REFERENCE GUIDE

THE CANADA - BRITISH COLUMBIA ENVIRONMENTAL FARM PLAN PROGRAM

CANADIAN AGRICULTURAL PARTNERSHIP

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BRITISH COLUMBIA

ENVIRONMENTAL FARM PLAN PROGRAM

REFERENCE GUIDE

ENVIRONMENTAL FARM PLAN

For Use with the Publication

Canada - British Columbia Environmental Farm Plan:
PLANNING WORKBOOK

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Sixth Edition

During the development of the 2005 ordinal guide input was solicited or received from the following groups and organizations. Some of the names have changed from that time and are reflected here.

Producer Groups

Abbotsford Soil Conservation Association
Associated Ginseng Growers of BC
BC Agriculture Council
BC Association of Cattle Feeders
BC Bison Association
BC Blueberry Council
BC Broiler Egg Producers Association
BC Cattleman's Association
BC Cherry Association
BC Chicken Growers Association
BC Christmas Tree Council
BC Cranberry Growers Association
BC Dairy Association
BC Egg
BC Forage Council
BC Fruit Growers' Association
BC Goat Association
BC Grain Producers Association
BC Grape Growers' Association
BC Greenhouse Growers' Association
BC Honey Producers Association
BC Hot House
BC Landscape & Nursery Association
BC Llama and Alpaca Association
BC Pork
BC Potato & Vegetable Growers Association
BC Sheep Federation
BC Strawberry Growers Association
BC Turkey
BC Vegetable Marketing Commission
BC Wine Institute
Cariboo Sheep Breeders' Association
Certified Organic Associations of BC
Comox Valley Farmers Institute
Fraser Valley Cole Crop Growers Association
Fraser Valley Peas, Bush Beans and Corn Growers Association
Horse Council of BC
Inter-Island Sheep Breeders Association
Lower Mainland Sheep Producers Association
Nanaimo-Cedar Farmers Institute
Peace River Forage Association
Peace River Soil and Water Conservation District
Raspberry Industry Development Council
Sustainable Poultry Farming Group
United Flower Growers'
Western Canada Turfgrass Association

Government Agencies

Agriculture and Agri-Food Canada
BC Ministry of Agriculture, Food and Fisheries
BC Ministry of Forests, Lands, Natural Resource Operations & Rural Development
BC Ministry of Health
BC Ministry of Environment and Climate Change
Canada Wildlife Service [CWS]
Canadian Food Inspection Agency
Environment Canada
Fisheries and Oceans Canada [DFO]
Provincial Agricultural Land Commission

Non Government Agencies

British Columbia Institute of Agrologists
Ducks Unlimited Canada
Malaspina University College
UBC Faculty of Agricultural Sciences
Union of BC Municipalities
University College of the Fraser Valley – Agricultural Department

LIMITATION OF LIABILITY AND USER'S RESPONSIBILITY

The primary purpose of the Environmental Farm Plan is to assist producers in assessing environmental risk on their farms.

While every effort has been made to ensure the accuracy and completeness of these materials, these materials should not be considered the final word on areas of practice that they cover. You should seek the advice of appropriate professionals and experts as the facts of your situation may differ from those set out in the materials.

All information in this guide and related materials is provided entirely "as is" and no representations, warranties or conditions, either expressed or implied, are made in connection with your use of or reliance upon, this information. This information is provided to you, as the user, entirely at your risk.

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INTRODUCTION 1

The long term wellbeing of farms and ranches depends on good quality soil, water, air and other natural resources. In order to preserve these resources good management needs to include protection of the environment. An effective way to accomplish this broad goal is through sound environmental farm planning.

The measures necessary to sustain natural resources over the long term will depend on types of livestock raised, crops grown, farm or ranch locations within the Province and on production practices. Practices described in this publication may not be suitable for all producers due to differences in weather, soil and other conditions. Additional measures may be necessary for operations where specified practices described in this publication do not protect the environment adequately. It is in the best interest of producers to determine the necessary environmental precautions for their specific situation.

This Reference Guide provides information on various environmental laws and makes suggestions for environmentally sound practices. It is the primary reference when completing worksheets in the *British Columbia Environmental Farm Plan: Planning Workbook*. This assessment and planning process is not a legal requirement; it is a voluntary one to help producers identify areas where environmental improvements should occur on a farm or ranch.

This Reference Guide is intended for **all agricultural producers** in British Columbia. Suggested planning and management practices were developed with the cooperation of the BC Agricultural Council, BC Agriculture and Research Development Corporation, producer associations, and government and non-government agencies. Note that this publication and the companion **Planning Workbook** are designed for use on privately owned farmland. However, the discussions and principles apply to all land used for agricultural production.

USE OF THIS PUBLICATION

Publication Format

Chapters 2, 3, 4, 5 and 6. These chapters cover general information on all areas of environmental management related to **FARM PRODUCTION** (Farmstead, Livestock, Crops, Pest Management, and Nutrient Application).

Chapters 7, 8, 9, and 10. These chapters cover general information on all areas of environmental management related to **RESOURCE PROTECTION** (Biodiversity, Soils, Water, and Air).

Chapters 11 and 12. These chapters cover broad **ENVIRONMENTAL CONCEPTS** within the context of agricultural production (Stewardship Areas and Climate Change).

Each of chapters 2 to 12 has the following format:

- **a chapter "tab sheet"** lists metric to imperial conversions of all measurements used in the chapter (except Table & Worksheet numbers), and has the chapter contents list on the reverse side;
- an "Introduction" that lists all subsections;
- the **first section** in **farm production** chapters 2, 3, 4, 5 and 6 that outlines interaction with the environment are highlighted by a brown colour bar (e.g., in Chapter 4, in the **Crops** and **the Environment** section, the relationship and importance of crops in the nutrient cycle is discussed);
- the **first section** in *Resource Protection and Environmental Concept* chapters 7, 8, 9, 10, 11 and 12 provides the factors associated with potential Environmental impacts (e.g., in Chapter 9, the **Water Quality and Quantity Factors section** deals with specific farm practices: for each practice the primary concerns, legislation and beneficial management practices are covered.

ENVIRONMENTAL CONCERNS

This section highlights the primary environmental concerns associated with the specific practice

LEGISLATION

This section has a brief outline of the main legislation pertaining to the practice; this section **must not** be considered to be complete; an outline of other legislation that may also apply is in Appendix A

BENEFICIAL MANAGEMENT PRACTICES

This section recommends beneficial management practices that address the environmental concerns that are listed in the above section

Appendix A. Lists primary legislation affecting agriculture and the environment.

Appendix B. Provides climatic and irrigation information.

Appendix C. Lists all publications and Internet web site addresses referred to in the text.

Appendix D. Lists glossary of terms used, as well as closely related terms.

Appendix E. Features a detailed metric to imperial conversion table.

Index. Contains an alphabetical list of subject matter with page numbers.

Conventions and Definitions

Commonly used acronyms and styles in this publication are:

- **AFF** for the BC Ministry of Agriculture, Food and Fisheries;
- **ENV** for the BC Ministry of Environment and Climate Change Strategy;
- *italics* – identifies a piece of legislation;
- **bold** or ***bold*** – emphasizes particularly important information;
- 📖 – indicates a reference publication (listed in Appendix C.1);
- 💻 – indicates website information (listed in Appendix C.2);
- 📄 – indicates online pdf information (listed in Appendix C.2);
- ➔ – means go to the page within this publication for more information;
- e.g., – means "for example", and is not necessarily all inclusive;
- i.e., – means "that is", and is meant to further define a word or phrase;
- in the Beneficial Management Practice sections:
  - "*xx* m or more (suggested)" – means a distance suggested as a practice;
  - "at least *xx* m (Act or Regulation)" – means a distance required by legislation.

Equations. These are included within the Worksheets.

Worksheets. These are laid out in using a format of "question, calculation, answer". Within the Reference Guide, Worksheets are filled out as examples – blank Worksheets are available in the Planning Workbook.

Tables. These are shown on a tan background. If the information is used in a Worksheet, it is indicated in the right-hand end of the title bar.

Crops. Includes all agricultural crops.

Livestock. Includes all farmed animals and birds.

Legislation. References to legislation in this publication are current at the time of writing. However, legislation and the procedures to obtain permits and approvals will be changing over the next several years. ***If in doubt about the currency and validity of given legislation, contact the appropriate environmental agency.***

Distance measurements given in legislation are meant to be horizontal, unless stated as "depth".

Legislation is identified by either a Canadian or British Columbian flag:

Federal Legislation Provincial Legislation

Metric Measurements. This publication uses metric units **except** in the Water Supply and Irrigation sections where units of water are in US gallons and area is in acres.

Metric measurements are written in abbreviated form. For instance, 30 m means 30 metres, 1 km means 1 kilometre, etc. Conversions for all metric numbers used in each chapter are given on the chapter "tab page" (except Tables & Worksheets).

Environmental Farm Plans

This publication is to be used by producers as a reference when completing the *Environmental Farm Plan: Planning Workbook*. However, it also directs a producer to specialized *Management Publications*, where appropriate. These management publications are available for subjects such as Grazing, Integrated Pests (IPM), Nutrients, Riparian Areas, Irrigation, Biodiversity and Drainage.

Beneficial Management Practices (BMPs)

A beneficial management practice is a farm practice which, from experience, provides environmental protection when used to carry out a particular farm activity. This publication identifies the majority of recommended beneficial management practices for the farm activities discussed. For some practices, information is referred to in separate publications.

All beneficial management practices may not need to be implemented on every farm. Some farms may be following practices, which upon review, may be found to be equal to or better than a suggested beneficial management practices.

Producers not following a prescribed practice in this Reference Guide should evaluate whether implementation of the practice will benefit the environment. Beneficial practices or their equivalents that address significant environmental concerns should be followed. Practices not addressing significant environmental concerns may still be beneficial to both the producer and the environment and may be implemented at the producer's discretion.

Limitations of this Reference Guide

All portions of this publication will not typically apply to each producer.

It is not recommended to extract portions of this publication without considering the environmental context of the entire operation.

Individuals unfamiliar with agricultural production or resource protection should not attempt to assess a farm operation based on this publication alone. This publication is not a Regulation and is not intended to be adopted into legislation. However, government agencies are encouraged to use its contents when dealing with environmental issues affecting the agricultural industry.

This publication provides advice only and does not constitute or imply approval under any federal or provincial Acts. Contact must be made with the appropriate agency whenever approvals, permits, licences and documentation are required to implement improvements.

CHAPTER 2 METRIC CONVERSIONS

Metric	Imperial Equivalent
300 mm	12 inches
15 cm	6 inches
30 cm	1 foot
1 m	3 feet
3 m	10 feet
4.5 m	15 feet
7 m	23 feet
12 m	40 feet
15 m	50 feet
30 m	100 feet
30.5 m	100 feet
122 m	400 feet
5 kg	11 pounds
50 kg	110 pounds
2 litres	0.5 gallon
5 litres	1.3 gallon
50 litres	13 gallons
100 litre	26 gallons
50 cubic metres	65 cubic yards

Conversions in this table are rounded to a convenient number.
See Appendix E for exact conversion factor.

Values from tables and examples are not included in Metric Conversions

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CHAPTER 2

FARMSTEAD

INTRODUCTION

This chapter discusses farmstead management for protection of the environment. It contains introductory information on the relationship between the farmstead and the environment. It also contains information on environmental concerns, legislation and beneficial management practices related to:

- Buildings and roads;
- Farm waste,
- Chemical fertilizer,
- Petroleum,
- Wood residue,
- Compost,
- Energy use,
- Heat production and agricultural boilers; and
- On-farm processing and sales.

FARMSTEAD AND THE ENVIRONMENT

The primary role of the farmstead is to be the headquarters for farm production. Most farm construction, handling of wastes from septic and disposal sites, petroleum and wood residue storage, composting, and processing and sales occur in this centralized location.

Many BC agricultural production sites are located in areas that are under intense pressure from non-agricultural activities. Concerns arising from farmsteads often relate to farm buildings and roads. Location, orientation and management of structures can significantly influence environmental impacts. Good site planning and management may also prevent disputes between neighbours.

In addition, a large number of agricultural production sites are located in what is considered to be wildfire interface areas or areas at risk due to flooding caused by heavy rain events. Given the predictions regarding climate change and wildfire and weather event frequency and severity, consideration must also be given to reducing the risks of wildfires and flooding to farmsteads. Location, construction and management of structures and landscaping can significantly influence impacts.

BUILDINGS AND ROADS

The following discussion on buildings is meant to be general. Specific siting and management practices relating to fertilizers, petroleum, wood residue, livestock, crops and pesticides buildings are found in their respective sections.

BUILDINGS AND ROADS ENVIRONMENTAL CONCERNS

Environmental concerns related to buildings and roads are:

- Siting and construction that results in water pollution; or in unacceptable odours to neighbours;
- Escape of contents from buildings that results in air or water pollution;
- Impermeable surfaces such as building roofs, roads and yards that result in change of the flow, volumes and direction of runoff causing erosion or downstream flooding;
- Disruption of riparian vegetation, streams, lakes or wetlands due to stream crossings and bridges that result in impacts to aquatic life, wildlife and water quality.

For information on these concerns:

➔ see Impacts on Biodiversity and Habitat, **page 7-7**, refer to Farm Activities and Impacts

➔ see Water Quality and Quantity Factors, **page 9-1,** refer to Contaminants and to Overland Flow

➔ see Air Quality Factors, **page 10-1**, refer to Contaminants, Dust and Particulates and Odours

➔ see Impacts of Agricultural Activities on Greenhouse Gas Emissions, **page 12-6,** and refer to Farm Activities and Impacts

FireSmart Canada website

BUILDINGS AND ROADS LEGISLATION

The following is a brief outline of the main legislation that applies to buildings and roads:

➔ see **page A-1** for a summary of these and other Acts and Regulations

Local Bylaws

The *National Farm Building Code 1995* outlines standards for building construction **and is enforced only where proclaimed by local governments.**

Many local governments have developed Soil Fill and Removal Bylaws, which pertain to the use of materials for preparing building sites and roadways on farmland.

Farm Bylaws

Farm Bylaws are bylaws that manage or restrict specific farm practices, beyond what could be considered using local government zoning powers. They are meant to ensure that farms can operate while addressing Local Government concerns about nuisance or other factors generally related to intensive agriculture. Farm Bylaws must be approved by the Minister of Agriculture. The communities in which these bylaws exist are called 'regulated communities.' Current regulated communities in BC include City of Abbotsford, Township of Langley, Corporation of Delta and City of Kelowna.

Agricultural Land Commission Act

The *Agricultural Land Commission (ALC) Act* S.B.C. 2002, c. 36, and *Agricultural Land Reserve (ALR) Regulations* are the legislative framework for the establishment, administration, and procedures of BC's agricultural land preservation program. The ALC Act takes precedence over, but does not replace other legislation and bylaws that may apply to the land. Local and regional governments, as well as other provincial agencies, are expected to plan in accordance with the provincial policy of preserving agricultural land.

The *ALR General Regulation*, B.C. Reg. 171/2002, identifies the procedures for submitting applications and notices of intent.

The *ALR Use Regulation*, B.C. Reg. 30/2019 specifies land uses permitted in the ALR:

- SECTION 20(1): restricts the use of land within an agricultural land reserve (ALR) to farm uses unless specified by the Act, the *Agricultural Land Reserve Use Regulation* or the Commission.
- SECTION 20.1(1): restricts the number and size of a residence on agricultural land to one house 500m^2 or less of total floor area.
- SECTION 20.3(1) – 20.3(6): restricts the removal or placement of fill on agricultural land and describes the requisite notice of intent and soil or fill use application procedures.

Some farm activities that may be governed by the *ALR Use Regulation* #30/2019 include:

- SECTIONS 6 – 17:
  - Land development works;
  - Soil testing, biosolids, and soil amendments;
  - Cannabis;
  - Horse facilities;
  - Forestry;
  - Farm products and retail sales;
  - Agri-tourism;
  - Alcohol production; and
  - Gathering events.
- SECTION 18: Guides the use of agricultural land for construction and upgrading of roads.
- SECTIONS 22 – 27 describe permitted non-farm uses that may be prohibited by local governments. These include:
  - Parks;
  - Keeping of animals (e.g., pet breeding and boarding);
  - Home occupation;
  - Infrastructure (e.g., force mains, pipelines, water lines, dikes, access roads);
  - Aggregate removal (under certain conditions);
  - Producing, storing and applying compost classified as Class A compost under the *Organic Matter Recycling Regulation* is permitted, but may be prohibited, if at least 50% but less than 100% of the compost is used on the agricultural land on which it was produced.
- SECTIONS 28 – 34 provide guidance and restrictions for residential use in the ALR, including secondary suites, additional residences, agri-tourism accommodation, and tourist accommodation.
- SECTION 35 describes conditions under which the removal and placement of fill on agricultural land may be permitted.
- SECTION 36 outlines the types of fill that are prohibited from being placed on agricultural land. These include construction or demolition waste (including rubble, concrete, cement, rebar, drywall, wood waste); asphalt; glass; synthetic polymers; treated wood; and unchipped lumber.

For more information see the following informational bulletins:

- IB-04 Cannabis Production in the ALR
- IB-05 Residences in the ALR
- IB-06 Accommodation for Tourists in the ALR
- IB-07 Soil or Fill Uses in the ALR
- Policy L-23: Placement of Fill for Soil Bound Agricultural Practices

Building Act

This Act was introduced in 2015 and replaced the *BC Building Regulation*. The act oversees residential building and plumbing through codes. These codes are largely based on the National Codes of Canada, with a small proportion of variations that are specific to BC.

The act establishes the Province as the sole authority to set building requirements (that is, technical requirements for the construction, alteration, repair, and demolition of buildings) - the objective is to create more consistent building requirements across BC, while still providing local governments with flexibility to meet their needs. It establishes qualification requirements for building officials to improve consistency in how the BC Building Code is interpreted, applied, and enforced and supports local governments and other local authorities through the implementation of a provincial review process to evaluate innovative building proposals.

It applies in all parts of the Province except the City of Vancouver and federal lands and First Nations Reserves.

For more information consult the BC Building Act Guide.

Drinking Water Protection Act

This Act and Regulations have requirements regarding the protection of drinking water quality and regulate domestic water systems (those serving more than one single-family residence).

- SECTION 23(1): subject to subsection (3), a person must not (a) introduce anything or cause or allow anything to be introduced into a domestic water system, a drinking water source, a well recharge zone or an area adjacent to a drinking water source, or (b) do or cause any other thing to be done or to occur if this will result or is likely to result in a drinking water health hazard in relation to a domestic water system.

Environmental Management Act

Under the *Hazardous Waste Regulation* waste oil cannot be applied to land for the purpose of dust suppression.

The *Code of Practice for Agricultural Environmental Management* requires persons to use environmentally responsible and sustainable agricultural practices when carrying out agricultural operations, for the purpose of minimizing the introduction of waste into the environment and preventing adverse impacts to the environment and human health. The AEM Code includes requirements for building setbacks from water sources and property boundaries in Part 4 of the AEM Code.

Farm Practices Protection (Right to Farm) Act

This Act protects farmers from liability in lawsuits alleging nuisance associated with dust, odour, noise and other disturbances resulting from the farm operation when they meet certain regulatory conditions.

Riparian Areas Protection Act

The *Riparian Areas Protection Act* creates the authority for government to enact Provincial directives to protect areas that border streams, lakes, and wetlands. The *Riparian Areas Regulation* (RAR) calls on local governments to protect riparian areas during residential, commercial, and industrial development by ensuring that a Qualified Environmental Professional (QEP) conducts a science-based assessment of proposed residential, commercial, and industrial activities in riparian areas.

With this Act, and through the *Riparian Areas Regulation*, local governments in certain regions of the Province are able to protect riparian areas during residential, commercial, and industrial development by ensuring that a Qualified Environmental Professional (QEP) conducts a science-based assessment of proposed activities. This includes residential buildings on land zoned for agricultural purposes. SECTION 12 provides Provincial directives on streamside protection.

The RAR only applies to the residential portion of the farm and only in the southern half of BC. The RAR does not apply to *farm practices* as defined in the *Farm Practices Protection Act*. In some cases, this can lead to the misunderstanding that the RAR does not apply to lands zoned for agriculture, or in the ALR. The RAR does apply to these lands for activities that are not *farm practices*, for example residential construction. It is important to note that local governments have the ability to establish bylaws that apply to agricultural lands, and some have implemented setbacks for agricultural buildings that complement the setbacks designated under RAR.

Public Health Act

Administered by the Ministry of Health, this Act has a specific prohibition that "a person must not willingly cause a health hazard, or act in a manner that the person knows, or ought to know, will cause a health hazard". This prohibition would apply to farm practices that may result in a health hazard, such as when nutrients, contaminants or pathogens are discharged to land, water or air so as to pose a public health problem. Any situation that entails a health hazard will enable health officers to investigate using their powers under the Act. Under the *Public Health Act*, the local Health Authority must investigate any health hazard and has authority to order that a person prevent or stop a health hazard, or mitigate the harm or prevent further harm from a health hazard amongst other powers. Similar regulatory provisions exist for addressing health hazards to drinking water supplies under the *Drinking Water Protection Act.*

Health Hazard Regulation regulates the distance of wells from possible source of contamination

SECTION 8 (1) A person who installs a well, or who controls a well installed on or after July 20, 1917, must ensure that the well is located at least:

(a) 30 m from any probable source of contamination;

(b) 6 m from any private dwelling, and;

(c) unless contamination of the well would be impossible because of the physical conformation, 120 m from any cemetery or dumping ground.

(2) A person who controls a well installed before July 20, 1917, must:

(a) remove any source of contamination within the distances set out in subsection (1), or

(b) subject to subsection (3), close the well in accordance with SECTION 6 of the Code of Practice under the *Ground Water Protection Regulation*, B.C. Reg. 299/2004.

(3) Subsection (2) (b) does not apply to a well located within 6 m of a private dwelling unless it can be shown that the well should be abandoned for a reason other than proximity to a private dwelling.

(4) A well that does not meet the requirements of this section is prescribed as a health hazard.

