sweet corn, berry and fruit crops. Vegetable crops must be irrigated with a subsurface drip irrigation system. Root crops may not be irrigated with reclaimed water if they are likely to be eaten raw. Processed vegetables should be thoroughly washed and cooked.

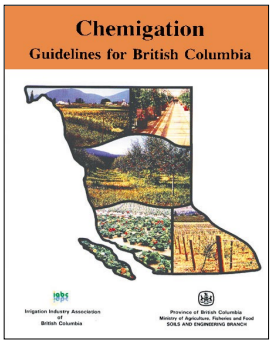
Extra precautions should be taken with sweet corn and some cole crops. Water that accumulates inside the husks may not have an opportunity to drain away, and may be shielded from the disinfecting effects of sunlight. There is greater potential for bacteria growth under these conditions.

2.4 Backflow Prevention Requirements

Irrigation systems are often deemed to be a cross connection with a potable water source. Where a cross connection has been determined, the installation of a backflow prevention device is required to protect the water source from contamination. There are codes, bylaws and standards that must be followed when designing an irrigation system when a cross connection is a consideration.

Codes and Bylaws

BC Plumbing Code



The B.C. Plumbing Code sets minimum requirements for backflow prevention from buildings to the point of connection with public services. Water purveyors may set more stringent standards but cannot set standards that are less rigorous than what is outlined in the B.C. Plumbing Code.

Section 6.2 of the Plumbing Code provides information on protection from contamination from cross connection systems. These standards are shown in Section 4, Cross Connection Control, of "Chemigation Guidelines for British Columbia"

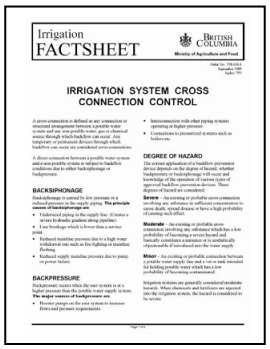
Chemigation Guidelines for British Columbia

Municipal Bylaws

Municipalities, Irrigation Districts and other water purveyors may make bylaws governing the requirements for backflow prevention. Many water purveyors will have adopted a bylaw similar to the example shown in Appendix A of "Chemigation Guidelines for British Columbia". Contact your water purveyor to obtain a copy of the bylaw that pertains in your area.

Many bylaws may specify which type of backflow prevention device must be used. Backflow prevention devices should be tested upon installation and once every year after that. The device must be tested by a certified tester who is familiar with the design and intended operation of the device.

Backflow Prevention


Irrigation
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IRRIGATION SYSTEM CROSS CONNECTION CONTROL

BACKSIPHONAGE

BACKPRESSURE

DEGREE OF HAZARD

A backflow preventor is a device used to protect a potable water source supply from accidental contamination. Irrigation systems may be considered a cross connection source that may put potable water sources at risk. Drip irrigation systems often lay on the surface and may have pesticides, herbicides or fertilizers enter the lines through the emitters. Sprinkler irrigation systems also come in contact with pesticides through crop spraying which may be a source of contamination. Irrigation systems that apply chemicals are definitely a source of potable water contamination.

Irrigation System Cross Connection Control

Chemigation Guidelines for British Columbia

The water source, irrigation system type and what the irrigation system is used for all determine the minimum type of backflow prevention unit that should be used. For example a greenhouse obtaining water from a purveyor but storing it in a tank before pumping from the tank into the irrigation system can use a 30-cm air gap between the water supply line and the irrigation storage tank as an approved backflow prevention method. In this case the air gap protects the potable water supply and additional backflow prevention is not required. Also where the irrigation water is supplied by a self contained reservoir a backflow preventor is usually not required.

Most irrigation systems however are directly connected to the water supply. Where the water source is a potable supply, an approved backflow prevention device should be installed. Table 2.1 provides guidance on the suggested minimum backflow prevention requirements for irrigation and chemigation systems from various water sources.

Table 2.1 Minimum Backflow Prevention Requirements for Irrigation Systems		
Water Use / Water Source	Irrigation	Chemigation
Reclaimed Water	PVB	---
Groundwater	RP	RP
Water Purveyor	DCVA	RP
Surface Water	---	RP
Self-Contained Reservoir	---	---
Liquid Manure	---	RP or Air Gap

PVB = Pressure Vacuum Breaker
RP = Reduced Pressure (device)
DCVA = Double Check Valve Assembly

Air Gap

A 0.25-m air gap can be an effective backflow prevention device. Air gaps are most commonly used where the water source for the chemigation system is a self-contained pond or reservoir. The air gap must be maintained between the maximum surface elevation of the reservoirs for irrigation supply and frost protection and can utilize an air gap as a backflow prevention device.