The *Sewerage System Regulation* SECTION 3.1(2) requires separation distances from wells to be at least:

- 15 m from a holding tank.
- 30 m from a sewerage system.

Sewerage System Standard Practice Manual

Water Sustainability Act

Water Sustainability Act (WSA) is the principal law for managing the diversion and use of water in British Columbia. The WSA establishes that all water in *streams* and *groundwater* in British Columbia is owned by the Crown on behalf of the residents of the Province.

Under the WSA no person may divert water from a stream or from *groundwater* unless the person holds an authorization or the diversion and use of water is allowed by the Act or under a regulation. An authorization can take the form of a "use approval", which allows for short term use of water for up to 24 months, or a water licence

which establishes a long term water right. Authorization holders have some responsibilities including the need to pay water fees and rentals and make beneficial use of the water they are authorized to divert, store and use.

In most cases any person who diverts water for use or storage must apply to the Province for the right to use the water and pay an annual rental fee for that use. The requirement for groundwater licensing for non-domestic (e.g., farm or business use) came into force on February 29, 2016 and applies to new groundwater users as well as those who began using groundwater prior to February 29, 2016.

- SECTION 6: Prohibits diverting water without a licence except in limited circumstances for fire suppression, domestic use and mineral prospecting.
- SECTION 11: Requires approvals for making changes in and about streams.

The *Water Sustainability Regulation* contains the rules for applications for licensing of surface and groundwater diversions and use, and for "changes in and about a stream."

Wildlife Act

The provincial *Wildlife Act* protects wildlife designated under the Act from direct harm, except as allowed by regulation (e.g., hunting or trapping), or under permit. Legal designations such as Endangered or Threatened under the Act increases the penalties for harming a species. The Act also enables the protection of habitat in a Critical Wildlife Management Area.

- SECTION 6: regulates endangered and threatened species.
- SECTION 7: makes it an offence to alter, destroy or damage wildlife habitat within a wildlife management area.
- SECTION 34: makes it an offence to possess, take injure, molest or destroy the nest of an eagle, peregrine falcon, osprey, heron or burrowing owl or the nest of any bird not mentioned above when the nest is occupied by the bird or its egg.

Fisheries Act

Administered by both Fisheries and Oceans Canada and Environment and Climate Change Canada, this Act is established to manage Canada's fisheries resources, including fish habitat. The Act can also be administered provincially by FLNRORD and ENV. The Act applies to all Canadian waters that contain fish, including ditches, channelized streams, creeks, rivers, marshes, lakes, estuaries, coastal waters and marine offshore areas. It also applies to seasonally wetted areas that provide fish habitat such as shorelines, stream banks, floodplains, intermittent tributaries and privately owned land. The Act includes provisions for stiff fines and imprisonment to ensure compliance.

The purpose of this Act is to provide a framework for (a) the proper management and control of fisheries; and (b) the conservation and protection of fish and fish habitat, including by preventing pollution.

This Act was updated in 2019 and now empowers the Minister to make regulations for the purposes of the conservation and protection of biodiversity.

The definition of fish habitat is: "water frequented by fish and any other areas on which fish depend directly or indirectly to carry out their life processes, including spawning grounds and nursery, rearing, food supply and migration areas." The quantity, timing and quality of the water flow that are necessary to sustain fish habitat are also deemed to be a fish habitat. Furthermore, serious harm to fish includes the death of fish or any permanent alteration to, or destruction of, fish habitat.

Provisions of the *2019 Fisheries Act* relevant to agricultural operations include:

- Protection for all fish and fish habitats;
- Prohibition against the death of fish or the 'harmful alteration, disruption or destruction of fish habitat';
- A permitting framework and codes of practice to improve management of large and small projects impacting fish and fish habitat;
- Protection of fish and/or fish habitats that are sensitive, highly productive, rare or unique; and
- Consideration for the cumulative effects of development activities on fish and fish habitat.

Specific sections of the Act include:

SECTION 34.2(1) The Minister may establish standards and codes of practice for:

(a) the avoidance of death to fish and harmful alteration, disruption or destruction of fish habitat;

(b) the conservation and protection of fish or fish habitat; and

(c) the prevention of pollution.

SECTION 34.4(1) No person shall carry on any work, undertaking or activity, other than fishing, that results in the death of fish.

SECTION 35 (1) No person shall carry on any work, undertaking or activity that results in the harmful alteration, disruption or destruction of fish habitat.

Every person who contravenes subsection 34.4(1) or 35(1) is guilty of an offence and liable.

Notifying authorities about serious harm to fish or deposit of a deleterious substance:

SECTION 38 (4.1) Every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations of a harmful alteration, disruption or destruction of fish habitat that is not authorized under this Act, or of a serious and imminent danger of such an occurrence, if the person at any material time:

(a) owns or has the charge, management or control of the work, undertaking or activity that resulted in the occurrence or the danger of the occurrence; or

(b) causes or contributes to the occurrence or the danger of the occurrence.

SECTION 38 (5) If there occurs a deposit of a deleterious substance in water frequented by fish that is not authorized under this Act, or if there is a serious and imminent danger of such an occurrence, and detriment to fish habitat or fish or to the use by humans of fish results or may reasonably be expected to result from the occurrence, then every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations.

SECTION 38 (7) As soon as feasible after the occurrence or after learning of the danger of the occurrence, the person shall provide an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations with a written report on the occurrence or danger of the occurrence.

Complying with the Fisheries Act

Species at Risk Act

This Act has sections that protect listed species, their residence and critical habitat. It applies to federal lands, internal waters (i.e., all watercourses), territorial sea of Canada, and the air space above them.

The provisions of the *Species at Risk Act* (known as the 'safety net') could be invoked on BC crown and private lands using a federal order under the Act if provincial action is not sufficient to protect listed species.

BUILDINGS AND ROADS BENEFICIAL MANAGEMENT PRACTICES

Comply with applicable buildings and roads related legislation, including the above, and where appropriate, implement the following beneficial management practices to protect the environment.

Many of the following practices can be used on existing buildings and roads and all practices should be considered with new construction. Good site planning and management of structures can significantly reduce environmental impacts and may also prevent neighbour disputes.

Farm Building Siting

Existing Building Sites. Evaluate farm activities to ensure that pollution is not occurring, and to verify that Normal Farm Practices are being followed.

The *Farm Practices Protection Act* defines a normal farm practice as an activity "that is conducted by a farm business in a manner consistent with proper and accepted customs and standards as established and followed by similar farm businesses under similar circumstances."

When assessing an existing site, the following factors should be considered:

- Potential for leachate generation and/or runoff from farm building sites.

➔ see Runoff, **page 9-50**

- Proximity to sensitive areas (i.e. watercourses, habitat, domestic water sources, areas used for human activities).
- The implications of climate change (e.g. adapting to future impacts of increased frequency or size of flooding or runoff events).
- If farm infrastructure is vulnerable to wildfire risks, and if appropriate, use FireSmart practices to make farm building more defensible in the event of a fire.

New Building Sites. When selecting a new construction site, implement the following practices:

- For protection by the *Farm Practices Protection (Right to Farm) Act*, locate on land zoned for agriculture or in the Agricultural Land Reserve;
- Follow Normal Farm Practices;
- Locate buildings with probable sources of contamination at least 30 m from a well (*Health Hazards Regulation*), 30 m or more from a water intake used for domestic purposes (suggested);
- When locating buildings, consider the function of the building and the impact on neighbourings properties and land use;
- Understand the projected changes in flood risk with a changing climate and locate buildings with past and future water levels in mind;
- Consider risk of wildfire, and evaluate the potential benefits of building FireSmart buildings (see reference below);
- Locate buildings using setback identified in Part 4 of the *Code of Practice for Agricultural Environmental Management* or "standards" from watercourses as outlined in the following publications and in Categories 1-4 listed below;
- **Table 2.1** summarizes the setback distances for each facility Category;
- In cases where watercourse classification mapping is not available, or in unique situations where setback standards create undue hardship or non-conformance is apparent, consult a qualified environmental professional.

FireSmart Manual

Agricultural Building Setbacks from Watercourses in Farming Areas

Guide for Bylaw Development in Farming Areas

Flood Construction Levels and Setbacks for Farm Building Situations

Natural streams watercourses that have not been significantly altered by human activity and are predominantly in their natural state

Channelized streams permanent or relocated streams that have been dyked, diverted or straightened and carry drainage flows from headwaters or significant sources of groundwater. Reaches of channelized streams may be confined by roads and fences and in many cases can also meander through fields.

Man made channels that divert irrigation water from a stream but return overflow water back to a stream in a manner that allows fish access are classified as channelized streams.

Constructed ditches man made drainage channels that carry drainage water from one property but do not carry water from headwaters or significant sources of groundwater. Flows in agricultural constructed ditches may be year round and are not regulated. Constructed ditches may also deliver water for irrigation purposes.

Constructed channels man made drainage channels that carry drainage water from more than one property but do not carry water from headwaters or significant sources of groundwater. Flows in agricultural constructed channels may be year round and are not regulated. Constructed channels may also deliver water for irrigation purposes.

Category 1 facilities are structures, buildings, constructed surfaces, or areas identified by the *Code of Practice for Agricultural Environmental Management* (AEM code) which are considered to pose a high risk for causing pollution. Category 1 facilities include solid agricultural waste field storages with greater than two weeks storage, confined livestock areas with greater than ten agricultural units, and seasonal feeding areas.

- Category 1 facilities must be set back 30 m from any watercourse

Category 2 facilities are structures, buildings, constructed surfaces, or areas covered by the AEM Code and other regulations which are considered to pose a slightly lower risk for causing pollution than those in Category 1.

- Category 2 facilities include:
  - Agricultural by-product storage facilities (e.g., engineered manure pits);
  - Chemical, compost and wood residue storages;
  - On-farm soiless growing media production facilities;
  - Mushroom barns;
  - Temporary field storage, on-ground, under-pen storage;
  - Silos; incinerators; and
  - Petroleum storages.
- Category 2 facilities must be set back a minimum distance of 15 m from any watercourse

Category 3 facilities are structures, buildings, constructed surfaces, or areas which are at a higher risk of discharging contaminants than Category 4 buildings, are not identified by the AEM Code. Examples of Category 3 facilities are livestock barns, brooder houses, fur farming sheds, livestock shelters and stables, hatcheries, and milking facilities.

- Category 3 facilities must be set back 15 m from natural and channelized streams and 5 m from constructed channels and constructed ditches, other than those maintained by municipalities, for which a 7 m setback is required.

Category 4 facilities are structures, buildings, constructed surfaces, or areas for which a risk of discharging contaminants is not likely or can be easily contained. Examples of Category 4 facilities include greenhouses, machine storages, on-farm processing facilities, direct farm marketing facilities, crop storages, granaries, shelters, hives, machine and equipment storages, cideries, retention and detention ponds, and other impervious surfaces.

- Category 4 facilities must be setback 15 m from natural streams. For channelized streams, a minimum setback of 10 m up to a maximum of 15 m's required based on two times the channel width measured from the top of bank. A 5 m setback must be left adjacent to constructed channels and constructed ditches other than those maintained by municipalities, for which a 7 m setback is required. Take into account building setback standards as defined above, and implement the following practices when constructing a new building.
- Locate on a sufficiently large land base to meet setback distances of facilities from property boundaries and consider providing room for expansion.
- Provide sufficient separation distance from neighbours for dispersion of odour, dust and noise.
- Favour sites that provide protection from wind by using windbreaks or by taking advantage of terrain
- Where protection is inadequate, favour sites where improvements can be made by planting windbreaks or constructing screens (these will also reduce noise, odour, and visual impacts an operation may have on adjacent property or occupants; windbreaks also reduce energy loss from buildings and store carbon to help offset climate change.

In areas with higher risks of wildfire, consider leaving a 10 m buffer free of highly combustible vegetation around farm infrastructure.

➔ see Buffers, **page 11-4**

- Locate structures (buildings, wind break fences, etc.) relative to one another to account for wind-drifted snow.
- Allow for 'swirl chamber' effects to deposit snow in out-of-the way locations.
- make long-term plans so that future expansions do not interfere with effective waste cleanup and contaminated runoff control.
- Comply with local government bylaws and special management areas, if applicable.
- Locate on an adequately drained site, avoiding areas defined by a suggested one-in-100 year flood recurrence interval.
- Detain clean runoff from yards, buildings and roads such that peak flow to receiving watercourses is not increased over predevelopment levels.
- Site farm buildings such as livestock, nursery beds, greenhouses, or storages downslope from wells.
- Position high-activity buildings and work areas away from neighbouring residences to minimize sight and sound impacts.
- Avoid sensitive fish and wildlife habitat (e.g., bird nesting, riparian areas, wetlands).

Farmstead Planning Canada

Plan Farm Buildings as a System

Siting and Management of Poultry Barns

Siting and Management of Dairy Barns and Operations

Agricultural Setbacks from Watercourses in Farming Areas

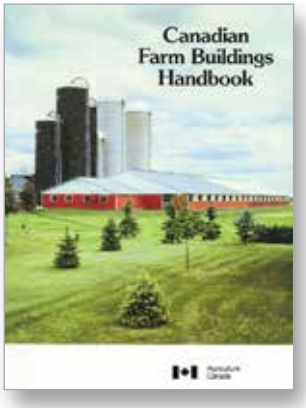
TABLE 2.1	Building and Facilities Setbacks from Watercourses for Riparian Protection and Drinking Water Protection in Farming Areas ★[!af]			
Watercourse Type	Category 1	Category 2	Category 3	Category 4
	▪ Confined Livestock Area more than 10 agricultural units [d] ▪ Temporary field Storage with greater than 2 weeks storage time ▪ Outdoor agricultural composting ▪ Seasonal feeding (on ground or mobile bins) ▪ Mortalities or processing waste –outdoor composting pile or burial pit	▪ Confined livestock area less than 10 agricultural units [!dg] ▪ Wood residue storage or Use[!] ▪ Agricultural By-product Permanent Storage Structure [!] ▪ On-ground under pen storage or temporary field storage of less than 2 weeks of by-products [!] ▪ Composting structure [!] (agricultural by-products, mortalities or processing waste) ▪ Incinerator [!h] (mortalities, solids and semi-solids) ▪ Mushroom barn ▪ On-farm soilless medium production and storage ▪ Silo ▪ Petroleum Storage ▪ Chemical storage (Pesticides and Fertilizer)	▪ Brooder house ▪ Hatchery ▪ Fur farming shed ▪ Livestock barn ▪ Livestock Shelter ▪ Milking facility ▪ Stable	▪ Boiler Room ▪ Cidery ▪ Cold Frame ▪ Crop Storage ▪ Detention Pond ▪ Direct Farm Marketing ▪ Granary ▪ Greenhouse ▪ Machinery Storage ▪ On-Farm Processing ▪ On-Farm Product Preparation ▪ Retention Pond ▪ Impervious Surfaces
Natural Streams Setbacks	30 m	15 m	15 m	15 m
Channelized Streams Setbacks	30 m	15 m	15 m	Twice channel width [b] Minimum of 10 m Maximum 15 m
Constructed Channels and Ditches Setbacks	30 m	15 m	5 m [c]	5 m [c]
Setback to Drinking Water Source	30 m	30 m	30 m	15m [i]

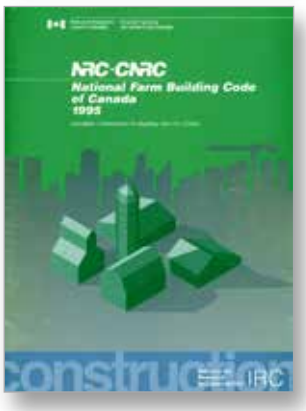
Notes
* Property safety and risk management concerns may require larger setbacks in some instances and will then override the setback standards shown here.
! Building and facilities have setbacks identified in the Code of Practice for Agricultural Environmental Management
a Setback distances are measured from the top of bank.
b Channel width is determined from the top of bank to top of bank.
c The minimum building setback distance from a constructed channel or constructed ditch which a municipality is responsible for maintaining is 7 metres.
d One agriculture unit is equal to the live weight of 455 kg (1000 lbs) of livestock, poultry or farmed game or any combination equaling this weight.
e There is no differentiation between constructed channels and constructed ditches for the purposes of building setbacks, only for drainage maintenance purposes.
f The recommended setback from a domestic water intake for all agricultural buildings is 30 m.
g The Code of Practice for Agricultural Environmental Management requirement is 5m setback, recommended setback is 15m.
h The setback from domestic water for incinerator is 15m.
i Probable source of contamination then the separation increases to 30m.

Farm Building Construction

Whether for livestock or storage purposes, good construction ensures both effective use and low environmental impact from farm structures. Although updating has been discontinued, farm building plans are available at the Ministry of Agriculture, Food and Fisheries office. **Figure 2.1** shows a typical barn wall with environmentally sound construction. For siting, sanitation and waste handling, construct all agricultural buildings using the following beneficial practices:

- Use the most up-to-date building designs capable of withstanding severe wind events.
- If using off-farm wastes for fill material, ensure that they do not pollute.
- Use building layouts that allow for effective and efficient cleanup.
- For storage buildings containing hazardous materials, ensure that impervious surfaces and continuous sills, even under doorways, are incorporated in construction for containment.
- Consider dry flood-proofing buildings to create a water-tight structure for storing higher risk materials.
- Collect and manage roof water when more than a suggested 10% of the site is roofed to avoid significant stormwater flow changes caused by impervious roofing.
- In high rainfall areas, incorporate eavestroughs to divert roof drainage.
- Divert drainage away from buildings (requires perimeter drainage), watercourses and wells, and sources of contamination (e.g., manure, compost piles).
- Install pumping systems to remove water from buildings prone to flood or stormwater inundation.
- Install gravel splash pads at the base of walls to control roof water erosion.
- If buildings have galvanized metal roofing, ensure the roof water (which could contain zinc levels toxic to fish) is directed away from watercourses.
- Have the roof water infiltrate the soil to allow the soil to tie up the zinc.
- Ensure that separate drainage systems are not cross-connected during construction.
- Install back-flow prevention devices on all water supply lines used for medicated livestock watering, mixing pesticides, fertilizers or potentially harmful cleaning products.
- Extend concrete foundation walls at least 300 mm (suggested) above grade line to discourage rodents and water from entering buildings.
- Insulate the roof and perimeter walls of all heated or cooled buildings, apply an appropriate vapour barrier and seal all window, door and other openings to minimize energy loss.
- Keep buildings and heating, cooling and ventilation systems in proper repair.





Farm Building Structures Factsheet

Canadian Farm Buildings Handbook (1988)

Placement of Fill or Removal of Soil: Construction of a Single Family Residence

Placement of Fill for Soil-Bound Agricultural Activities

National Farm Building Code of Canada (1995) (This is only available in hard copy by order)

Note: The farm building requirements related to fire protection, structural design and dangerous goods are being discussed for publication in the 2020 editions of the *National Building Code* and *National Fire Code*. The fire and structural requirements in the *National Farm Building Code* have not been reviewed or revised since the 1995 edition and are increasingly in conflict with the latest edition of the Codes.

FireSmartCanada Resources Library

Extreme Weather Event Preparedness and Mitigation (Cowichan Valley Pilot Project Lessons for all BC Regions)

Building Drains. Buildings are often fitted with perimeter drains and downspouts to divert clean roof water away from the foundation. If a layout contains drains that collect contaminated water (e.g., manure), test that the drains are not cross connected (put an 'ENV-approved dye' such as a water fluorescein into the contaminated drains and check that it does not exit at a clean water outlet).

Building Ventilation. Ventilation systems remove dust, gases and odours from buildings. In buildings where dust and odour levels are high, hoods on sidewall exhaust fans direct discharges downward toward the ground. The use of chimney fans may also be beneficial. Install hoods, protective flaps or louvers on ventilation ports to prevent the entry of rain and snow, reduce energy loss from buildings, as well as to ensure predictable exhaust rates. Vegetative filters intercept odour and dust laden exhaust when they are placed around buildings or near discharge points. Extreme heat waves can be hard on livestock housed in barns; proper ventilation plays a critical role in preventing livestock heat stress that may result from extreme weather patterns. Proper ventilation has added importance for preventing livestock heat stress resulting from climate change.

➔ see Indoor Poultry and Livestock Housing, **page 3-2**, and refer to Vegetative Filters,
➔ see Buffers, **page 11-4**

- Ventilation of Agricultural Systems website
- Agricultural Building Ventilation Systems
- Minimizing the Chances of Ventilation Disasters
- Ventilation of the Milking Complex
- Housing for Healthier Calves
- Potato Storage Ventilation
- Ventilation Best Practices Handbook
- Management of Confined Spaces in Agriculture - WorkSafeBC

Leachate. Some buildings will have products stored or used that could be leached to groundwater.

➔ see Leachate, **page 9-58**

Water Supply. Some buildings will require water to be supplied to them.

➔ see Water Supply, **page 9-5**

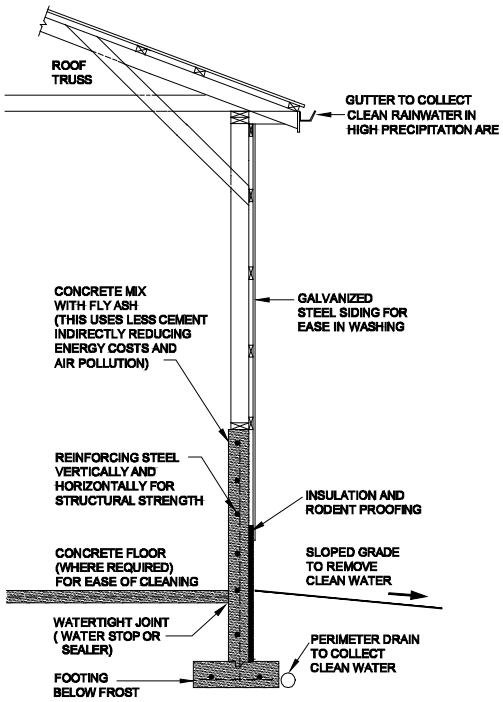


FIGURE 2.1 Environmentally Sound Building Construction

Farm Roads

Farm roads to buildings or fields may affect the natural water flow from fields and surrounding areas thereby negatively impacting nearby watercourses. Implement the following practices to minimize the impact of roads to watercourses:

- Locate culverts to allow for controlled drainage of runoff to reduce erosion (the risk of concentrated water flow causing soil erosion increases as the slope and length of a road increases).
- Consider the potential for changes in runoff and flooding with climate change when locating farm roads.
- Construct roads to follow contours - the risk of soil erosion increases when roads are constructed along a slope rather than across a slope except for short lengths, grades should not exceed 10 percent (suggested) i.e., 1 m fall for 10 m of road length. Steeper grades may require water bars or frequent culvert installations.
- Transport materials such as manure and pesticides well back from watercourses in case accidental spills occur.
- Plan the farm so that an egress (secondary access or exit) is integrated into the site.
- Ensure that farm access points are accessible to emergency vehicles by designing driveways that are wide enough and not encumbered by overhanging structures or vegetation.
- Have all weather roads so emergency vehicles can access farm buildings.
- Construct permanent farm roads with compacted, well-drained gravel or other suitable material.
- Consider the use of pervious surfacing to minimize surface runoff.
- Keep hard-surface areas to a minimum to reduce surface runoff.
- Limit wood residue use on roads.

➔ see Wood Residue, **page 2-40**

- If using off-farm wastes for road construction ensure they are acceptable and do not pollute (for example the use of broken concrete or ground asphalt would be acceptable). For more information see your local government soil fill and removal bylaw.
- Locate and elevate road beds, when appropriate, to function as berms and flood protection barriers.
- Use dust suppression agents such as water and wetting agents, calcium chloride or lignosulfonates.
- Used or waste oil is not allowed to be used as a dust suppressant.

REPORTING REQUIREMENT

Under the ***Spill Reporting Regulation***, chemical spills must be reported immediately to the Provincial Emergency Program (EMP) at 1-800-663-3456 (24hr service) if they exceed the amounts set forth in the Spill Reporting Regulation Factsheet:
https://www2.gov.bc.ca/assets/gov/environment/air-land-water/spills-and-environmental-emergencies/docs/materials/fact_sheet_spill_reporting.pdf

Buildings and Roads Near Water

Farm buildings and roads, and the management of water can have impacts on surface water and groundwater if not managed properly.

Adjacent Watercourses. Watercourses and water used for domestic purposes are protected under various environmental laws.

- Site and construct farm buildings and roads so as not to negatively impact fish and wildlife habitat, and water quality and quantity.
- Select areas that reduce or avoid the risk of water contamination by using sufficient setbacks, buffers, or berms.
- Do not allow runoff that contains manure, fertilizer, pesticide, soil or salts used as dust suppressing agents that is harmful to fisheries resource to enter a watercourse.

➔ see Farm Building Siting, **page 2-8**

➔ see Buffers, **page 11-4**

➔ see Changes In and About a Stream, **page 7-17**

➔ and see Runoff, **page 9-50**

Runoff. Runoff is the overland flow of water (also known as stormwater) from rainfall, melting snow and ice, or excess irrigation. Wells and groundwater can become contaminated either by direct entry of runoff into the well or by entry along the well casing. Control and collect all runoff that becomes contaminated on the farm. Runoff should also be prevented from running into potential sources of contamination (e.g., manure storages, compost piles, stored silage, feed bunkers, confined livestock areas) that could form leachate, or pick up nutrients and then runoff into watercourses. Link runoff water storage to irrigation or stock water systems to make beneficial use of surplus water with more unpredictable precipitation patterns.

Land covered by farm structures (e.g., barns, greenhouses) or impermeable surfaces (e.g., roads, yards) reduces the capability of a site to allow precipitation to infiltrate. This results in increased water leaving the farm through drainage systems (surface channels, tiles and ditches) during peak rainfall periods. This increased peak flow has the potential to cause flooding and erosion leading to the discharge of unacceptable levels of suspended solids.

➔ see Runoff, **page 9-50**

Groundwater. Determine soil permeability and groundwater levels at construction sites. Environmental problems can be avoided by selecting a site with permeability characteristics suitable for controlling leaching into groundwater.

➔ see Leachate, **page 9-57**

Wells provide a pathway for contaminants to groundwater either by direct entry, or by entry from outside the well along the well casing.

➔ see Water Supply, **page 9-5**

Stream Crossings

Be sure to refer to the *Water Sustainability Act* to determine if the work being undertaken requires a "notification" or a " change approval" under the Act.

Water Licences and Approvals BC

Changes in and About a Stream: (FrontCounterBC Application Portal)

Whenever a stream crossing is constructed or used for vehicles or livestock, it must not negatively impact fish, fish habitat, or other wildlife.

Implement the following practices for stream crossings:

- Before construction seek either a 'notification' or 'approval' from the Ministry of Forests, Lands, Natural Resource Operations & Rural Development (FLNRORD).
- Be at a right angle to stream flow and at the narrowest section possible.
- Have stream culverts sized to allow for safe fish passage and to carry anticipated 100 year peak flow at a minimum (suggested) and integrate climate change projections into stream culvert sizing decisions (encouraged).
- Not damage fish habitat nor create blockages for fish passage (e.g., clear-span bridges are more "fish-friendly" than culverts).
- The following best management practices are required for instream or bed-level crossings:
  - before construction seek the appropriate 'notification' or 'approval' from FLNRORD;
  - not restrict water flow and allow unrestricted fish passage;
  - prevent and control sediment discharge into the stream;
  - be managed to discourage livestock loitering in or near watercourses;
  - if water quality is impacted by vehicle or livestock crossing, install a hard surface (such as adding gravel or concrete to a silty stream bottom).

➔ see Changes In and About a Stream, **page 7-17**

Changes in and About a Stream: FrontCounterBC application site

Bridge Construction (as it relates to constructed ditches)

Culvert Installation in Constructed Ditches

Land Clearing and Development

Land clearing and development has the potential to alter the quality and quantity of surface and groundwater flows, quality of air, and fish and wildlife habitat. Clearing land can also significantly reduce the carbon-storage potential and increase greenhouse gas emissions.

Care should be taken to plan any land clearing or development to minimize disruption of natural processes. Once disrupted, these important processes and habitats are difficult, expensive and often impossible to restore. In the Farm Bylaws regulated communities of the City of Kelowna, City of Abbotsford, Township of Langley, and Corporation of Delta, additional farm-side vegetative buffers may be required.

➔ see **Chapter 7**, Biodiversity

Guide to Edge Planning

Monitor and document impacts to help assess the need for change. Consider using alternative production systems, such as agroforestry, that can retain some of the natural features of undeveloped land.

➔ see **Chapter 7**, Biodiversity

➔ see **Chapter 9**, Water

➔ see **Chapter 10**, Air

➔ see **Chapter 11**, Stewardship Areas

➔ see **Chapter 12**, Climate Change

Landscaped Buffer Specifications

Before undergoing land clearing and development proactively, confirm presence of listed species through the Conservation Data Center. Recovery action plans, critical habitat designations and suggested beneficial management practices have been developed for each species and if you have listed species present, you will need to undertake appropriate mitigation.

In the case where there are Species at Risk on the farm property, care must be taken to ensure that farm development and activities are done with appropriate mitigation for that species.

Information on listed species is available through:

- Conservation Data Centre
- BC Ecosystems Explorer
- EFP Biodiversity Guide
- Riparian Area Management Field Workbook

➔ See **Chapter 7**: Biodiversity

Adjacent Land Development

Neighbouring land uses may have a negative impact on agricultural operations. Incompatible uses may include both industrial and residential development. Select new farm production sites with such influences in mind. On existing sites, scheduling activities, such as manure spreading, to avoid times when outdoor recreational activities are occurring will minimize neighbourhood disputes. On occasions where timing conflicts cannot be avoided, open communication often helps to improve understanding and acceptance.

- Guide to Edge Planning
- Farm Practices in BC website

Odour Considerations

Odour emissions from intensive production facilities (e.g. livestock or mushroom) may have a negative impact if they are sited near populated or sensitive areas. When designing and siting production facilities it is important to consider the following when predicting the frequency and intensity of odours on surrounding areas and neighbours:

- site specific climate conditions (temperature, moisture, humidity, wind speed, wind direction, etc.);
- topography of the site;
- management practices (manure storage and agitation practices, dust management and manure spreading technologies);
- the potential of contaminants associated with odours to contaminate watercourses or impact neighbouring properties;
- the use of odour reducing tools (i.e., windbreaks, vegetative buffers, biofilters and bioscrubbers).

➔ See Odour, **page 10-17**

Treated Wood Products

Treated wood is often used to prevent infestation by pests and to slow decay. Properly applied and cured water-based preservatives, such as chromated copper arsenic, do not present a significant leaching problem. Oil-based preservatives, such as creosote, leach out of wood more readily and may cause problems. Wood posts treated with registered preservatives are not considered "hazardous waste" under the *Hazardous Waste Regulation* of the *Environmental Management Act*. For treated wood disposal.

➔ see Farm Refuse Disposal, **page 2-23**

The pollution potential posed by treating wood or by using treated material can be minimized by implementing the following practices:

- Avoid erecting posts in watercourses.
- Use old treated materials near watercourses – freshly treated materials are more likely to leach.
- If wood is to be treated on the farm, ensure that mixing, treatment, and application sites are located far from watercourses and not susceptible to spills, leaching or runoff.

Abandoned Farm Sites and Farmland

Both the building sites and associated fields on farms that are no longer maintained, taken out of production or abandoned, can become an environmental concern. Implement the following practices:

- Cap abandoned water wells.
- Ensure adequate control measures are in place to prevent pests and weeds from multiplying and affecting neighbouring farms.
- Remove feed sources to avoid attracting wildlife and rodents.
- Clean up all products that may cause pollution.
- Fence off abandoned storages to avoid safety hazards.
- Empty manure and fuel storage facilities.
- Decommission manure storage facilities.
- Minimize the threat of invasive species and noxious weeds.
- Properly dispose of pesticides and fertilizers.

➔ see Pesticide and Pesticide Container Disposal, **page 5-29**

FARM WASTE

This section discusses wastes generated on the farm but not addressed by the *Code of Practice for Agricultural Environmental Management*. This includes onsite sewage wastes and refuse but not manure, crop residues or mushroom media.

FARM WASTE ENVIRONMENTAL CONCERNS

Primary environmental concerns related to farm wastes are:

- septic absorption field failure that results in pollution of water;
- materials and leachate released from on-farm refuse disposal sites that results in air or water pollution, or in attraction of wildlife;
- carcass disposal.

For information on these concerns:

➔ see Impacts on Biodiversity and Habitat, **page 7-7**, refer to Impacts of Agriculture on Biodiversity and Habitat

➔ see Soil Quality Factors, **page 8-1**, refer to Contaminants

➔ see Water Quality and Quantity Factors, **page 9-1**, refer to Contaminants, and to Solids

➔ see Mortality Disposal, **page 3-49**

FARM WASTE LEGISLATION

The following is a brief outline of the main legislation that applies to farm wastes.

➔ see **page A-1** for a summary of these and other Acts and Regulations

Agricultural Land Commission Act

The *Agricultural Land Commission (ALC) Act* S.B.C. 2002, c. 36, and *Agricultural Land Reserve (ALR) Regulations* are the legislative framework for the establishment, administration, and procedures of BC's agricultural land preservation program. The ALC Act takes precedence over, but does not replace other legislation and bylaws that may apply to the land. Local and regional governments, as well as other provincial agencies, are expected to plan in accordance with the provincial policy of preserving agricultural land.

The *ALR Use Regulation*, B.C. Reg. 30/2019 specifies designated land uses permitted in the ALR. These include:

- SECTION 7: The use of agricultural land for storing and applying biosolids and soil amendments, other than compost

The use of agricultural land for producing, storing and applying compost if, in the case of:

(a) Compost classified as Class A compost under the *Organic Matter Recycling Regulation*, all of the compost produced, stored and applied is used on the agricultural land on which it was produced, or

(b) Any other compost, the compost is from agricultural by-products that were produced for a farm use.

SECTION 27 describes permitted non-farm uses that may be prohibited by local governments. This includes:

(4) Producing, storing and applying compost classified as Class A compost under the *Organic Matter Recycling Regulation* is permitted, but may be prohibited, if at least 50% but less than 100% of the compost is used on the agricultural land on which it was produced.

SECTION 36 outlines the types of fill that are prohibited from being placed on agricultural land. These include construction or demolition waste (including rubble, concrete, cement, rebar, drywall, wood waste); asphalt; glass; synthetic polymers; treated wood; and unchipped lumber.

For more information see the following informational bulletins:

IB-07 Soil or Fill Uses in the ALR

Drinking Water Protection Act

This Act and Regulations have requirements regarding the protection of drinking water quality and regulate domestic water systems (those serving more than one single-family residence).

- SECTION 23(1): subject to subsection (3), a person must not (a) introduce anything or cause or allow anything to be introduced into a domestic water system, a drinking water source, a well recharge zone or an area adjacent to a drinking water source, or (b) do or cause any other thing to be done or to occur if this will result or is likely to result in a drinking water health hazard in relation to a domestic water system.

Environmental Management Act

This Act regulates all wastes disposed from farm and farm house operations.

- SECTIONS 14 AND 15: allow for the authorization of waste discharges, including household and other general refuse, to a site, such as an approved landfill.

The *Code of Practice for Agricultural Environmental Management* requires persons to use environmentally responsible and sustainable agricultural practices when carrying out agricutural operations, for the purpose of minimizing the introduction of waste into the environment and preventing adverse impacts to the environment and human health. The AEM Code includes requirements for building setbacks from water sources and property boundaries.

The AEM Code defines agricultural by-products as manure, soiled animal bedding, spoiled feed or silage, vegetative debris, composting process products, mushroom-growing substrate, and soilless media. The AEM Code also covers carcass disposal, semi-solid waste, solid waste, wastewater, and processing waste.

The *Hazardous Waste Regulation*, the *Waste Discharge Regulation* and the *Open Burning Smoke Control Regulation* have disposal provisions for specific wastes.

Public Health Act

Administered by the Ministry of Health, this Act has a specific prohibition that "a person must not willingly cause a health hazard, or act in a manner that the person knows, or ought to know, will cause a health hazard". This prohibition would apply to farm practices that may result in a health hazard, such as when nutrients, contaminants or pathogens are discharged to land, water or air to pose a public health problem.

Any situation that entails a health hazard will enable health officers to investigate using their powers under the Act. Under the *Public Health Act*, the local Health Authority must investigate any health hazard and has authority to order that a person prevent or stop a health hazard, or mitigate the harm or prevent further harm from a health hazard amongst other powers. Similar regulatory provisions exist for addressing health hazards to drinking water supplies under the *Drinking Water Protection Act*.

Health Hazard Regulation regulates the distance of wells from possible source of contamination

SECTION 8 (1) A person who installs a well, or who controls a well installed on or after July 20, 1917, must ensure that the well is located at least:

(a) 30 m from any probable source of contamination,

(b) 6 m from any private dwelling, and

(c) Unless contamination of the well would be impossible because of the physical conformation, 120 m from any cemetery or dumping ground.

(2) A person who controls a well installed before July 20, 1917, must:

(a) Remove any source of contamination within the distances set out in subsection (1), or

(b) Subject to subsection (3), close the well in accordance with SECTION 6 of the *Code of Practice under the Ground Water Protection Regulation*, B.C. Reg. 299/2004.

(3) Subsection (2) (b) does not apply to a well located within 6 m of a private dwelling unless it can be shown that the well should be abandoned for a reason other than proximity to a private dwelling.

(4) A well that does not meet the requirements of this section is prescribed as a health hazard.

- *The Sewerage System Regulation* SECTION 3.1(2) requires separations distances (as defined in the Sewerage System Standard Practice Manual) from wells to be at least:
  - 15 m from a holding tank,
  - 30 m from a sewerage system.

Fisheries Act

Administered by both Fisheries and Oceans Canada and Environment and Climate Change Canada, this Act is established to manage Canada's fisheries resources, including fish habitat. The Act can also be administered provincially by FLNRORD and ENV. The Act applies to all Canadian waters that contain fish, including ditches, channelized streams, creeks, rivers, marshes, lakes, estuaries, coastal waters and marine offshore areas. It also applies to seasonally wetted areas that provide fish habitat such as shorelines, stream banks, floodplains, intermittent tributaries and privately owned land. The Act includes provisions for stiff fines and imprisonment to ensure compliance.

The purpose of this Act is to provide a framework for (a) the proper management and control of fisheries; and (b) the conservation and protection of fish and fish habitat, including by preventing pollution.

This Act was updated in 2019 and now empowers the Minister to make regulations for the purposes of the conservation and protection of biodiversity.

The definition of fish habitat is: "water frequented by fish and any other areas on which fish depend directly or indirectly to carry out their life processes, including spawning grounds and nursery, rearing, food supply and migration areas". The quantity, timing and quality of the water flow that are necessary to sustain fish habitat are also deemed to be a fish habitat. Furthermore, serious harm to fish includes the death of fish or any permanent alteration to, or destruction of, fish habitat.

Provisions of the *2019 Fisheries Act* relevant to agricultural operations include:

- Protection for all fish and fish habitats;
- Prohibition against the death of fish or the 'harmful alteration, disruption or destruction of fish habitat';
- A permitting framework and codes of practice to improve management of large and small projects impacting fish and fish habitat;
- Protection of fish and/or fish habitats that are sensitive, highly productive, rare or unique; and
- Consideration for the cumulative effects of development activities on fish and fish habitat.

Specific sections of the Act include:

SECTION 34.2(1) The Minister may establish standards and codes of practice for:

(a) the avoidance of death to fish and harmful alteration, disruption or destruction of fish habitat;

(b) the conservation and protection of fish or fish habitat; and

(c) the prevention of pollution.

SECTION 34.4(1) No person shall carry on any work, undertaking or activity, other than fishing, that results in the death of fish.

SECTION 35 (1) No person shall carry on any work, undertaking or activity that results in the harmful alteration, disruption or destruction of fish habitat.

Every person who contravenes subsection 34.4(1) or 35(1) is guilty of an offence and liable

Notifying authorities about serious harm to fish or deposit of a deleterious substance:

SECTION 38 (4.1) Every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations of a harmful alteration, disruption or destruction of fish habitat that is not authorized under this Act, or of a serious and imminent danger of such an occurrence, if the person at any material time:

(a) Owns or has the charge, management or control of the work, undertaking or activity that resulted in the occurrence or the danger of the occurrence; or

(b) Causes or contributes to the occurrence or the danger of the occurrence.

SECTION 38 (5) If there occurs a deposit of a deleterious substance in water frequented by fish that is not authorized under this Act, or if there is a serious and imminent danger of such an occurrence, and detriment to fish habitat or fish or to the use by humans of fish results or may reasonably be expected to result from the occurrence, then every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations.

SECTION 38 (7) As soon as feasible after the occurrence or after learning of the danger of the occurrence, the person shall provide an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations with a written report on the occurrence or danger of the occurrence.

FARM WASTE BENEFICIAL MANAGEMENT PRACTICES

Comply with applicable farm waste related legislation, including the above, and where appropriate, implement the following beneficial management practices to protect the environment.

Farm Sewerage Systems

Siting and Construction. Construction of domestic sewerage systems from farm residences, barns and other structures are regulated by the Ministry of Health including septic tanks, adsorption fields and residential lagoon systems. All new and existing systems must function so as not to create a health hazard. Registered Onsite Wastewater Practitioners must be consulted if repairs or new construction are anticipated.

Separation from wells must be at least:

- 15 m from a holding tank (*Public Health Act*)
- 30 m from a sewerage system (*Public Health Act*)

Maintenance. Efficient operation of the disposal system depends primarily on maintenance of the septic tank. Periodically remove solids that accumulate in the tank to prevent them from reaching the field and causing system failure. Owners are required to maintain sewerage systems (including solids removal from the tank) according to maintenance plans as determined by a qualified professional.

Septic Savvy: How to care for your Residential Septic System

Sewerage System Standard Practice Manual

Outhouses. If in building toilets are impractical, portable toilets or outhouses can be used. These types of toilets are commonly used for harvest and field workers. Toilets need to be located and maintained (clean, supplied with paper towel, toilet paper and soap) so that their use is encouraged and field urinating and defecating is discouraged. Outhouses or pit toilets can cause an environmental or health hazard if improperly constructed or sited. Check with the local health authority to determine what standards or guidelines for outhouses exist in the region.

Wastewater. Waste wash and fuming water generated from rinsing produce, cleaning, handwashing etc. contain pathogens and need to be collected in a way to control the spread of contamination into ground or surface water. Direct discharge of waste water on the ground is to be avoided.

Farm Refuse Disposal Sites

Implement the following practices for approved on-farm disposal sites:

- Do not locate the site:
  - On sandy or gravely soils or in gullies;
  - In areas of high groundwater or on a flood plain.
- Do locate the site:
  - At least 120 m from any well (*Health Hazards Regulation*) and down slope of any well;
  - 30 m or more (suggested) from any watercourse.
- Do manage the site to:
  - Protect watercourses and groundwater;
  - Avoid wildlife attraction and wind dispersal (bury and cover wastes) avoid burying organic materials; organic decomposition can release methane, a powerful greenhouse gas;
  - Separate livestock mortalities (use a different site).
- Record locations, amount, and type of material in on-farm disposal sites.

Farm Refuse Disposal

Material Disposal. When purchasing, consider products that contribute to a lower impact on the environment during production, packaging, marketing and shipping. Also consider products that can be reused or recycled.