Pressure Vacuum Breaker

A pressure vacuum breaker (PVB) has an atmospheric vent valve which is internally loaded by a spring. A spring helps open the valve and the PVB can therefore be installed on the pressure side of a shutoff valve and used in situations that are operating under continuous pressure. A PVB must be installed 30 cm (12 in) above the highest sprinkler or dripper on the chemigation system.

Acceptable use of atmospheric and pressure vacuum breakers include situations where non-potable water is pumped into an irrigation system that is cross-connected to an irrigation district or municipal pipeline where only backsiphonage is likely. PVBs are not approved for use on irrigation systems that are applying chemigation.

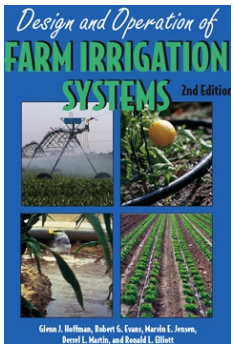
Reduced-Pressure Device

A reduced-pressure (RP) device consists of two independently acting, internally loaded check valves separated by a reduced-pressure zone. The device should be installed as a unit between two tightly closing shutoff valves. The RP, while slightly more costly, is considered the best protection for backflow prevention. The main reason is that the unit will leak water when it is not operating properly, allowing a quick visual inspection to inform the operator if the unit is malfunctioning. The unit can then be fixed

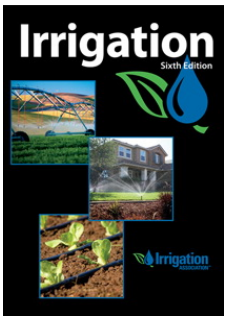
prior to chemigation proceeding. An RP must be installed upstream of the chemical injection system and preferably above ground with adequate space to ease maintenance and testing. A strainer with a blow-out tapping should be installed ahead of the RP. The lines should be thoroughly flushed before installation of the RP. Most failures during testing are due to debris fouling either the first or second check valve seats. If possible, the RP should not be installed in a pit below ground level. Flooding of the pit could cause a direct cross-connection through the relief valve. If installation in a pit is absolutely necessary, adequate drainage must be provided. Devices that are larger than 6.4 cm (2.5 in) shall have support blocks to prevent damage. An RP is susceptible to fluctuating supply pressures on an extreme low flow or static flow condition, which may cause nuisance dripping and eventual fouling of the device. The RP shall be inspected and tested after installation to ensure it is installed correctly and operating satisfactorily, and it must be tested by a Certified Tester before every irrigation season. The RP must be drained in the fall and protected from freezing. The manufacturer can provide recommendations on how to drain each water-trapping cavity of the device.

Double Check Valve Assembly

A double check valve assembly (DCVA) consists of two approved check valves, internally loaded either by a spring or weight, installed as a unit between two tightly closing shutoff valves. The DCVA is an approved backflow prevention device effective against backflow caused by backpressure or backsiphonage. The DCVA must be installed upstream of the chemical injection system at a location that is readily accessible for testing.



The irrigation lines should be thoroughly flushed before installation of the DCVA. Most failures during testing are due to debris fouling either the first or second check valve seats. The DCVA should be installed above ground with adequate space to simplify maintenance and testing. It shall be inspected and tested after installation to ensure it is installed correctly and operating satisfactorily. A strainer with a blow-out tapping should be installed ahead of the DCVA. The DCVA, like the RP, must be drained in the fall and protected from freezing. Again, the manufacturer can provide recommendations on how to drain all water-trapping cavities of the device. The DCVA must be tested by a Certified Tester before every irrigation season.



If possible, a DCVA should not be installed in a pit because any leaky test cocks would then become cross-connections when the pit is flooded. If the unit must be installed in a pit, provisions for pit drainage must be provided. Test-cock taps should also be plugged to reduce the danger of leaks if the device does become submerged. The vault should be large enough to provide free access for testing or repairing the device, DCVAs larger than 6.4 cm (2.5 in) shall have support blocks to prevent damage.

Design and Operation of Farm Irrigation Systems, 2nd Edition, Chapter 19

Irrigation, 6th Edition