When disposing of farm waste, use permitted landfills or where they are available, waste disposal services. Untreated wood products may be reused or burnt; paint can be returned to a Product Care Depot.

http://www.productcare.org/

Plastics Disposal. Plastic wastes are not exempted by the *Code of Practice for Agricultural Environmental Management*, and disposal practices must therefore comply with the *Environmental Management Act*. Wherever possible, reuse or return all waste plastics to depots for recycling. The Recycling Council of BC has a hotline to answer questions about recycling in BC 1-800-667-4321. Properly dispose of plastics that have contained or contacted toxic materials. ➔ see Pesticide Container Disposal, **page 5-29**

Implement the following practices for waste plastics:

- Reuse plastics where possible:
  - Reuse plant pots and bedding containers (thoroughly clean and disinfect to avoid plant disease transfer);
  - Replace non-recyclable or difficult to remove plastic products such as plant clips and twine with biodegradable materials;
  - Use refillable containers;
  - Clean and reuse waste sheet plastic for other purposes, such as coverings.
- Recycle plastics where possible:
  - Grind up waste polystyrene for use as a potting soil amendment;
  - Separate plastic products from plant debris and clean before recycling or taking to an approved landfill;
  - Use a roller or baler to compress waste plastics into smaller volumes for easier handling;
  - Encourage suppliers to accept the return of waste plastics.
- If recycling or reusing plastics is not an option:
  - Do not burn on-farm due to the release of hazardous gasses.

➔ see Open Burning, **page 10-5**

  - **Do not bury plastics on farm property.**
  - An alternative disposal method is to use an approved landfill.

Treated Wood Disposal. Implement the following practices for disposal of treated wood material, such as pallets, boards, or posts (note that waste wood products treated with registered wood preservatives are not "hazardous waste" under the *Hazardous Waste Regulation* of the *Environmental Management Act*):

- Reuse treated wood products for other applications such as landscape construction.
- Dispose of treated wood products at an approved landfill.
- Obtain an authorization permit from ENV to bury the material on a farm property.

DO NOT burn treated wood materials on the farm. High-temperature burning at an approved incineration facility is the only environmentally safe way to burn such materials. To reduce the use of treated wood products, investigate alternatives such as metal, concrete, or recycled plastic posts.

➔ see Treated Wood Products, **page 2-18**

Machinery and Equipment Disposal. When possible reuse or recycle machinery components; otherwise dispose of such products to recyclers. If spent machinery remains on the property, remove potential damaging fluids (e.g., refrigerants, oils, fuels, antifreeze) and safely dispose. Send batteries, tires and oils to collection depots for recycling.

Metal Disposal. Most suppliers of commercial products stored in metal drums and cans accept the return of these containers. Recycling options also currently exist for most types of metal containers. An alternative disposal method is to use an approved landfill – **do not bury metal on a farm property.**

Rockwool Disposal. Rockwool is an inert, non-polluting, non-degradable soilless medium manufactured from lava rock for use in greenhouse and nursery production. Implement the following beneficial management practices:

- Reuse rockwool where possible.
- Rotate crops to reduce or eliminate the risk of pathogens – rockwool slabs can function effectively for three to four years without replacement if handled carefully and if sterilized between crops.
- Recycle rockwool where possible.
- Do not store product for long periods or in anticipation of recycling.
- Where rockwool is disposed of use an approved landfill – **do not bury rockwool on a farm property.**
- In some cases, rockwool may be used as a soil amendment to improve soil structure and to allow any residual nutrients to be taken up by crops:
  - consult ENV if use of rockwool as a soil amendment is being considered.

Ash Disposal. Ash from auxiliary fuel fired refuse incinerators that serve industrial, recreational or camp operations in remote areas can be land filled or used as a soil conditioner by farms or ranches. If used as a soil amendment, prior testing for heavy metals is recommended.

- Contact ENV to see if this type of ash disposal or use is appropriate.

Animal Health Care Products Disposal

The use of medication in livestock production is common practice. Dispose of spent medicines, empty containers and other medical items in an acceptable manner. Implement the following practices:

- Consult your veterinarian about the proper and safe disposal of spent medicines and/or see if they can be returned.
- Package medical waste equipment that has the potential to puncture within a rigid container, and discard with household waste if permitted.
- Follow suppliers' or manufacturers' instructions for disposal of syringes, medications, outdated medical supplies and other items.
- Contact ENV when disposal quantities are in excess of 5 kg or 5 litres.

CHEMICAL FERTILIZER

CHEMICAL FERTILIZER ENVIRONMENTAL CONCERNS

Primary environmental concerns related to chemical fertilizer are:

- Fertilizer receiving, storing and dispensing where:
  - Spills or fires result in soil, water or air pollution gas emissions result in air pollution or contribute to climate change;
  - Leachates result in water pollution.
- ➔ see **Chapter 6**, Nutrient Application, for information on fertilizer use

For information on these concerns:

- ➔ see Impacts on Biodiversity and Habitat, **page 7-8**, refer to Farm Activities and Impacts
- ➔ see Soil Quality Factors, **page 8-2**, refer to Contaminants
- ➔ see Water Quality and Quantity Factors, **page 9-1**, refer to Contaminants
- ➔ see Air Quality Factors, **page 10-1**, refer to Contaminants

CHEMICAL FERTILIZER LEGISLATION

The following is a brief outline of the main legislation that applies to chemical fertilizers.

- ➔ see **page A-1** for a summary of these and other Acts and Regulations

Agricultural Land Commission Act

The *Agricultural Land Commission (ALC) Act* S.B.C. 2002, c. 36, and *Agricultural Land Reserve (ALR) Regulations* are the legislative framework for the establishment, administration, and procedures of BC's agricultural land preservation program. The ALC Act takes precedence over, but does not replace other legislation and bylaws that may apply to the land. Local and regional governments, as well as other provincial agencies, are expected to plan in accordance with the provincial policy of preserving agricultural land.

The *ALR Use Regulation,* B.C. Reg. 30/2019 specifies designated land uses permitted in the ALR. These include:

SECTION 7:

- The use of agricultural land for storing and applying biosolids and soil amendments, other than compost.
- The use of agricultural land for producing, storing and applying compost if, in the case of:
  - Compost classified as Class A compost under the *Organic Matter Recycling Regulation*, all of the compost produced, stored and applied is used on the agricultural land on which it was produced, or
  - Any other compost, the compost is from agricultural by-products that were produced for a farm use.

SECTION 27: describes permitted non-farm uses that may be prohibited by local governments. This includes:

(4) Producing, storing and applying compost classified as Class A compost under the *Organic Matter Recycling Regulation* is permitted, but may be prohibited, if at least 50% but less than 100% of the compost is used on the agricultural land on which it was produced.

SECTION 36: Outlines the types of fill that are prohibited from being placed on agricultural land. These include construction or demolition waste (including rubble, concrete, cement, rebar, drywall, wood waste); asphalt; glass; synthetic polymers; treated wood; and unchipped lumber.

For more information see the following informational bulletins:

IB-07 Soil or Fill Uses in the ALR;

Drinking Water Protection Act

This Act and Regulations have requirements regarding the protection of drinking water quality and regulate domestic water systems (those serving **more** than one single-family residence).

- SECTION 23(1): subject to subsection (3), a person must not (a) introduce anything or cause or allow anything to be introduced into a domestic water system, a drinking water source, a well recharge zone or an area adjacent to a drinking water source, or (b) do or cause any other thing to be done or to occur if this will result or is likely to result in a drinking water health hazard in relation to a domestic water system.

Environmental Management Act

The *Spill Reporting* Regulation requires spills of a polluting substance be reported immediately to the Provincial Emergency Program (PEP) at

1-800-663-3456 (24 hour service). Report spills of fertilizer greater than 50 kg or 50 litres.

REPORTING REQUIREMENT

Under the *Spill Reporting* Regulation, chemical spills must be reported immediately to the Provincial Emergency Program (EMP) at 1-800-663-3456 (24hr service) if they exceed the amounts set forth in the Spill Reporting Regulation Factsheet:
https://www2.gov.bc.ca/assets/gov/environment/air-land-water/spills-and-environmental-emergencies/docs/materials/fact_sheet_spill_reporting.pdf

Fertilizers are included in the definition of nutrient sources in the *Code of Practice for Agricultural Environmental Management*.

➔see **Chapter 6**, Nutrient Application, for information on the use of nutrient sources.

Public Health Act

Administered by the Ministry of Health, this Act has a specific prohibition that "a person must not willingly cause a health hazard, or act in a manner that the person knows, or ought to know, will cause a health hazard". This prohibition would apply to farm practices that may result in a health hazard, such as when nutrients, contaminants or pathogens are discharged to land, water or air so as to pose a public health problem. Any situation that entails a health hazard will enable health officers to investigate using their powers under the Act. Under the *Public Health Act*, the local Health Authority must investigate any health hazard and has authority to order that a person prevent or stop a health hazard, or mitigate the harm or prevent further harm from a health hazard amongst other powers. Similar regulatory provisions exist for addressing health hazards to drinking water supplies under the *Drinking Water Protection Act.*

The *Health Hazard Regulation* regulates the distance of wells from possible source of contamination

SECTION 8 (1) A person who installs a well, or who controls a well installed on or after July 20, 1917, must ensure that the well is located at least:

(a) 30 m from any probable source of contamination,

(b) 6 m from any private dwelling, and

(c) Unless contamination of the well would be impossible because of the physical conformation, 120 m from any cemetery or dumping ground.

(2) A person who controls a well installed before July 20, 1917, must:

(a) Remove any source of contamination within the distances set out in subsection (1), or

(b) Subject to subsection (3), close the well in accordance with section 6 of the *Code of Practice under the Ground Water Protection Regulation*, B.C. Reg. 299/2004.

(3) Subsection (2) (b) does not apply to a well located within 6 m of a private dwelling unless it can be shown that the well should be abandoned for a reason other than proximity to a private dwelling.

(4) A well that does not meet the requirements of this section is prescribed as a health hazard.

SECTION 11 Mandatory reporting of health hazards

(11) If a prescribed person becomes aware that a prescribed health hazard exists or may exist, the person must promptly report the following information, to the extent of his or her knowledge, to a prescribed person:

(a) The nature of the health hazard, including its location and cause or source;

(b) The identity of persons involved in causing or responding to the health hazard;

(c) The persons who may be adversely affected by the health hazard;

(d) Prescribed information;

(e) Any other relevant information requested by the person to whom the report is made.

Fisheries Act

Administered by both Fisheries and Oceans Canada and Environment and Climate Change Canada, this Act is established to manage Canada's fisheries resources, including fish habitat. The Act can also be administered provincially by FLNRORD and ENV. The Act applies to all Canadian waters that contain fish, including ditches, channelized streams, creeks, rivers, marshes, lakes, estuaries, coastal waters and marine offshore areas. It also applies to seasonally wetted areas that provide fish habitat such as shorelines, stream banks, floodplains, intermittent tributaries and privately owned land. The Act includes provisions for stiff fines and imprisonment to ensure compliance.

The purpose of this Act is to provide a framework for (a) the proper management and control of fisheries; and (b) the conservation and protection of fish and fish habitat, including by preventing pollution.

This Act was updated in 2019 and now empowers the Minister to make regulations for the purposes of the conservation and protection of biodiversity.

The definition of fish habitat is: "water frequented by fish and any other areas on which fish depend directly or indirectly to carry out their life processes, including spawning grounds and nursery, rearing, food supply and migration areas". The quantity, timing and quality of the water flow that are necessary to sustain fish habitat are also deemed to be a fish habitat. Furthermore, serious harm to fish includes the death of fish or any permanent alteration to, or destruction of, fish habitat.

Provisions of the *2019 Fisheries Act* relevant to agricultural operations include:

- Protection for all fish and fish habitats;
- Prohibition against the death of fish or the 'harmful alteration, disruption or destruction of fish habitat';
- A permitting framework and codes of practice to improve management of large and small projects impacting fish and fish habitat;
- Protection of fish and/or fish habitats that are sensitive, highly productive, rare or unique; and
- Consideration for the cumulative effects of development activities on fish and fish habitat.

Specific sections of the Act include:

SECTION 34.2(1) The Minister may establish standards and codes of practice for:

(a) The avoidance of death to fish and harmful alteration, disruption or destruction of fish habitat;

(b) The conservation and protection of fish or fish habitat; and

(c) The prevention of pollution.

SECTION 34.4(1) No person shall carry on any work, undertaking or activity, other than fishing, that results in the death of fish.

SECTION 35 (1) No person shall carry on any work, undertaking or activity that results in the harmful alteration, disruption or destruction of fish habitat.

Every person who contravenes subsection 34.4(1) or 35(1) is guilty of an offence and liable.

Notifying authorities about serious harm to fish or deposit of a deleterious substance:

SECTION 38 (4.1) Every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations of a harmful alteration, disruption or destruction of fish habitat that is not authorized under this Act, or of a serious and imminent danger of such an occurrence, if the person at any material time.

(a) Owns or has the charge, management or control of the work, undertaking or activity that resulted in the occurrence or the danger of the occurrence; or

(b) Causes or contributes to the occurrence or the danger of the occurrence.

SECTION 38 (5) If there occurs a deposit of a deleterious substance in water frequented by fish that is not authorized under this Act, or if there is a serious and imminent danger of such an occurrence, and detriment to fish habitat or fish or to the use by humans of fish results or may reasonably be expected to result from the occurrence, then every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations.

SECTION 38 (7) As soon as feasible after the occurrence or after learning of the danger of the occurrence, the person shall provide an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations with a written report on the occurrence or danger of the occurrence.person at any material time

(a) Owns or has the charge, management or control of the work, undertaking or activity that resulted in the occurrence or the danger of the occurrence; or

(b) Causes or contributes to the occurrence or the danger of the occurrence.

SECTION 38 (5) If there occurs a deposit of a deleterious substance in water frequented by fish that is not authorized under this Act, or if there is a serious and imminent danger of such an occurrence, and detriment to fish habitat or fish or to the use by humans of fish results or may reasonably be expected to result from the occurrence, then every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations.

SECTION 38 (7) As soon as feasible after the occurrence or after learning of the danger of the occurrence, the person shall provide an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations with a written report on the occurrence or danger of the occurrence.

CHEMICAL FERTILIZER BENEFICIAL MANAGEMENT PRACTICES

Comply with applicable chemical fertilizer related legislation, including the above, and where appropriate, implement the following beneficial management practices to protect the environment.

➔ see **Chapter 6**, Nutrient Application, for information on fertilizer use

Chemical Fertilizer Handling Storage and Disposal

When handling, storing and disposing of chemical fertilizers implement the following practices:

- Locate away from yard drain inlets, ditches, wells and watercourses:
  - At least 30 m from wells (*Health Hazards Regulation*);
  - To meet the Agriculture Building Setback Standards (suggested).

➔ see Farm Building Siting, **page 2-8**

  - 30 m or more from a water intake used for domestic purposes (suggested).
- Locate handling and storage areas above the 100-year flood level (suggested) or the flood level expected based on climate change projections.
- Clean up fertilizer spills as soon as possible.

Dry fertilizer is very soluble and should be stored under cover to prevent any water contact. Liquid fertilizers should be stored in watertight containers with secondary containment. Check storage tanks for both liquid and gaseous fertilizers every day for leaks. Liquid and gaseous storage tanks should be protected from collision.

In the event of anhydrous ammonia leak, the tank and surrounding area should be showered with water. This water should be prevented from entering a watercourse as it will contain ammonia.

Store chemical fertilizers, pesticides and fuel in separate facilities to avoid cross-contamination and unpredictable chemical reactions. Keep oxidizing fertilizers (e.g., ammonium nitrate) away from any fuel or source of open flame or spark. Buy only the amounts you need to avoid storing large amounts of fertilizer. If you must store fertilizers for longer periods of time, size facilities appropriately. Construct a storage facility such that it can be locked and have an impermeable floor with leachate and spill collection. Clearly label all containers.

Implement the following practices for unwanted, unused, old, wrongly formulated, or spoiled fertilizer:

- Do not bury unwanted or spilled fertilizers on your property.
- Spread unused product on alternative sites or crops in amounts that ensure efficient nutrient utilization.
- Add small amounts to materials that are to be composted.

Chemical Fertilizer Spills

Fertilizer spills larger than 50 kg or 50 litres must be reported in accordance with the *Spill Reporting Regulation.* If a fertilizer spill occurs implement the following practices:

- Use berms or containment to prevent spread.
- Clean up sites by removing both fertilizer and soil that contains excess nutrients and manage the same as liquid or solid fertilizer.

REPORTING REQUIREMENT

Under the ***Spill Reporting Regulation***, fertilizer spills larger than 50 kg or 50 L must be reported immediately to the Provincial Emergency Program (PEP) at 1-800-663-3456 (24hr service).

Chemical Fertilizer Contingency Plan

Develop a contingency plan when storing any amount of fertilizer. The plan should provide a timely and effective response to emergencies involving the unexpected release of fertilizer products into the environment, from:

- Accidental spills, such as when transporting, storing, dispensing or applying.
- Release due to building fires or natural events, such as forest fires, floods, or earthquakes.
- Release due to vandalism.
- Application errors, such as applying too much fertilizer.

Emergency Plan Template for Farms

Emergency Management Plan for SmallBC Farms

PETROLEUM

PETROLEUM ENVIRONMENTAL CONCERNS

Primary environmental concerns related to petroleum are:

- Receiving, storing, dispensing and using petroleum products where spills or fires result in soil, water, air or habitat pollution.
- Gas emissions from storage that result in air pollution.
- Disposal of used oils that results in soil, water, air or habitat pollution.
- Internal combustion engine-driven pumps that result in water pollution.
- Petroleum losses from gas emissions or used oil disposal that increase the level of greenhouse gas emissions.

For information on these concerns:

➔ see Impacts on Biodiversity and Habitat, **page 7-7**, refer to Farm Activities and Impacts

➔ see Soil Quality Factors, **page 8-1**, refer to Contaminants, and to Micronutrients and Metals

➔ see Water Quality and Quantity Factors, **page 9-1**, refer to Contaminants, and to Micronutrients and Metals

➔ see Air Quality Factors, **page 10-1**, refer to Contaminants

➔ see Climate Change Mitigation Best Management Practices, **page 12-9**

PETROLEUM LEGISLATION

The following is a brief outline of the main legislation that applies to petroleum products.

➔ see **page A-1** for a summary of these and other Acts and Regulations

Local Bylaws

The National Farm Building Code 1995 outlines standards for above ground fuel tanks storing more than 100 litres and **is enforced only where proclaimed by local government.**

- SECTION 3.1.4: requires equipment being fueled and the above ground fuel storage tanks be at least 12 m from any other building or property line. Fuel storages must be located outdoors or in buildings used only for the purpose of fuel storage.

Drinking Water Protection Act

This Act and Regulations have requirements regarding the protection of drinking water quality and regulate domestic water systems (those serving **more** than one single-family residence).

SECTION 23 (1): Subject to subsection (3), a person must not

(a) Introduce anything or cause or allow anything to be introduced into a domestic water system, a drinking water source, a well recharge zone or an area adjacent to a drinking water source, or

(b) Do or cause any other thing to be done or to occur if this will result or is likely to result in a drinking water health hazard in relation to a domestic water system.

The *Spill Reporting Regulation* requires spills of a polluting substance be reported immediately to the Provincial Emergency Program (PEP) at **1-800-663-3456** (24 hour service). Report spills of petroleum or lubricants greater 100 litres.

Under the *Hazardous Waste Regulation* waste oil cannot be applied to land for the purpose of dust suppression.

Public Health Act

Administered by the Ministry of Health, this Act has a specific prohibition that "a person must not willingly cause a health hazard, or act in a manner that the person knows, or ought to know, will cause a health hazard". This prohibition would apply to farm practices that may result in a health hazard, such as when nutrients, contaminants or pathogens are discharged to land, water or air so as to pose a public health problem. Any situation that entails a health hazard will enable health officers to investigate using their powers under the Act. Under the *Public Health Act*, the local Health Authority must investigate any health hazard and has authority to order that a person prevent or stop a health hazard, or mitigate the harm or prevent further harm from a health hazard amongst other powers. Similar regulatory provisions exist for addressing health hazards to drinking water supplies under the *Drinking Water Protection Act*. SECTION 11: requires the reporting of any health hazard to a prescribed person (a health hazard may be the escape of toxic substances)

Health Hazard Regulation regulates the distance of wells from possible source of contamination

SECTION 8 (1) A person who installs a well, or who controls a well installed on or after July 20, 1917, must ensure that the well is located at least:

(a) 30 m from any probable source of contamination,

(b) 6 m from any private dwelling, and

(c) Unless contamination of the well would be impossible because of the physical conformation, 120 m from any cemetery or dumping ground.

(2) A person who controls a well installed before July 20, 1917, must:

(a) Remove any source of contamination within the distances set out in subsection (1), or

(b) Subject to subsection (3), close the well in accordance with section 6 of the *Code of Practice under the Ground Water Protection Regulation*, B.C. Reg. 299/2004.

(3) Subsection (2) (b) does not apply to a well located within 6 m of a private dwelling unless it can be shown that the well should be abandoned for a reason other than proximity to a private dwelling.

(4) A well that does not meet the requirements of this section is prescribed as a health hazard.

Environmental Management Act

- The *Spill Reporting Regulation* requires spills of a polluting substance be reported immediately to the Provincial Emergency Program (EMP) at **1-800-663-3456** (24 hour service)

REPORTING REQUIREMENT

Under the ***Spill Reporting Regulation***, chemical spills must be reported immediately to the Provincial Emergency Program (EMP) at 1-800-663-3456 (24hr service) if they exceed the amounts set forth in the Spill Reporting Regulation Factsheet:
https://www2.gov.bc.ca/assets/gov/environment/air-land-water/spills-and-environmental-emergencies/docs/materials/fact_sheet_spill_reporting.pdf

Fisheries Act

Administered by both Fisheries and Oceans Canada and Environment and Climate Change Canada, this Act is established to manage Canada's fisheries resources, including fish habitat. The Act can also be administered provincially by FLNRORD and ENV. The Act applies to all Canadian waters that contain fish, including ditches, channelized streams, creeks, rivers, marshes, lakes, estuaries, coastal waters and marine offshore areas. It also applies to seasonally wetted areas that provide fish habitat such as shorelines, stream banks, floodplains, intermittent tributaries and privately owned land. The Act includes provisions for stiff fines and imprisonment to ensure compliance.

The purpose of this Act is to provide a framework for (a) the proper management and control of fisheries; and (b) the conservation and protection of fish and fish habitat, including by preventing pollution.

This Act was updated in 2019 and now empowers the Minister to make regulations for the purposes of the conservation and protection of biodiversity.

The definition of fish habitat is: "water frequented by fish and any other areas on which fish depend directly or indirectly to carry out their life processes, including spawning grounds and nursery, rearing, food supply and migration areas". The quantity, timing and quality of the water flow that are necessary to sustain fish habitat are also deemed to be a fish habitat. Furthermore, serious harm to fish includes the death of fish or any permanent alteration to, or destruction of, fish habitat.

Provisions of the *Fisheries Act* relevant to agricultural operations include:

- Protection for all fish and fish habitats
- Prohibition against the death of fish or the 'harmful alteration, disruption or destruction of fish habitat'
- A permitting framework and codes of practice to improve management of large and small projects impacting fish and fish habitat
- Protection of fish and/or fish habitats that are sensitive, highly productive, rare or unique; and
- Consideration for the cumulative effects of development activities on fish and fish habitat

Specific sections of the Act include:

SECTION 34.2(1) The Minister may establish standards and codes of practice for:

(a) The avoidance of death to fish and harmful alteration, disruption or destruction of fish habitat;

(b) The conservation and protection of fish or fish habitat; and

(c) The prevention of pollution.

SECTION 34.4(1) No person shall carry on any work, undertaking or activity, other than fishing, that results in the death of fish.

SECTION 35 (1) No person shall carry on any work, undertaking or activity that results in the harmful alteration, disruption or destruction of fish habitat.

Every person who contravenes subsection 34.4(1) or 35(1) is guilty of an offence and liable.

Notifying authorities about serious harm to fish or deposit of a deleterious substance:

SECTION 38 (4.1) Every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations of a harmful alteration, disruption or destruction of fish habitat that is not authorized under this Act, or of a serious and imminent danger of such an occurrence, if the person at any material time.

(a) Owns or has the charge, management or control of the work, undertaking or activity that resulted in the occurrence or the danger of the occurrence; or

(b) Causes or contributes to the occurrence or the danger of the occurrence.

SECTION 38 (5) If there occurs a deposit of a deleterious substance in water frequented by fish that is not authorized under this Act, or if there is a serious and imminent danger of such an occurrence, and detriment to fish habitat or fish or to the use by humans of fish results or may reasonably be expected to result from the occurrence, then every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations.

SECTION 38 (7) As soon as feasible after the occurrence or after learning of the danger of the occurrence, the person shall provide an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations with a written report on the occurrence or danger of the occurrence.

Migratory Birds Convention Act

This Act prohibits the deposit of oil or waste oil onto any area frequented by migratory birds. This Act protects migratory birds and their eggs and nests.

- SECTION 5.1: prohibits the deposit of substance(s) harmful to migratory birds in any area frequented by migratory birds, or in a place where the substance(s) can enter these areas. The *Migratory Birds Regulations* under this Act also has sections of importance.
- SECTION 6: no person shall: disturb, destroy or take a nest, egg, nest shelter, eider duck shelter or duck box of a migratory bird without permit.
- SECTION 24(1): any person may, without a permit, use equipment, other than an aircraft or firearms, to scare migratory birds that are causing, or a likely to cause damage to crops or other property (other control measures require a permit).

PETROLEUM BENEFICIAL MANAGEMENT PRACTICES

Comply with applicable petroleum related legislation, including the above and where appropriate, implement the following beneficial management practices to protect the environment.

Petroleum Storage

Mobile Fuel Storage. Jerry cans, drums and truck-box fuel tanks are commonly used in farm operations. Implement the following practices:

- Do not fill beyond their safe filling level.
- Keep drums upright and secure during transport.
- Avoid dispensing from horizontal drums.
- Have secondary containment for truck box fuel tanks that are removed from the truck or trailer and operated in a fixed location for any length of time.
- Carry a fuel spill cleanup kit.

Stationary Fuel Storage. Implement the following practices for all tanks (refer to **Figure 2.2**, for aboveground tank illustration):

- Locate tanks away from yard drain inlets, ditches, wells and watercourses:
  - At least 30 m from wells (*Health Hazards Regulation*);
  - To meet the Agriculture Building Setback Standards (suggested);

    ➔ see Farm Building Siting, **page 2-8**
  - 30 m or more from a water intake used for domestic purposes (suggested).
- Support tanks on non-combustible material (e.g., metal).
- Construct storage tanks in accordance with accepted engineering practices.
- Size spill containment to hold a single tank's volume plus 10%, or, for multiple tanks, the largest tank's volume plus 10%.
- Use an anti-siphoning device in tank discharge lines or self-closing nozzles.
- Ensure no drips, leaks or overflow occurs when receiving or dispensing fuel.
- Use bumper guards to protect tanks from direct collision by vehicles.
- Ensure that a fuel spill cleanup kit is readily available.

ENV recommends that underground fuel storage tanks have:

- Secondary containment for all tanks and piping (i.e., double-wall).
- Corrosion protection for all steel tanks and piping.
- A leak detection system.
- An overfill protection device for the tank.
- A self-closing nozzle on the dispensing line.
- Ensure no drips, leaks or overflow occurs when receiving or dispensing fuel.
- Use bumper guards to protect tanks from direct collision by vehicles.
- Ensure that a fuel spill cleanup kit is readily available.

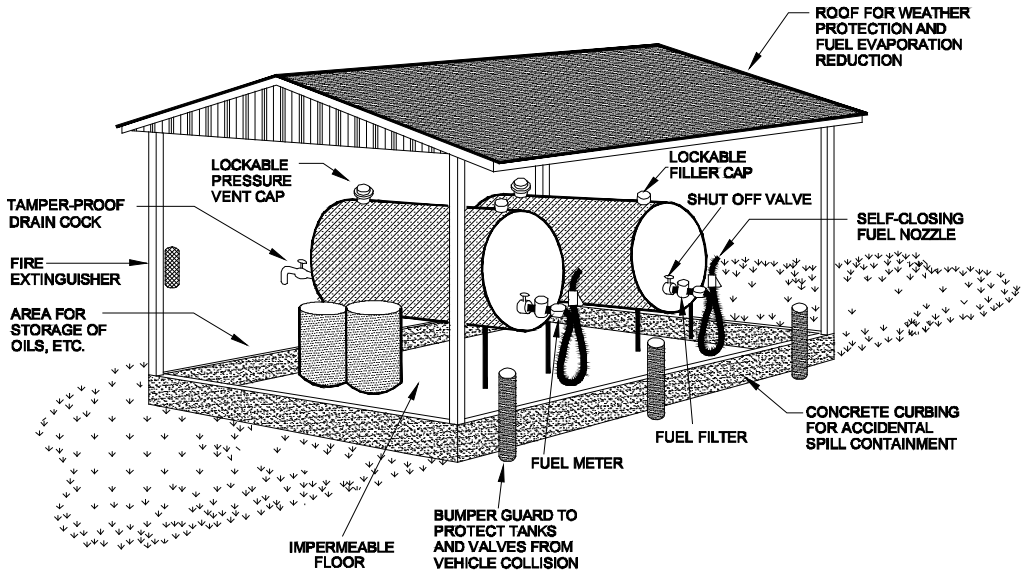


FIGURE 2.2 A Well-Planned Above Ground Fuel Storage Facility

VOC Emission Reduction from Fuel Evaporation

Fuel evaporation during storage results in volatile organic compound (VOC) emissions and is an environmental concern. Evaporation from aboveground tanks is due to heating of the tank by the sun which causes the fuel to volatilize and vent to the atmosphere. Underground tanks have lower evaporation losses. Implement the following beneficial management practices to reduce the release of VOCs into the atmosphere:

- Construct an improved fuel storage facility.
- Dispose of used or unwanted petroleum in a timely manner.
- Minimize fuel evaporation from fuel storage, refer to **Table 2.2**, next page:
  - Paint fuel storage a light colour (e.g., white or silver);
  - Build fuel storage tanks below ground;
  - When possible shade tanks or build a covered storage facility.
- Contain gases by using a pressure release valve vent cap that allows tank pressure to build up slightly before emissions are released.
- To estimate fuel losses from fuel storage refer to:

  Farm Storage and Handling of Petroleum Products

  A Field Guide to Fuel Handling, Transportation & Storage

➔ see Petroleum Storage, **page 2-35**

Used Oil Disposal

When installing or retrofitting fuel storage facilities follow the fuel loss beneficial management practices that are outlined in **Table 2.2**.

Improper disposal of spent or used oils can cause an environmental concern. The best alternative is to return oil to an approved recycling centre. Under the *Environmental Management Act*, all vendors of petroleum products are required to accept the return of waste oil from customers. Safely recover and store waste petroleum products and return them periodically to the supplier or a depot for recycling. Do not apply used oil to roads for dust suppression (*Hazardous Waste Regulation*).

➔ see Farm Roads, **page 2-14**

TABLE 2.2 Fuel Loss Beneficial Management Practices

1. Paint the Tank

   The use of reflective paint (white or silver) will reduce losses by up to 40% over a dark tank. A coat of paint will also reduce rusting of the tank.

2. Use a Pressure Vent Cap

   Direct venting of the tank fumes are restricted until a slight pressure has built up in the tank. Losses are reduced further by 50%. A painted and pressure-vented tank has 75% less evaporation losses than a dark tank. These two improvements should be considered standard for all farm fuel tanks, especially gasoline storage tanks.

3. Shade the Tank

   A painted and pressure-vented tank in the shade further reduces losses by over 40%. A simple roof over the tank will provide complete shading. The cover will also reduce weathering of hoses and valves, provide storage for lubricants and solvents and provide cover from the weather while refuelling.

4. Use a Double-walled Tank

   While more expensive than other tanks, when replacing a tank, consider a double-walled tank for spill containment and reduced evaporation losses

Petroleum Spills

Be prepared to handle spills by having a petroleum spill cleanup kit when transporting, storing or dispensing fuels. Such a kit includes containers for contaminated waste and absorbent materials such as clay, kitty litter or sawdust and a means, such as shovel, to collect contaminated material.

Report any petroleum spill to the nearest Medical Health Officer located at the nearest Regional Health Unit, as required by the *Public Health Act*.

REPORTING REQUIREMENT

Under the ***Spill Reporting Regulation***, petroleum spills over 100 litres must be reported immediately to the Provincial Emergency Program (PEP) at 1-800-663-3456 (24hr service).

Contact the Pollution Prevention Program of the regional ENV office for assistance in remediation or disposal options regardless of the extent of the contamination.

Petroleum spills of less than 100 L do not require reporting but do need to be managed to minimize environmental impacts. If a petroleum spill can be contained and there is no danger of the spilled product leaching into a watercourse, the contaminated soil may remain in place or be moved to a safer area and spread. Soil microbes will break down the petroleum product and decontaminate the soil over time (i.e., bioremediation).

If a spill takes place in a public area such as a highway, call the local police and contact the 24-hour Provincial Emergency Program at 1-800-663-3456.

Stationary Engines. Internal combustion engines located near watercourses create a potential for contamination. To minimize this possibility, use secondary containment for the engine and its fuel tank, such as a metal pan large enough to capture fuel spills from the fuel system.

Note: small quantities of petroleum products can cause extensive water pollution.

Petroleum Contingency Plan

Develop a contingency plan when storing quantities of petroleum products. The plan should provide a timely and effective response to emergencies involving the release of petroleum products into the environment, from:

- Accidental spills, such as when transporting, storing, applying or dispensing.
- Release due to building fires or natural events, such as forest fires, floods, or earthquakes.
- Release due to vandalism.

Contingency Plan – Template for On-Farm Planning

Emergency Plan – Template for Farms

Emergency Management Plan – for Small BC Farms

WOOD RESIDUE

For the purpose of this publication, the definition of wood residue is the one given in the AEM Code under the *Code of Practice for Agricultural Environmental Management*:

Wood residue **includes** hog fuel, mill ends, wood chips, bark and sawdust;

- Wood residue means any wood or wood product that is chipped or ground (e.g., hog fuel, mil ends, wood chips, bark and sawdust):
  - Originates from wood processing, land clearing activities, if the majority of the greenery is removed and no soil is present, or trimming or pruning activities;
  - Not treated or coated with chemicals, including preservatives, glues, paints, varnishes, oils or finishing materials;
  - Does not contain a foreign substance harmful to humans, animals or plants when combusted;
  - Has not been exposed to salt water, and
  - Has not been used or recovered from construction or demolition activites.

WOOD RESIDUE ENVIRONMENTAL CONCERNS

The environmental hazards associated with the use and storage of wood residue are easily overlooked as wood is a natural material. The process of wood residue decay accelerates significantly when wood is ground or chipped.

Primary environmental concerns related to wood residue are:

- The handling and use of wood residue where direct deposit into watercourses results in pollution of water or habitat loss; or application onto soil results in pollution of the soil; or storage results in pollution of air.
- The formation of wood residue leachate that enters watercourses or domestic water sources and results in pollution of water and fish kills.

For information on these concerns:

➔ see Impacts on Biodiversity and Habitat, **page 7-7**, refer to Farm Activities and Impacts

➔ see Soil Quality Factors, **page 8-1**, refer to Carbon-to-Nitrogen Ratio, to Contaminants, and to pH

➔ see Water Quality and Quantity Factors, **page 9-1,** refer to Contaminants, and to Micronutrients and Metals

➔ see Air Quality Factors, **page 10-2**, refer to Dust and Particulates, and to Open Burning

WOOD RESIDUE LEGISLATION

The following is a brief outline of the main legislation that applies to wood residue.

➔ see **page A-1** for a summary of these and other Acts and Regulations

Agricultural Land Commission

The *Agricultural Land Commission (ALC) Act* S.B.C. 2002, c. 36, and *Agricultural Land Reserve (ALR) Regulations* are the legislative framework for the establishment, administration, and procedures of BC's agricultural land preservation program. The ALC Act takes precedence over, but does not replace other legislation and bylaws that may apply to the land. Local and regional governments, as well as other provincial agencies, are expected to plan in accordance with the provincial policy of preserving agricultural land.

The *ALR Use Regulation*, B.C. Reg. 30/2019 specifies land uses permitted in the ALR.

- SECTION 20.3(1) – 20.3(6): restricts the removal or placement of fill on agricultural land and describes the requisite notice of intent and soil or fill use application procedures.
- SECTION 36: outlines the types of fill that are prohibited from being placed on agricultural land. This includes construction or demolition waste (including rubble, concrete, cement, rebar, drywall, wood waste); asphalt; glass; synthetic polymers; treated wood; and unchipped lumber.

For more information see the following informational bulletins:

IB-07 Soil or Fill Uses in the ALR

Drinking Water Protection Act

This Act and Regulations have requirements regarding the protection of drinking water quality and regulate domestic water systems (those serving more than one single-family residence).

- SECTION 23(1): subject to subsection (3), a person must not (a) introduce anything or cause or allow anything to be introduced into a domestic water system, a drinking water source, a well recharge zone or an area adjacent to a drinking water source, or (b) do or cause any other thing to be done or to occur if this will result or is likely to result in a drinking water health hazard in relation to a domestic water system

Environmental Management Act

SECTION 6 of this Act covers Waste Disposal:

> 6(1) For the purposes of this section, "the conduct of a prescribed industry, trade or business" includes the operation by any person of facilities or vehicles for the collection, storage, treatment, handling, transportation, discharge, destruction or other disposal of waste in relation to the prescribed industry, trade or business.
>
> (2) Subject to subsection (5), a person must not introduce or cause or allow waste to be introduced into the environment in the course of conducting a prescribed industry, trade or business.

The Act has four Regulations which covers wood residue use on farms.

Code of Practice for Agricultural Environmental Management; Antisapstain Chemical Waste Control Regulation; *Code of Practice for Soil Amendments;* and *Waste Discharge Regulation*

The *Code of Practice for Agricultural Environmental Management* states that:

- SECTION 17(3): wood residue stored in a permanent structure, or as temporary field storage, or applied to land in a layer 30 cm deep or more must be 30 m from a drinking water source, 15 m from a watercourse, and must not be located on the property boundary.
- SECTION 17(4): wood residue applied to land in a layer less than 30 cm deep must be 30 m from a well or diversion point, and 3 m from watercourses and any other drinking water source.
- SECTION 45: wood residue may only be stored in a permanent storage structure or as temporary field storage for up to 12 months.
- SECTION 46: wood residue storage and application must meet the following criteria:
  - Wood residue is not stored on or land applied to areas that are prone to seasonal flooding or in areas with standing water.
  - Wood residue, leachate, contaminated runoff solid and dust do not escape.
  - Leachate must not escape from the storage and that runoff is diverted away from the storage.
- SECTION 47(2): wood residue may only be used as plant mulch, component of growing media, soil conditioner, ground cover, on-farm access ways, livestock bedding, for composting with agricultural by-products and in areas where livestock, poultry or farmed game are confined or exercised, as fuel for wood-fired boilers.
- SECTION 47(1): wood residue may not be used for the construction of berms, as an envelope for tile drains, as fill, or to create an access way through a watercourse.

If wood residue is stored in a permanent storage structure in an area categorized as a vulnerable aquifer recharge area, the following sections apply:

- SECTION 23: a person who uses a modified or new permanent storage structure in a vulnerable aquifer recharge area must ensure that there is a protective base under the storage structure.
- SECTION 22: the protective base must regularly maintained and assessed for leaks, taking corrective action if necessary and documenting said corrective action.

If wood residue is stored in the field, there following sections may apply:

- SECTION 25(1): a person who uses temporary field storage in a high precipitation area must cover the stored materials between October 1 and April 1 of the following year.
- SECTION 25(2): a person who uses temporary field storage for 2 weeks or more in a vulnerable aquifer discharge area must not locate the storage directly on or over coarse textured soil.

The *Antisapstain Chemical Waste Control Regulation* prohibits the use of wood residues containing antisapstain chemicals from being used as mulch or as fuel in wood-burning appliances.

- SECTION 2(C): a person shall not introduce into the environment emmision to the air consisting of combustion products of antisaptain chemicals and their by-products.
- SECTION 11: trim ends, broken lumber, chips, sawdust, planer shavings and other wood residue resulting from processing and handling of wood following its treatment with antisapstain chemicals.

  (a) Shall not be provided to a person for use as mulch or for burning in a residential fireplace, stove or other burning device other than an incinerator permitted under paragraph (b),

  (b) Shall be incinerated only in a hog fuel burning incinerator, or other incineration device, that is designed:
  (i) To burn the wood residue at a minimum combustion temperature of 900°C, and
  (ii) For gases in the combustion zone to have a minimum residence time of one second, and

  (c) If the antisapstain chemical is a chlorophenol, shall not be provided to a person for the purpose of supplying digesters in pulp manufacturing processes.

The *Code of Practice for Soil Amendments* regulates the storage, application and use of industrial residues of wood (as defined).

- SECTION 8: if more than 5 m^3 of soil amendments are to be applied to a site in a year, before applying the soil amendment, the discharger must have a land application plan.

The *Waste Discharge Regulation* exempts the use of industrial wood residue as a soil conditioner or ground cover in non-agricultural operations from SECTIONS 6(2) and 6(3) of the Act under certain conditions:

> (6) The use of industrial wood residue as a soil conditioner or ground cover in non-agricultural operations is exempt from SECTION 6(2) and 6(3) of the Act if:
>
> (a) Less than 100 m^3/year is spread on a single property, and
>
> (b) It is applied in accordance with good agronomic practices.

The *Waste Discharge Regulation* allows the use of wood residue:

- SECTION 3(5):
  - As a plant mulch or in residential gardens.
  - As foundation material for animal bedding.
  - As sports areas (such as riding arenas).

Public Health Act

This Act has conditions under the *Health Hazards Regulation*:

- SECTION 8: separation distance from wells to be at least 30 m from any probable source of contamination (probable source of contamination could include wood residue leachate).

Fisheries Act

Administered by both Fisheries and Oceans Canada and Environment and Climate Change Canada, this Act is established to manage Canada's fisheries resources, including fish habitat. The Act can also be administered provincially by FLNRORD and ENV. The Act applies to all Canadian waters that contain fish, including ditches, channelized streams, creeks, rivers, marshes, lakes, estuaries, coastal waters and marine offshore areas. It also applies to seasonally wetted areas that provide fish habitat such as shorelines, stream banks, floodplains, intermittent tributaries and privately owned land. The Act includes provisions for stiff fines and imprisonment to ensure compliance.

The purpose of this Act is to provide a framework for (a) the proper management and control of fisheries; and (b) the conservation and protection of fish and fish habitat, including by preventing pollution.

This Act was updated in 2019 and now empowers the Minister to make regulations for the purposes of the conservation and protection of biodiversity.

The definition of fish habitat is: "water frequented by fish and any other areas on which fish depend directly or indirectly to carry out their life processes, including spawning grounds and nursery, rearing, food supply and migration areas". The quantity, timing and quality of the water flow that are necessary to sustain fish habitat are also deemed to be a fish habitat. Furthermore, serious harm to fish includes the death of fish or any permanent alteration to, or destruction of, fish habitat.

Provisions of the *Fisheries Act* relevant to agricultural operations include:

- Protection for all fish and fish habitats;
- Prohibition against the death of fish or the 'harmful alteration, disruption or destruction of fish habitat';
- A permitting framework and codes of practice to improve management of large and small projects impacting fish and fish habitat;
- Protection of fish and/or fish habitats that are sensitive, highly productive, rare or unique; and
- Consideration for the cumulative effects of development activities on fish and fish habitat.

Specific sections of the Act include:

SECTION 34.2(1) The Minister may establish standards and codes of practice for:

(a) The avoidance of death to fish and harmful alteration, disruption or destruction of fish habitat;

(b) The conservation and protection of fish or fish habitat; and

(c) The prevention of pollution.

SECTION 34.4(1) No person shall carry on any work, undertaking or activity, other than fishing, that results in the death of fish.

SECTION 35 (1) No person shall carry on any work, undertaking or activity that results in the harmful alteration, disruption or destruction of fish habitat.

Every person who contravenes subsection 34.4(1) or 35(1) is guilty of an offence and liable.

Notifying authorities about serious harm to fish or deposit of a deleterious substance:

SECTION 38 (4.1) Every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations of a harmful alteration, disruption or destruction of fish habitat that is not authorized under this Act, or of a serious and imminent danger of such an occurrence, if the person at any material time.

(a) Owns or has the charge, management or control of the work, undertaking or activity that resulted in the occurrence or the danger of the occurrence; or

(b) Causes or contributes to the occurrence or the danger of the occurrence.

SECTION 38 (5) If there occurs a deposit of a deleterious substance in water frequented by fish that is not authorized under this Act, or if there is a serious and imminent danger of such an occurrence, and detriment to fish habitat or fish or to the use by humans of fish results or may reasonably be expected to result from the occurrence, then every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations.

SECTION 38 (7) As soon as feasible after the occurrence or after learning of the danger of the occurrence, the person shall provide an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations with a written report on the occurrence or danger of the occurrence.

WOOD RESIDUE BENEFICIAL MANAGEMENT PRACTICES

Comply with applicable wood residue related legislation, including the above, and where appropriate, use the following beneficial management practices to protect the environment.

Wood Residue Storage

When storing wood residue implement the following practices:

- Locate storage area away from drain inlets, ditches, wells and watercourses.
  - At least 30 m from wells (*Health Hazards Regulation*);
  - To meet the Agriculture Building Setback Standards (suggested);
    ➔ see Farm Building Siting, **page 2-8**
  - 30 m or more from a water intake used for domestic purposes.
- Store to prevent leachate entering surface or groundwater by:
  - Covering piles to reduce leachate (in high precipitation areas, cover wood residue between October 1st and April 1st);
  - Using impermeable surfaces to prevent leaching into soil and groundwater;
  - Collect or contain leachate with berms.
- Use appropriate construction or adequate buffer to keep wood residue from blowing onto watercourses and neighbours.
  ➔ see Buffers, **page 11-4**

Wood Residue Use

Appropriate agricultural uses of wood residue are restricted to plant mulch, animal bedding, groundcover, farm access ways and fuel for boilers. When using wood residue, implement the following practices:

- Do not place directly into surface water.
- The use of wood residue to create access ways across streams or across ditches is not permitted under the *Environmental Management Act.*
- Use adequate buffers between areas receiving wood residue and watercourses to prevent leachate contamination.
  ➔ see Buffers, **page 11-4**
- Do not apply wood waste to a depth of greater than 15 cm per year in outdoor areas (suggested).
- Limit the total depth of wood residue applied outdoors to no greater than 30 cm total (suggested).
- Do not use wood residue that may contain antisapstain chemicals, wood preservatives, or fire retardation chemicals.
  - Wood residue containing these chemicals can affect livestock, wildlife and fish that come into contact with the treated wood residue or leachate.
- To reduce the risk of causing pollution, utilize sawdust from weathered wood residue or from less toxic softwood tree species such as spruce, pine or fir, or from hardwoods.
  - Avoid using the bark of softwood trees, wherever possible, since they contain more resinous ingredients than heartwoods or sapwoods (resinous ingredients have a higher risk of producing toxic leachate).
  - Use weathered wood residue with low bark content near sensitive areas (the production of leachate declines as wood residue ages).
- Apply only to soils having a carbon-nitrogen ratio (C:N) of 30:1 or lower.
- Do not bury wood residue; decomposition without oxygen releases methane, a powerful greenhouse gas.
- Do not shred wood residue unless necessary (shredding increases surface area, resulting in more rapid decomposition, generating more toxic leachate).
- Collect all leachate that poses the potential to pollute surface water or groundwater.

➔ see Wood Residue Leachate Control, **page 2-47**

- Use alternative materials where polluting wood residue leachate cannot be collected.
- Buy only as much as you need for your farm's activities.

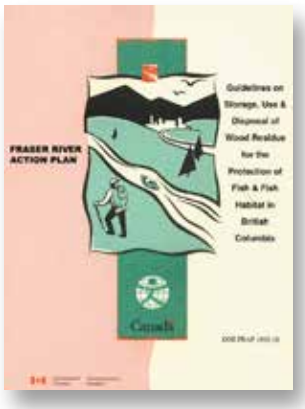
Farm Practice: Woodwaste

Woodwaste Use in Agriculture

Woodwaste Use – Precautions to Horse Owners

Guidelines on Storage, Use & Disposal of Wood Residue for the Protection of Fish & Fish Habitat in British Columbia

Agricultural Land Commission Policy L-23: Placement of Fill for Soil Bound Agricultural Activities



Livestock Bedding. Sawdust and shavings can be excellent wood-based beddings. Implement the following additional practice:

- Monitor the Carbon-to-Nitrogen ratio (C:N) of soil receiving bedding (repeated applications of bedding may result in a C:N shift that could reduce crop growth in time).

Drainage Systems. Implement the following additional practice:

- Do not use wood residue as a substitute for drain rock around drainage piping.

Riding Arenas and Turnout Paddocks. Implement the following additional practices:

- Ensure that drainage systems under wood residue riding arenas and turnout paddocks do not discharge into any ditch, creek, stream, or pond.
- Do not use wood residue as landfill to level a site (apply clean fill for leveling purposes before laying down any wood residue).
- Use alternative footing materials, such as sand, if the wood residue stipulations within the *Code of Practice for Agricultural Environmental Management* cannot be met.

Crop Mulches. Implement the following additional practices:

- Minimize the depth and width of mulch around plants.
- Limit the application of wood residue mulches in combination with nitrogen application to prevent crop "burning" and nutrient loss as wood residue begins to degrade.
- Do not irrigate with water containing wood residue leachate if the water contacts the crop.
- Use other materials such as compost or clean chopped straw if runoff or drainage containing wood residue leachate cannot be handled in an environmentally sound manner.

On-Farm Access Ways. Implement the following additional practices:

- Do not use wood residue simply as a fill material.
- The use of wood residue to create access ways across streams or across ditches is not permitted under the *Environmental Management Act.*
- Use other products, such as geotextiles with gravel and sand on roadways, if runoff or drainage containing wood residue leachate cannot be handled in an environmentally sound manner.

Cranberry Berms. Do not use wood residue for the construction of berms.

Nursery Bedding Material. Implement the following additional practice:

- For the preparation of nursery beds, use geotextile fabrics either alone or in combination with sand and gravel as alternatives to wood residue.

Fuel for Boilers. *The Code of Practice for Agricultural Environmental Management* has requirements for using wood as a fuel for boilers.

➔ see Heat Production and Agricultural Boilers, **page 2-54**

Open Burning. Before burning wood residue material, ensure that alternative end uses such as bedding, mulch material, or compost feedstock have been considered.

➔ see Open Burning, **page 10-23**

Wood Residue Leachate Control

Wood residue leachate is generated by water moving through wood residue and is characterized by a dark colour, "oily" sheen and a foul odour. Varying amounts of leachate are produced in almost all situations where wood residue is used. Areas of the Province with higher precipitation are more prone to leachate generation. Irrigation has a similar effect. Surface runoff from wood residue can carry toxic leachate to adjacent fish-bearing streams or to ditch water that enters fish-bearing watercourses. Prevent leachate from entering watercourses or domestic water supplies.

The impacts of wood residue on the environment will be minimized when it is used on well-drained upland sites with medium-textured soils and a deep water table. Leachate detoxification occurs at sites by natural attenuation in the soil. Fine-textured soils have a high ability to attenuate leachate, but restricted infiltration may reduce the amount of attenuation since more runoff is likely to occur. On rapidly drained sites with coarse-textured soils, limit the amounts of wood residue to account for the sites lower absorption and degradation capacity. On poorly drained sites where the water table is near the surface, some form of drainage system may be needed to collect and treat leachate.

➔ see Contaminant Leaching in Soil, **page 8-15**

Limiting Leachate. Limiting use of wood residue to only that which is absolutely necessary reduces leachate production. Limit contact time between leaching waters and wood residue. Reducing the thickness of applied wood residue, covering stored wood residue, and diversion of uncontaminated runoff to prevent infiltration are all effective means of reducing leachate production.

Leachate Collection, Treatment and Use.

➔ see Leachate, **page 9-54** for collection and treatment and use.

COMPOST

COMPOST ENVIRONMENTAL CONCERNS

Primary environmental concerns related to compost are:

- Storing, handling and processing raw materials that results in soil, water or air pollution.
- Disposal of leachate that results in soil, water or air pollution.
- Odour, particulate and gas emissions from composting that results in air pollution.

➔ see **Chapter 6**, Nutrient Application, regarding compost application to land

For information on these concerns:

➔ see Soil Quality Factors, **page 8-2**, refer to Contaminants

➔ see Water Quality and Quantity Factors, **page 9-1**, refer to Contaminants, and to Oxygen Demand

➔ see Air Quality Factors, **page 10-1**, refer to Contaminants, to Dust and Particulates, and to Odours

COMPOST LEGISLATION

The following is a brief outline of the main legislation that applies to composting.

➔ see **page A-1** for a summary of these and other Acts and Regulations

Farm Bylaws

The City of Abbotsford and Township of Langley have farm bylaws approved by the Minister of Agriculture to regulate mushroom composting operations, and some other composting operations as well. These bylaws require farms to have an enclosed building with all air emissions biofiltered. They also require a storm water management plan and a waste water management plan. Composting must occur on the same parcel as mushroom growing barns are located. Up to 80% of mushroom compost can be sold, and located in Zone A6 100% can be sold.

Agricultural Land Commission

The *Agricultural Land Commission (ALC) Act* S.B.C. 2002, c. 36, and *Agricultural Land Reserve (ALR) Regulations* are the legislative framework for the establishment, administration, and procedures of BC's agricultural land preservation program. The ALC Act takes precedence over, but does not replace other legislation and bylaws that may apply to the land. Local and regional governments, as well as other provincial agencies, are expected to plan in accordance with the provincial policy of preserving agricultural land.

The ALR General Regulation, B.C. Reg. 171/2002, identifies the procedures for submitting applications and notices of intent.

The ALR Use Regulation, B.C. Reg. 30/2019 specifies land uses permitted in the ALR.

SECTION 20(1): restricts the use of land within an agricultural land reserve (ALR) to farm uses unless specified by the Act, the *Agricultural Land Reserve Use Regulation* or the Commission.

SECTION 20.3(1) – 20.3(6): restricts the removal or placement of fill on agricultural land and describes the requisite notice of intent and soil or fill use application procedures.

Some farm activities that may be governed by the *ALR Use Regulation* #30/2019 include:

SECTIONS 6 – 17:

- Land development works.
- Soil testing, biosolids, and soil amendments.

SECTIONS 22 – 27: describes permitted non-farm uses that may be prohibited by local governments. These include:

- Producing, storing and applying compost classified as Class A compost under the *Organic Matter Recycling Regulation* is permitted, but may be prohibited, if at least 50% but less than 100% of the compost is used on the agricultural land on which it was produced.

SECTION 36: outlines the types of fill that are prohibited from being placed on agricultural land. These include construction or demolition waste (including rubble, concrete, cement, rebar, drywall, wood waste); asphalt; glass; synthetic polymers; treated wood; and unchipped lumber.

For more information see the following informational bulletins:

IB-07 Soil or Fill Uses in the ALR

Drinking Water Protection Act

This Act and Regulations have requirements regarding the protection of drinking water quality and regulate domestic water systems (those serving more than one single-family residence).

- SECTION 23(1): subject to subsection (3), a person must not (a) introduce anything or cause or allow anything to be introduced into a domestic water system, a drinking water source, a well recharge zone or an area adjacent to a drinking water source, or (b) do or cause any other thing to be done or to occur if this will result or is likely to result in a drinking water health hazard in relation to a domestic water system.

Environmental Management Act

This Act has three Regulations that address composting activities on farms. In general, industrial and commercial composting processes fall under the *Organic Matter Recycling Regulation* and the product may be distributed as a compost, whereas on-farm composting of agricultural by-products falls under the *Code of Practice for Agricultural Environmental Management.*

The *Code of Practice for Agricultural Environmental Management* defines an agricultural composting process distinct from that described in the *Organic Matter Recycling Regulation,* where agricultural by-products, wood residue, mortalities, or processing wastes are mixed or layered and managed to decompose anaerobically with either periodic turning or forced aeration. If distributed by an operation, products of an agricultural composting process may not be described as compost or composted (SECTION 43).

- SECTION 17: composting structures must be 30 m away from drinking water sources and 15 m away from watercourses, whereas outdoor composting piles must be 30 m away from both drinking water sources and watercourses.
- SECTION 40: agricultural composting processes must ensure that:
  - All leachate is collected and contained, as well as contaminated runoff and solids.
  - Runoff is diverted away from compost piles.
  - If leachate, contaminated runoff and solids do escape, that they do not enter a watercourse, cross a property boundary or go below the water table; and that.
  - Air contaminants do not cross a property boundary.
  - Composting is carried out in a manner that deters the attraction and access of domestic pets, wildlife, and vectors.

- SECTION 41: a person who carries out a composting process in a structure must ensure that the structure has a protective base and that the protective base is maintained so it does not leak.
- SECTION 42: requirements for outdoor composting piles:
  - The pile is not located in an area with standing water, saturated soil and/or that is susceptible to seasonal flooding.
  - The pile is monitored and that composting records, such as material source, temperature, and location are kept.
  - The pile is not left for more than 12 months.
  - No additional pile is erected in the same location for 3 years.
- SECTION 43 of the AEM Code requires those who distribute the product of agricultural composting to:
  - If distributing 5 m^3 or less of a product of agricultural composting, keep records of the volume distributed, the date of distribution and type of by-product distributed.
  - If distributing 5 m^3 or more of a product of agricultural composting, ensure each distribution has a receipt that is signed by the receiver which shows the volume and type of material distributed, the date of distribution, and the name and business contact information of the receiver.
- If in a vulnerable aquifer recharge area, SECTION 22 requires the protective base of permanent composting structures be assessed every 6 months for leakage, taking any corrective action necessary to stop the leak. Records must be kept of the assessment and any corrective actions taken.

See Schedule B Vulnerable Aquifer Recharge Areas

- If in a high-precipitation area (greater than 600 mm precipitation from October 1 to April 30), SECTION 25 requires outdoor composting piles be covered from October 1 to April 1 and if stored for longer than 2 weeks, the pile must not be situated on coarse-textured soil.

See Appendix B High Precipitation Areas of BC

The *Organic Matter Recycling Regulation* has requirements related to composting that affect operation, product quality and land application. This regulation does not apply to an agricultural composting process except in the case where the compost input materials are not all derived from agricultural by-products. In this case OMRR Class A compost criteria would need to be met in order to be allowed within the ALR.

The *Mushroom Compost Facilities Regulation* pertains to all composting associated with mushroom production. It regulates air and water discharges and has many specifications for production of mushroom media. Mushroom producers must also adhere to Farm Bylaws if they are operating within either the City of Abbotsford or the Township of Langley ➔ See **page 2-49**.

Public Health Act

This Act prohibits activities that may cause a health hazard:

Administered by the Ministry of Health, this Act has a specific prohibition that "a person must not willingly cause a health hazard, or act in a manner that the person knows, or ought to know, will cause a health hazard".

This prohibition would apply to farm practices that may result in a health hazard, such as when nutrients, contaminants or pathogens are discharged to land, water or air so as to pose a public health problem. Any situation that entails a health hazard will enable health officers to investigate using their powers under the Act. Under the *Public Health Act*, the local Health Authority must investigate any health hazard and has authority to order that a person prevent or stop a health hazard, or mitigate the harm or prevent further harm from a health hazard amongst other powers. Similar regulatory provisions exist for addressing health hazards to drinking water supplies under the *Drinking Water Protection Act*.

The Act also has conditions under the *Health Hazards Regulation*:

- SECTION 8(1): separation distance from wells to be at least 30 m from any probable source of contamination (probable source of contamination could include compost materials and leachate.

Fisheries Act

Administered by both Fisheries and Oceans Canada and Environment and Climate Change Canada, this Act is established to manage Canada's fisheries resources, including fish habitat. The Act can also be administered provincially by FLNRORD and ENV. The Act applies to all Canadian waters that contain fish, including ditches, channelized streams, creeks, rivers, marshes, lakes, estuaries, coastal waters and marine offshore areas. It also applies to seasonally wetted areas that provide fish habitat such as shorelines, stream banks, floodplains, intermittent tributaries and privately owned land. The Act includes provisions for stiff fines and imprisonment to ensure compliance.

The purpose of this Act is to provide a framework for (a) the proper management and control of fisheries; and (b) the conservation and protection of fish and fish habitat, including by preventing pollution.

This Act was updated in 2019 and now empowers the Minister to make regulations for the purposes of the conservation and protection of biodiversity.

The definition of fish habitat is: "water frequented by fish and any other areas on which fish depend directly or indirectly to carry out their life processes, including spawning grounds and nursery, rearing, food supply and migration areas". The quantity, timing and quality of the water flow that are necessary to sustain fish habitat are also deemed to be a fish habitat. Furthermore, serious harm to fish includes the death of fish or any permanent alteration to, or destruction of, fish habitat.

Provisions of the *2019 Fisheries Act* relevant to agricultural operations include:

- Protection for all fish and fish habitats;
- Prohibition against the death of fish or the 'harmful alteration, disruption or destruction of fish habitat';
- A permitting framework and codes of practice to improve management of large and small projects impacting fish and fish habitat;
- Protection of fish and/or fish habitats that are sensitive, highly productive, rare or unique; and
- Consideration for the cumulative effects of development activities on fish and fish habitat.

Specific sections of the Act include:

SECTION 34.2(1) The Minister may establish standards and codes of practice for:

(a) The avoidance of death to fish and harmful alteration, disruption or destruction of fish habitat;

(b) The conservation and protection of fish or fish habitat; and

(c) The prevention of pollution.

SECTION 34.4(1) No person shall carry on any work, undertaking or activity, other than fishing, that results in the death of fish.

SECTION 35 (1) No person shall carry on any work, undertaking or activity that results in the harmful alteration, disruption or destruction of fish habitat.

Every person who contravenes subsection 34.4(1) or 35(1) is guilty of an offence and liable.

Notifying authorities about serious harm to fish or deposit of a deleterious substance:

SECTION 38 (4.1) Every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations of a harmful alteration, disruption or destruction of fish habitat that is not authorized under this Act, or of a serious and imminent danger of such an occurrence, if the person at any material time .

(a) Owns or has the charge, management or control of the work, undertaking or activity that resulted in the occurrence or the danger of the occurrence; or

(b) Causes or contributes to the occurrence or the danger of the occurrence.

SECTION 38 (5) If there occurs a deposit of a deleterious substance in water frequented by fish that is not authorized under this Act, or if there is a serious and imminent danger of such an occurrence, and detriment to fish habitat or fish or to the use by humans of fish results or may reasonably be expected to result from the occurrence, then every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations.

SECTION 38 (7) As soon as feasible after the occurrence or after learning of the danger of the occurrence, the person shall provide an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations with a written report on the occurrence or danger of the occurrence.

COMPOST BENEFICIAL MANAGEMENT PRACTICES

Comply with applicable composting related legislation, including the above, and where appropriate, use the following beneficial management practices to protect the environment.

➔ see **Chapter 6**, Nutrient Application, regarding compost application to land

Compost Handling and Storage

Production Site. The primary consideration when siting a compost production area is the prevention of water pollution. Some situations may require distances greater than those specified in legislation.

➔ see Farm Building Siting, **page 2-8**

Potential odour nuisance complaints or other conflicts with neighbours, such as noise impacts, may be reduced by using the following practices:

- Locate buildings according to the Agriculture Building Setback Standards (suggested).

➔ see Farm Building Siting, **page 2-8**

- Locate buildings and operations as far as possible from rural residences or residential areas.
- Take advantage of unique topography or microclimate conditions that could affect odour impacts.
- Site buildings and operations so that prevailing winds transport odours away from rural residences or residential areas.
- Keep compost material indoors or covered whenever possible.
- Organize activities in accordance with weather situatio.n
- If handling material with high odour potential, ensure fast processing with sufficient absorbent bulk material.
- Try to avoid compost activities on weekends or in evening hours.
- Good housekeeping at the site can substantially reduce odour potential.
- Barriers such as trees or natural mounds are not effective to control odour. They are, however, visual screenings.
- Log your activities and weather daily. Consult your records in case of complaints to correct future activities.

Materials Storage. To avoid runoff and odour problems, store raw materials and finished compost under cover. Storage areas can be a simple, open structure with a roof. A concrete push wall could be added at one end to aid in the handling of materials with a front-end loader. Organic materials, if not handled carefully, may begin to decompose while in storage.

If the product is stored directly on the ground rather than on a raised concrete pad, divert runoff from the area.

➔ see Runoff, **page 9-50**

Compost Facility. Composting is a method of recycling organic matter into stable organic material that can serve as a nutrient source or soil conditioner. The composting process should promote aerobic decay of organic materials while preventing the escape of potentially harmful gases and liquids. An effectively managed setup will produce temperatures high enough to destroy disease organisms contained in the plant material.

Design buildings used for composting to provide adequate ventilation. Improper design will lead to moisture condensation and accelerated deterioration of the structure. Choose building techniques and products to withstand the aggressive corrosion caused by condensates of dissolved ammonia and reduced sulfur compounds that develop in most composting operations. The pH of those condensates can change between 5.5 to 8.0 during the process.

Good housekeeping practices, including frequent cleanup of spilled materials, will reduce the potential for odour problems.

- On-Farm Composting in British Columbia
- Recycling Council of BC Factsheets

Compost Leachate Control

During decomposition of organic materials, nitrate-nitrogen, ammonia and organic compounds are produced. If water passes through compost materials, runoff carrying these compounds will be generated, causing risks to surface water and groundwater. Covering stored compost raw materials and finished compost, and diversion of uncontaminated runoff to prevent infiltration, are all effective means of reducing leachate production.

➔ see Leachate, **page 9-57**

In areas receiving high precipitation, composting on bare ground without cover is not recommended. Significant leaching from compost piles will occur, transporting organic and nutrient contaminants into the soil. These contaminants will slowly move down through the soil and may contribute to groundwater pollution. Therefore, composting in high precipitation areas should be conducted under cover, on impervious surfaces with leachate collection.

In low rainfall areas, compost may be produced outside on uncovered concrete slabs, as shown in **Figure 2.3**, below. Collect, store, and recycle or apply all runoff to land. ➔ see Runoff, **page 9-50**

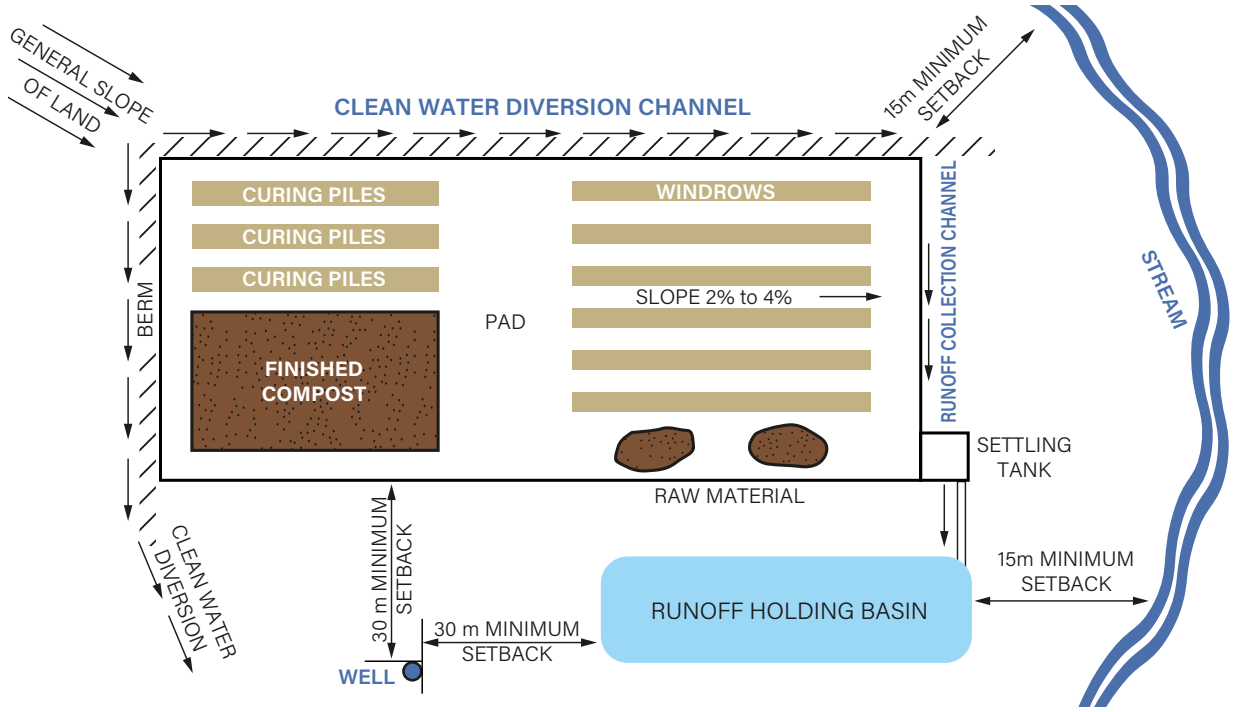


FIGURE 2.3 A Well-Planned Outdoor Composting Facility

Composting Odour Control

Most odour-related composting issues are related to sulphur components and small chain VOCs. Ammonia is often a lesser odour concern but can be a health concern for farm workers. Composting results in the release of large amounts of moisture and ammonia. If ammonia and other gases are released at unacceptably high levels, it may be necessary to enclose the composting facility completely and incorporate air emissions treatment systems.

Odour control starts with feedstock preparation: fast processing (mixing with bulking agents), control of moisture content and porosity, and an appropriate carbon to nitrogen ratio (C:N). Excessive ammonia release is often the result of imbalanced C:N ratios. The production of sulphur components and odorous organic components is often the result of high moisture and the lack of oxygen during the composting process. Too little biological activity is often the result of excessive porosity or lack of moisture.

Biofilters are typically the most effective ways of controlling odour emissions where emissions are collected from the compost operation. The combination of scrubbers with biofilters should be considered where those emissions contain elevated levels of ammonia.

➔ see Indoor Poultry and Livestock Housing, **page 3-5**

Ensuring compost piles are aerated, by regular turning or by forced or passive aeration will reduce production of in-acceptable odours. However, odour emissions can only be reduced but not avoided. Organizing the activities in accordance with the weather is, therefore, an important operational strategy to reduce odour impact beyond the property lines.

Operators must not rely on buffers for the abatement of odours. However, they are a visual screen that help to reduce the complaints from perceived odour.

➔ see Buffers, **page 11-4**

Composting Noise Control

Grinding of raw ingredients, mixing of products and turning of compost piles can all generate significant amounts of noise. To reduce noise impacts on neighbours consider the timing of the operations. Also establish and maintain an adequate buffer between compost operations and neighbours to keep noise from causing a nuisance.

➔ see Buffers, **page 11-4**

Composting Fly Control

Elimination of fly breeding sites is the only effective means of preventing buildup of flies. An effective program must include proper storage and disposal management practices. Part of such a program also includes the management of compost at moistures that are less than optimum for breeding. Insecticidal baits and sprays – supplemented by biological control agents, sticky traps, and electrocuting devices – provide only localized and temporary fly control if proper management of breeding sites is not in place.

- Compost Facility Requirements Guidelines
- Management of Flies in Layer Barns

Mushroom Media

Implement the general composting practices outlined above and use specific mushroom media practices.

➔ see Mushroom, **page 4-23**

Composting Livestock Mortalities

Implement the general composting practices outlined above and use specific livestock mortality practices.

➔ see Livestock Mortality Disposal, **page 3-49**

Composting and Greenhouse Gases

The natural result of the composting process is the release of carbon dioxide. However, there is also the potential ot the emission of much more potent greenhouse gases such as methane and nitrous gas. The emission of these greenhouse gases depend strongly on the extent good management practices are implemented. Generally, composting can result in a net decrease in greenhouse gas emissions if it is returned to the soil as a fertilizer / conditioner to offset other energy intensive soil inputs (e.g., synthetic fertilizers) and by carbon sequestration. For processing very large volumes of organic materials, consider using anaerobic digesters with a methane capture system prior to composting. Decomposition in the absence of oxygen (anaerobic conditions) primarily releases methane that can be used as biofuel on or off-farm. The most easily biodegradable biomass materials are acceptable as feedstocks for anaerobic digestion. Biogas yields are low, and therefore anaerobic digestion is less suitable, for high cellulose material (e.g., woody materials).

ENERGY USE

ENERGY USE ENVIRONMENTAL CONCERNS

Primary environmental concerns related to energy use are:

- excess and inefficient use of energy that results in air pollution, or results in the unnecessary generation of greenhouse gases

For information on these concerns:

➔ see Air Contaminants, **page 10-1**, refer to Dust and Particulates and to Volatile Organic Compounds

➔ see Climate Change Factors, **page 12-1**, and refer to Agricultural Greenhouse Gases

ENERGY USE LEGISLATION

Carbon Tax Act

The *Carbon Tax Act* establishes a carbon tax in BC. Carbon tax is a broad based tax that applies to the purchase or use of fuels, such as gasoline, diesel, natural gas, heating oil, propane, coal, and the use of combustibles, such as peat and tires, when used to produce heat or energy. Carbon tax applies to fuels at different rates depending on their anticipated carbon emissions.

Farmers are required to pay carbon tax on fuel purchased or used for farming operations. However, coloured fuel purchased by a qualifying farmer that is delivered to their farm land is exempt from the carbon tax.

ENERGY USE BENEFICIAL MANAGEMENT PRACTICES

Energy Use

Where appropriate, implement the following beneficial management practices to protect the environment.

Purchase energy efficient equipment and use technologies that reduce energy consumption and gas emissions that contribute to climate change. Energy auditing services are valuable in identifying areas where such advantages can be realized. Complete an on-farm energy efficiency assessment using the "Farm Energy Assessment Tool" created by the Climate & Agriculture Initiative BC.

http://www.bcagclimateaction.ca/wp/wp-content/media/BC_FEA_Tool_v5.xls

Energy Use in Buildings and Yards. For energy efficiency in and around buildings, implement the following practices:

- Design and construct buildings to take advantage of natural light and the solar energy of the site.
- Use high efficiency furnaces for space and water heating and replace forced air systems with radiant heating.
- Retrofit end-of-life atmospheric boilers with condensing over forced draft boilers.
- Use energy efficient lighting such as fluorescent, LED, sodium, and metal halides.
- Use high efficiency electric motors.
- Use control systems such as temperature, humidity and light sensors, variable speed fans, timers, and dimmers that fine-tune energy input at required times and amounts.
- Use zone controls to limit lighting, ventilation, heating and cooling only to areas in active use.
- Use insulation, vapour barriers, weather stripping, window glazing and caulking in heated and cooled buildings.
- Insulate heat distribution pipes, hot water tanks, refrigerated tanks or walk-in coolers.
- Enclose and insulate curtain openings on barns.
- Use levels of insulation, vapour barriers and weather stripping in heated and cooled buildings that take local climatic conditions into account.
- Design livestock ventilation systems using appropriate minimum winter and maximum summer ventilation rates.
- Use heat exchangers on ventilated buildings (especially in colder climates).
- Install condensers on boilers or refrigeration units and reuse energy to pre-heat water or for other heating needs.
- Install fans to circulate air and reduce temperature layering.
- Use directed lighting in areas that require focussed tasks to be accomplished.
- Use renewable sources of energy such as wind, solar, geothermal, biomass where economical.

➔ see Climate Change Mitigation, **page 12-7**

- Establish shelterbelts and windbreaks around farm buildings to conserve heat and improve energy efficiency.
- Use geoexchange reservoirs for heating and cooling baseloads.

➔ see Buffers, **page 11-4**

- In greenhouses, use retractable curtains to shade crops at peak solar input (crop dependent) and to minimize heat loss at night.
- In greenhouses, use a thermal storage unit to capture excess daytime heat resulting from carbon dioxide generation for use during night time heating.
- In greenhouses, stage supplemental lighting to make maximum use of natural light.
- Where used, have heating and ventilation systems fully interlocked.
- Isolate and disable any boilers, compressors and hot water tanks when not in use for extended periods and maintain pressures at optimal levels.
- Do not heat stock water above 58°C, reduce hot water tank set points to between 55 and 60°C, and reduce air temperatures in office and workspaces when not in use.
- Conduct routine inspections and complete regular maintenance on all heating, cooling, compression and ventilation systems – ensure motors, fan blades and belts are clean and in good working order.

Energy Use in Field Operations. For field operations implement the following practices:

- Use appropriately sized equipment such that surplus power is not used when not needed.
- Convert or replace gas or diesel-powered equipment to electric or biofuels.
- Replace petroleum-powered PTO equipment or generators with electric power when practical.
- Use fuel efficient tractors, trucks, and stationary equipment.
- Use appropriate fuels for different seasons.
- Avoid extended engine idling.
- Match tractor power to expected loads by "gearing up – throttling down".
- Maintain all powered equipment as recommended by the manufacturer.
- Minimize the number of passes over a field by carrying out multiple operations at the same time.
- Minimize mechanical trimming and leaf thinning in orchards and vineyards to reduce equipment use and fuel consumption.
- Use no-till or reduced tillage practices.
- Use radial tires on all powered mobile equipment.
- Keep tires at recommended inflation pressures.
- Ballast tractors for optimum match of wheel slip, horsepower, and speed.
- Use efficient irrigation and watering systems to reduce pumping energy.

Pumping Livestock Water – It's all about energy choices!

Energy Free Water Fountains

Saving Energy on Your Farm: Resources and Factsheets, including the BC Farm Energy Assessment Tool

Energy Use in Crop Drying and Feed Processing. For crop drying and feed processing facilities implement the following practices:

- Use fuel efficient dryers and electrically efficient motors.
- Use automatic controls on low temperature aeration drying or monitor drying conditions frequently.
- Use continuous drying systems where possible.
- Monitor moisture content of materials while drying so that excessive drying is avoided.

HEAT PRODUCTION AND AGRICULTURAL BOILERS

HEAT PRODUCTION AND AGRICULTURAL BOILER ENVIRONMENTAL CONCERNS

Primary environmental concerns related to heat production with boilers are:

- Release of particulate matter from biomass fired boilers.
- Release of particulates and other harmful air contaminants (sulphur oxides and nitrogen oxides) from the burning of fossil fuels in boilers which can result in:
  - Health risks from inhaling the particulate;
  - Visual impairments from the emissions and due to the formation of smog;
  - Environmental impacts.
- Emission of carbon dioxide (CO_2) from fossil fuel fired boilers which contributes to climate change.
- The combustion of biomass is considered to be carbon neutral.

For information on these concerns:

➔ see Air Contaminants, **page 10-1**

➔ see Climate Change Factors, **page 12-1**

HEAT PRODUCTION AND AGRICULTURAL BOILER LEGISLATION

The following is a brief outline of the main legislation that applies to heat production and agricultural boilers.

➔ see **page A-1** for a summary of these and other Acts and Regulations

Local Bylaws

Regional and municipal governments can pass bylaws to control emissions from boilers.

Environmental Management Act

Under the *Environmental Management Act*, local governments may be delegated authority to manage air quality within their boundaries (e.g., Metro Vancouver). Local and regional governments can pass bylaws that regulate emissions from industrial, commercial and industrial sources, through permits, compliance promotion and enforcement.

The *Code of Practice for Agricultural Environmental Management* requires persons to use environmentally responsible and sustainable agricultural practices when carrying out agricultural operations for the purpose of minimizing the introduction of waste into the environment and preventing adverse impacts to the environment and human health. The AEM Code includes requirements for building setbacks from water sources and property boundaries.

The AEM Code regulates emissions from biomass fueled boilers used in agricultural production under Division 2:

- Registration requirements for boilers and heaters are described in SECTION 4 and 5.
- Division 2: contains emissions requirements for boilers and heaters:
  - SECTION 9: regulates types of acceptable fuel;
  - SECTION 10: outlines acceptable opacity of emissions;
  - SECTION 11: regulates particulate matter limits;
  - SECTIONS 12-14: provides directives around taking corrective action and record-keeping requirements.

BC Ministry of Environment and Climate Change Strategy Agricultural Boiler Registration, Output Capacity, and Emissions

The *Code of Practice for Agricultural Environmental Management* and the Metro Vancouver *Agricultural Boilers Emission Regulation Bylaw No. 1098* are harmonized with respect to boiler emission limits, registration, monitoring and reporting and allowable fuel types. If you are located in Metro Vancouver, please refer to:

Metro Vancouver Bylaw No. 1098

The AEM Code as well as the Metro Vancouver *Agricultural Boilers Emission Regulation* Bylaw defines biomass used for boiler fuel as:

- Agricultural fuel products, including agricultural pellets, manure pellets, corn kernels, corn stalks, seed hulls or wood or wood products;
- But does not include any raw manure; paper or paper product; wood or wood product that has been treated with glue, paint or preservative, that contains a toxic substance or is salt laden.

Emissions Standards: Traditional fuel sources for boilers include natural gas, heating oil and propane. Due to rising fuel costs, these fuel sources were replaced by biomass and subsequently new regulations that set standards for air emissions from agricultural boilers were implemented. In 2018, the amendments to the AEM Code were introduced to establish consistent rules for all boilers used in agriculture. The AEM Code as well as the *Agricultural Boilers Emission Regulation* Bylaw defines biomass used for boiler fuel as:

- Agricultural fuel products, including agricultural pellets, manure pellets, corn kernels, corn stalks, seed hulls or wood or wood products;
- But does not include any raw manure; paper or paper product; wood or wood product that has been treated with glue, paint or preservative, that contains a toxic substance or is salt laden.

The *Code of Practice for Agricultural Environmental Management* sets emission standards for biomass boilers used in agriculture. These limits are seen in **Table 2.3** next page. The limits are consistent with Metro Vancouver's Bylaw No. 1098.

TABLE 2.3 Emissions Regulation Limits for Boilers and Heaters Fuelled by Biomass

Capacity of Boiler or Heater	Emission Standards	
	Particulate Matter Limit	Opacity Limit
Greater than 3 MW	35 mg/m^3	10%
Less than or equal to 3 MW	50 mg/m^3	10%
less than or equal to 1 MW		20%

Any person who is operating a boiler or heater for agricultural purposes is required to register with the BC Ministry of Environment and Climate Change Strategy or, if located in Metro Vancouver, with Metro Vancouver before the boiler or heater is used.

This can be done by following the online registration guide found at:

- If located in BC, outside of Metro Vancouver:

  Agricultural Boilers in BC

- If located in Metro Vancouver:

  Agricultural Boilers in Metro Vancouver

If a boiler or heater is connected to a single stack and the combined capacity is:

- >1 MW, then requirements for biomass boilers and heaters over 1 MW applies.
- >3 MW, then requirements for biomass boilers and heaters over 3 MW applies.

Table 2.4 below will help to determine the boiler output.

TABLE 2.4	Boiler Capacity Conversion to Megawatts
Boiler capacity information may be found on the boiler nameplate (metal tag attached to the boiler), or from the boiler manufacturer.	
Reporting Capacity in megawatts (MW)*:	
_____GJ/hr x 0.2778 = _____MW	
_____MMBTU/hr x 0.2931 = _____MW	
_____Boiler BHP x 0.009803 = _____MW	
Example: The boiler plate indicates energy input of 400 BHP: Therefore 400 BHP x 0.009803 = 3.9212 MW. *GJ – Gigajoules, MMBTU – Millions of British Thermal Units, BHP – Boiler Horse Power	

HEAT PRODUCTION AND AGRICULTURAL BOILER BENEFICIAL MANAGEMENT PRACTICES

Emissions Reduction: Comply with applicable emissions related legislation, including the above, and where appropriate, implement the following beneficial management practices to protect the environment.

- Use energy management systems that ensure optimization of temperature and humidity.
- Implement emission control devices on biomass burners.
- Ensure biomass fuels have optimum moisture content.
- Use boilers with low particulate generation.
- Install flue condensers or other technology to recover boiler heat.
- Implement a maintenance program for solid fuel boilers and all heating system components.
- Use appropriately sized and efficiently operated heating plants for greenhouse and other production facilities.
- Use clean burning material in burners to ensure a clean burn and maximize energy generation.
- Separate out and do not burn contaminated biomass, such as treated wood.
- Establish and maintain adequate windbreak and shelterbelt buffers around farm buildings and livestock facilities to improve energy efficiency and sequester carbon.

➔ see Buffers, **page 11-4**

- Maximize the use of on-farm renewable energy, such as wind or solar to reduce imported energy needs.

➔ see Climate Change Mitigation, **page 12-7**

ON-FARM PROCESSING AND SALES

Farm gate sales refer to the ability of producers to sell their products directly to consumers from the farm itself, usually through a farm stand.

On-farm **product preparation** refers to the cleaning, sorting, separating, grading, or packing of farm products.

On-farm **processing** refers to processes that include mixing; drying; canning; size reduction; fermentation; and heat, cold, chemical or biological treatment to prepare farm products or value-added products for sale.

➔ see Crop Processing, **page 4-13**, for processing livestock feed

ON-FARM PROCESSING AND SALES ENVIRONMENTAL CONCERNS

Primary environmental concerns related to on-farm processing are:

- Disposal of processing wastes, waste product and wash water that results in soil, water or air pollution.
- Washing or processing crops with poor water quality (e.g., pathogens) that results in food unfit for consumption.

For information on these concerns:

➔ see Soil Quality Factors, **page 8-1**, refer to Contaminants, and to Salts

➔ see Water Quality and Quantity Factors, **page 9-1**, refer to Contaminants, and to Oxygen Demand

➔ see Air Contaminants, **page 10-1**, refer to Dust and Particulates, to Odours, and to Open Burning

ON-FARM PROCESSING AND SALES LEGISLATION

The following is a brief outline of the main legislation that applies to on-farm processing and sales.

➔ see **page A-1** for a summary of these and other Acts and Regulations

Local Bylaws

Local governments may regulate aspects of on-farm processing and sales that relate to size, setbacks, parking, signage, and hours of operation.

Agricultural Land Commission Act

The *Agricultural Land Commission (ALC) Act* S.B.C. 2002, c. 36, and *Agricultural Land Reserve (ALR) Regulations* are the legislative framework for the establishment, administration, and procedures of BC's agricultural land preservation program. The ALC Act takes precedence over, but does not replace other legislation and bylaws that may apply to the land. Local and regional governments, as well as other provincial agencies, are expected to plan in accordance with the provincial policy of preserving agricultural land.

The *ALR General Regulation*, B.C. Reg. 171/2002, identifies the procedures for submitting applications and notices of intent.

The *ALR Use Regulation*, B.C. Reg. 30/2019 specifies land uses permitted in the ALR.

- SECTION 20(1): restricts the use of land within an agricultural land reserve (ALR) to farm uses unless specified by the Act, the *Agricultural Land Reserve Use Regulation* or the Commission

Some farm activities that may be governed by the *ALR Use Regulation* #30/2019 include:

- SECTION 11: Farm products:

The use of agricultural land for storing, packing, preparing and processing farm products is designated as a farm use and may not be prohibited if at least 50% of the farm product is:

(a) Produced either on that agricultural land or by an association to which the owner of the agricultural land belongs, or

(b) Feed required for farm use on that agricultural land.

The use of agricultural land for conducting farm retail sales is designated as a farm use and may not be prohibited if

(a) All of the farm products offered for sale are produced on that agricultural land, or

(b) The area used for all retail sales meets both of the following conditions:

(i) The total area, both indoors and outdoors, does not exceed 300 m^2;

(ii) At least 50% of that area is limited to the sale of farm products produced either on that agricultural land or by an association to which the owner of the agricultural land belongs.

- SECTION 13: Alcohol production (beer, cider, spirits, mead, or wine) "ancillary use" means the following activities:

(a) Processing, storing and retail sales of an alcohol product produced by the alcohol production facility.

(b) Operating a food and beverage service lounge, if the area of the lounge does not exceed 125 m^2 indoors and 125 m^2 outdoors.

(c) Selling an alcoholic beverage other than one produced by the alcohol production facility, if the alcoholic beverage is intended to be consumed immediately and is sold.

(d) Conducting a cooking class, if the class is held in a food premises within the meaning of the *Food Premises Regulation* that has been constructed, and is being operated, in compliance with that regulation.

(e) Gathering for an event.

The use of agricultural land for constructing, maintaining and operating an alcohol production facility and the use of the facility for ancillary uses are designated as farm uses and may not be prohibited if

(a) At least 50% of the primary farm product used to make the alcohol product produced each year is harvested from the agricultural land on which the alcohol production facility is located, or

(b) The agricultural land on which the alcohol production facility is located is more than 2 ha in area and at least 50% of the primary farm product used to make the alcohol product produced each year is:

(i) Harvested from that agricultural land, or

(ii) Both harvested from that agricultural land and received from a farm operation located in British Columbia that provides that primary farm product to the alcohol production facility under a contract having a term of at least 3 years.

SECTIONS 22 – 27 describe permitted non-farm uses that may be prohibited by local governments. These include:

- Home occupation;
- Aggregate removal (under certain conditions);
- Producing, storing and applying compost classified as Class A compost under the *Organic Matter Recycling Regulation* is permitted, but may be prohibited, if at least 50% but less than 100% of the compost is used on the agricultural land on which it was produced.

For more information see the following policies and informational bulletins:

- Policy L-01: Farm Product Processing in the ALR
- Policy L-02: Farm Retail Sales in the ALR
- IB-01: Slaughter Plants and Handling Red Meat Waste in the ALR

Drinking Water Protection Act

This Act and Regulations have requirements regarding the protection of drinking water quality and regulate domestic water systems (those serving **more** than one single-family residence).

- SECTION 23(1): subject to subsection (3), a person must not

  (a) Introduce anything or cause or allow anything to be introduced into a domestic water system, a drinking water source, a well recharge zone or an area adjacent to a drinking water source, or

  (b) Do or cause any other thing to be done or to occur if this will result or is likely to result in a drinking water health hazard in relation to a domestic water system.

Food Safety Act

- The *Food Safety Act* encompasses the entire spectrum of British Columbia's food industry, from production and processing to retail and food service establishments. The Act is an important part of the legislative framework for food safety in BC. It clarifies the legal responsibility of food establishment operators with respect to the safety of their products; grants inspection and enforcement powers to inspectors; and specifies offences and penalties for infractions.
- The *Food Safety Act* also gives the Lieutenant Governor in Council the authority to establish regulations governing food production, food sale and the operation of food establishments. However, at present time, the only regulation in place under this Act is the *Meat Inspection Regulation.*
- The definition of "food establishment" is broad. The Ministry of Health administers the *Food Safety Act* except as it relates to food establishments where animals are slaughtered for food purposes, whereby the Ministry of Agriculture, Food and Fisheries administers it.
- The *Food Safety Act's Meat Inspection Regulation* authorizes slaughter facilities and associated licensing in BC. There are several classes of meat processing licensing, depending on location, size, and target consumers of the establishments.

Environmental Management Act

On-farm processing wastes are not regulated by the *Code of Practice for Agricultural Environmental Management*, and may require authorization for introduction of a waste to the environment. The discharge of processing waste may require a permit from ENV.

The *Ozone Depleting Substances and Other Halocarbons Regulation* regulates the servicing of refrigeration equipment and disposal of refrigerant gases.

The *Code of Practice for the Slaughter and Poultry Processing Industries* regulates the disposal of solid and liquid wastes produced by the slaughter industry under the *Waste Discharge Regulation.*

Public Health Act

This Act prohibits activities that may cause a health hazard:

- SECTION 15: a person must not willingly cause a health hazard, or act in a manner that the person knows, or ought to know, will cause a health hazard

The Act also has conditions under the *Health Hazards Regulation*:

- Separation distance from wells to be at least 30 m from any probable source of contamination (probable source of contamination could include processing wastes)

Under the *Food Premises Regulation*, food premises must be connected to a source of potable water and be connected to a waste disposal system, among other requirements. This Regulation applies to any of the roughly 23,000 food premises in B.C. where food intended for public consumption is sold, offered for sale, handled, prepared, packaged, processed, stored, etc.

- SECTION 4: sets out general construction requirements for food premises
- SECTION 7: every operator of food premises must immediately notify a health officer of any circumstance that exists in the food premises that may cause a health hazard
- SECTION 14: sets out processing, storage and display requirements for operators of food premises
- SECTIONS 23 AND 24: contain food safety management requirements

The *Food Premises Regulation* defines a "food premises" as any place where food intended for public consumption is sold, offered for sale, supplied, handled, prepared, packaged, displayed, served, processed stored, transported, or dispensed. However, premises in which only whole fresh fruits or vegetables are sold or offered for sale are exempt. Therefore, the *Food Premises Regulation* (FPR) only applies if processing occurs. The FPR requires that the construction or renovation plans of a food premises must by approved by a health officer. Specifications regarding potable water, waste disposal, lighting, ventilation, and kitchen equipment are all regulated.

The FPR also requires FOODSAFE training by operators and a permit to operate a food service establishment. Local Health Authorities are responsible for licensing, inspecting, and administering the FOODSAFE education program in their jurisdiction. Food businesses that prepare or serve food for immediate consumption must obtain a Health Operating Permit. An Application for Health Approval will need to be submitted to the local Environmental Health Officer and a food safety and a sanitation plan may be required as well. In addition to FOODSAFE certification, guidelines exist for mobile food premises and guidelines for the sale of foods at temporary markets (farmers markets). These have been developed by the BC Centre for Disease Control (BCCDC) in collaboration with BC Ministry of Health and the Five Regional Health Authorities: Vancouver Coastal, Fraser, Interior, Northern and Vancouver Island.

Transportation Act

The *Transportation Act* governs subject areas such as signage, safe access and sufficient parking.

Canada Agriculture Products Act

This Act has conditions under the *Fresh Fruit and Vegetable Regulation* requiring that no stagnant or polluted water is used in the washing or fluming of the produce, and only potable water is used in the final rinsing of the produce to remove any surface contaminant before packing.

The *Consumer Packaging and Labeling Act and Regulations* establishes basic labeling requirements for prepackaged consumer products.

Food and Drugs Act

The *Food and Drugs Act* covers the sale and marketing of food, drugs and cosmetics in Canada.

Fisheries Act

Administered by both Fisheries and Oceans Canada and Environment and Climate Change Canada, this Act is established to manage Canada's fisheries resources, including fish habitat. The Act can also be administered provincially by FLNRORD and ENV. The Act applies to all Canadian waters that contain fish, including ditches, channelized streams, creeks, rivers, marshes, lakes, estuaries, coastal waters and marine offshore areas. It also applies to seasonally wetted areas that provide fish habitat such as shorelines, stream banks, floodplains, intermittent tributaries and privately owned land. The Act includes provisions for stiff fines and imprisonment to ensure compliance.

The purpose of this Act is to provide a framework for (a) the proper management and control of fisheries; and (b) the conservation and protection of fish and fish habitat, including by preventing pollution.

This Act was updated in 2019 and now empowers the Minister to make regulations for the purposes of the conservation and protection of biodiversity.

The definition of fish habitat is: "water frequented by fish and any other areas on which fish depend directly or indirectly to carry out their life processes, including spawning grounds and nursery, rearing, food supply and migration areas". The quantity, timing and quality of the water flow that are necessary to sustain fish habitat are also deemed to be a fish habitat. Furthermore, serious harm to fish includes the death of fish or any permanent alteration to, or destruction of, fish habitat.

Provisions of the *2019 Fisheries Act* relevant to agricultural operations include:

- Protection for all fish and fish habitats;
- Prohibition against the death of fish or the 'harmful alteration, disruption or destruction of fish habitat;
- A permitting framework and codes of practice to improve management of large and small projects impacting fish and fish habitat;
- Protection of fish and/or fish habitats that are sensitive, highly productive, rare or unique; and
- Consideration for the cumulative effects of development activities on fish and fish habitat.

Specific sections of the Act include:

SECTION 34.2(1) The Minister may establish standards and codes of practice for:

(a) The avoidance of death to fish and harmful alteration, disruption or destruction of fish habitat;

(b) The conservation and protection of fish or fish habitat; and

(c) The prevention of pollution.

SECTION 34.4(1) No person shall carry on any work, undertaking or activity, other than fishing, that results in the death of fish.

SECTION 35 (1) No person shall carry on any work, undertaking or activity that results in the harmful alteration, disruption or destruction of fish habitat.

Every person who contravenes subsection 34.4(1) or 35(1) is guilty of an offence and liable.

Notifying authorities about serious harm to fish or deposit of a deleterious substance:

SECTION 38 (4.1) Every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations of a harmful alteration, disruption or destruction of fish habitat that is not authorized under this Act, or of a serious and imminent danger of such an occurrence, if the person at any material time

(a) Owns or has the charge, management or control of the work, undertaking or activity that resulted in the occurrence or the danger of the occurrence; or

(b) Causes or contributes to the occurrence or the danger of the occurrence.

SECTION 38 (5) If there occurs a deposit of a deleterious substance in water frequented by fish that is not authorized under this Act, or if there is a serious and imminent danger of such an occurrence, and detriment to fish habitat or fish or to the use by humans of fish results or may reasonably be expected to result from the occurrence, then every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations.

SECTION 38 (7) As soon as feasible after the occurrence or after learning of the danger of the occurrence, the person shall provide an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations with a written report on the occurrence or danger of the occurrence.

Health of Animals Act

Health of Animals Act and the *Health of Animals Regulation* covers diseases and toxic substances that may affect animals or that may be transmitted by animals to persons, and the protection of animals.

ON-FARM PROCESSING AND SALES BENEFICIAL MANAGEMENT PRACTICES

Comply with applicable on-farm processing and sales related legislation, including the above, and where appropriate, implement the following beneficial management practices to protect the environment.

On-farm product preparation, processing and sales can generate wastes and cause impacts which, for regulatory purposes, may not be regarded as agricultural. In such cases, investigate the requirements of the *Environmental Management Act* to ensure that environmental concerns are addressed.

Wastes derived from processing of primary agricultural production (e.g., carrot tops, stems of flowers) should be handled in the same manner as farm wastes. If the wastes can be adequately dealt with by the farming operation, a permit or approval may not be required. It is advisable to contact ENV if there are any questions regarding the handling and disposal of a particular waste material.

Separate approvals are required from both the Ministry of Health and the Canadian Food Inspection Agency contact your Regional Health Authority office for directions on what approvals are required.

Product Processing and On-Farm Direct Sales Facilities

For all agricultural operations that process product for direct sale, implement the following practices:

- Locate facilities away from yard drain inlets, ditches, wells and watercourses:
  - At least 30 m from wells (*Health Hazards Act;*)
  - To meet the Agriculture Building Setback Standards (suggested);

➔ see Farm Building Siting, **page 2-8**

  - At least 30 m from a water intake used for domestic purposes (suggested).
- Design and manage a facility so that contaminated runoff from parking lots, roofs, and other hard surfaces does not enter watercourses or wells.
- Have a professional design storage lagoons and tile fields for domestic sewage and register the sewage discharge with Ministry of Environment and Climate Change Strategy or Ministry of Health (*Environmental Management Act*).
- Recycle containers (e.g., berry flats), wash water, etc. whenever possible but use food safety precautions.

Direct Farm Marketing and Agritourism

Processing Water Quality. Agricultural operations that process product for direct sale use large volumes of water during processing operations. Implement the following practices to maintain water quality:

- Ensure water quality for processing, such as washing, meets potable (drinking) water requirements (*Canada Agricultural Products Act*).
- Organic certification standards may require specific water quality parameters for certified organic practices.
- Never discharge wash water directly into a watercourse.
- Never discharge wash water into a domestic sewer system without approval.
- Dispose of wash water in an environmentally acceptable waste water.

BC Irrigation Management Guide

BC Sprinkler Irrigation Manual: Irrigation Water Quality

Water Quality – Good Agricultural Practices

Farm Water Planning Guide

Drinking Water Quality. Direct farm markets may provide drinking water to customers. Ensure water quality standards are met by implementing the following monitoring practices:

- If providing drinking water to the public, ensure water meets drinking water standards *(Drinking Water Protection Regulation):*
  - No detectable fecal coliform bacteria per 100 ml.
  - No detectable *Escherichia coli* per 100 ml.
  - No detectable total coliform bacteria per 100 ml if a single sample is taken in a 30 day period.
  - At least 90% of samples have no detectable total coliform bacteria per 100 ml and no sample has more than 10 total coliform bacteria per 100 ml if more than one sample is taken in a 30 day period.
- Ensure limits on chemical and physical parameters (such as nitrates and heavy metals) are met.

Guidelines for Canadian Drinking Water Quality

BC Ministry of Environment and Climate Change Strategy Drinking Water Quality

Abattoirs

On-farm butchering, and the wrapping, freezing and processing of meat generates environmental concerns. The Province regulates the slaughter of livestock and poultry through the *Meat Inspection Regulation.* The BC Ministry of Environment and Climate Change Strategy has established the *Code of Practice for the Slaughter and Poultry Processing Industries* that addresses discharges to the environment from the slaughter and poultry processing industries. A number of other specific regulations and requirements that apply to abattoirs are administered primarily by the Canadian Food Inspection Agency, BC Ministry of Agriculture, Food and Fisheries, BC Center for Disease Control and the BC Ministry of Health.

Meat Inspection Licensing Factsheet

Composting Processing Wastes. Some wastes from on-farm processing can be composted. Ensure that composting meets the requirements of the *Organic Matter Recycling Regulation.*

➔ see Compost Legislation, **page 2-44**.

Ensure that the composting methods used minimize greenhouse gas emissions.

Specified Risk Material (SRM) material originates from cattle slaughter and is governed under the federal *Health of Animals Regulations*.

Specified Risk Material Transportation and Disposal: Canadian Food Inspection Agency

Food Safety and Inspection Branch has developed a Abattoir Code of Practice for Class A and B slaughter establishments in BC licensed under the *Meat Inspection Regulation*.

The Abattoir Code of Practice emphasizes an outcome-based approach, with specified acceptable outcomes that provide clarity and guidance around achieving regulatory compliance, allowing operators flexibility in achieving compliance, and maintain high food safety standards.

Class A & B Licences

Class D & E Licences for Rural and Remote Areas

CHAPTER 3 METRIC CONVERSIONS

Metric		Imperial Equivalent	
300	mm	12	inches
600	mm	24	inches
1	m	3	feet
15	m	50	feet
30	m	100	feet
30.5	m	100	feet
100	m	330	feet
2	m^2	22	square feet
6	m^2	65	square feet
2,100	m^2	22,600	square feet
3,000	m^2	32,300	square feet
20	kg	44	pounds
50	kg	110	pounds
100	kg	220	pounds
350	kg	770	pounds
700	kg	1540	pounds
700	kg/ha	625	lbs/ac
22	litres	5.8	gallons
45	litres	12	gallons
50	litres	13	gallons
20	MPa	3,000	psi

Conversions in this table are rounded to a convenient number.
See Appendix E for exact conversion factor.

Values from tables and examples are not included in Metric Conversions

CHAPTER 3 TABLE OF CONTENTS

CHAPTER 3

LIVESTOCK

INTRODUCTION

This chapter discusses livestock management practices for protection of the environment. It contains introductory information on the relationship between livestock and the environment. It also contains information on environmental concerns, legislation and beneficial management practices related to:

- Indoor poultry and livestock housing,
- Outdoor livestock areas,
- Manure handling and storage,
- Mortality disposal,
- Livestock and climate change.

LIVESTOCK AND THE ENVIRONMENT

Livestock are primarily raised and managed in farm operations for their value as food or food products, or in the case of horses, for recreational or other uses. Environmental concepts related to livestock activities are listed in alphabetical order below.

Climate Change

Livestock can have significant impacts on greenhouse gas emissions. Ruminants (e.g. cattle, sheep) digest carbohydrates methane is released through the process of enteric fermentation. Livetock manures may also release nitrous oxides. Both are powerful greenhouse gases contributing to climate change. These emissions can be somewhat offset by the positive effects of carbon capture associated with effective grazing management techniques.

Grazing

Livestock that graze on pasture or grass rangelands indirectly provide humans with food from forages, a food source otherwise not useable by humans.

Nutrient Cycle

When livestock graze or are fed grains and forage they become part of the nutrient cycle of a site. Depending on the management practices for a given site, livestock may:

- Remove nutrients by consumption as in grazing (with some retained in body mass).
- Add nutrients by consumption of feed transported to the site (with some deposited as wastes).

Depending on the nutrient requirements of a site, either may be positive or negative to the environment. Evaluate the nutrient status of grazing and feeding areas when deciding on fertilizer or manure application rates.

Vegetation Control

Livestock that graze are used to manage specific undesirable types of vegetation such as weeds and competing vegetation in forests. Livestock grazing can also be managed to remove herbaceous and small-woody vegetation from fire-breaks, lowering the risk of uncontrolled wildfires.

INDOOR POULTRY AND LIVESTOCK HOUSING

INDOOR POULTRY AND LIVESTOCK HOUSING ENVIRONMENTAL CONCERNS

Primary environmental concerns related to indoor livestock areas are:

- Impacts of indoor poultry and livestock housing on water quality:
  - Release of wastes (e.g., manure, milkhouse waste, bedding, spoiled feed) that results in water pollution.
  - Housing located close to a watercourse or well that results in water pollution.
  - Cross connection of "dirty water" lines with clean water lines that results in water pollution.
- Impacts of indoor poultry and livestock housing on air quality:
  - Release of methane (CH_4) from livestock manure contributes to the greenhouse effect and climate change.
  - Release of ammonia (NH_3) that contributes to smog formation.
  - Release of dust particulate matter and ammonia from animal housing can result in human health risks and in visibility reduction.
  - Release of odours associated with ammonia or other noxious gases that are carried by dust to surrounding neighbours.

For information on these concerns:

➔ see Water Quality and Quantity Factors, **page 9-1,** refer to Contaminants, and to Oxygen Demand

➔ see Air Quality Factors, **page 10-1**, refer to Dust and Particulates, and Greenhouse Gases

➔ see Climate Change Factors, **page 12-1**

INDOOR POULTRY AND LIVESTOCK HOUSING LEGISLATION

The following is a brief outline of the main legislation that applies to indoor housing.

➔ see **page A-1** for a summary of these and other Acts and Regulations

Drinking Water Protection Act

This Act and Regulations have requirements regarding the protection of drinking water quality and regulate domestic water systems (those serving **more** than one single-family residence).

- SECTION 23(1): subject to subsection (3), a person must not (a) introduce anything or cause or allow anything to be introduced into a domestic water system, a drinking water source, a well recharge zone or an area adjacent to a drinking water source, or (b) do or cause any other thing to be done or to occur if this will result or is likely to result in a drinking water health hazard in relation to a domestic water system

Enviromental Management Act

The *Code of Practice for Agricultural Environmental Management* requires persons to use environmentally responsible and sustainable agricultural practices when carrying out agricutural operations, for the purpose of minimizing the introduction of waste into the environment and preventing adverse impacts to the environment and human health. The AEM Code includes requirements for building setbacks from water sources and property boundaries in Part 4 of the Code.

The *Code of Practice for Agricultural Environmental Management* has specific requirements regarding agricultural by-products.

- SECTION 2: agricultural by-products must be collected, stored, handled, used and disposed of in a manner that prevents pollution
- SECTION 17: a storage facility must be located at least 15 m from any watercourse; at least 30 m from any source of water for domestic purposes

The Code also has a reference to air emissions from forced air ventilation systems:

- SECTION 7: states that emissions of air contaminants from forced air ventilation systems used in the agricultural operation must not enter a watercourse or cross a property boundary

Public Health Act

Administered by the Ministry of Health, this Act has a specific prohibition that "a person must not willingly cause a health hazard, or act in a manner that the person knows, or ought to know, will cause a health hazard". This prohibition would apply to farm practices that may result in a health hazard, such as when nutrients, contaminants or pathogens are discharged to land, water or air to pose a public health problem. Any situation that entails a health hazard will enable health officers to investigate using their powers under the Act. Under the *Public Health Act*, the local Health Authority must investigate any health hazard and has authority to order that a person prevent or stop a health hazard, or mitigate the harm or prevent further harm from a health hazard amongst other powers. Similar regulatory provisions exist for addressing health hazards to drinking water supplies under the *Drinking Water Protection Act*.

- Part 3, Division 1: Preventing Disease and other Health Hazards.
- SECTION 15: A person must not willingly cause a health hazard, or act in a manner that the person knows, or ought to know, will cause a health hazard.

The Act also has conditions under the *Health Hazards Regulation* to regulate the distance of wells from possible source of contamination:

SECTION 8 (1) A person who installs a well, or who controls a well must ensure that the well is located at least

(a) 30 m from any probable source of contamination,

(b) 6 m from any private dwelling, and

(c) Unless contamination of the well would be impossible because of the physical conformation, 120 m from any cemetery or dumping ground.

(2) A person who controls a well must:

(a) Remove any source of contamination within the distances set out in subsection (1), or

(b) Subject to subsection (3), close the well in accordance with section 6 of the Code of Practice under the *Ground Water Protection Regulation, B.C. Reg. 299/2004*.

(3) Subsection (2) (b) does not apply to a well located within 6 m of a private dwelling unless it can be shown that the well should be abandoned for a reason other than proximity to a private dwelling.

(4) A well that does not meet the requirements of this section is prescribed as a health hazard.

Fisheries Act

Administered by both Fisheries and Oceans Canada and Environment and Climate Change Canada, this Act is established to manage Canada's fisheries resources, including fish habitat. The Act can also be administered provincially by FLNRORD and ENV. The Act applies to all Canadian waters that contain fish, including ditches, channelized streams, creeks, rivers, marshes, lakes, estuaries, coastal waters and marine offshore areas. It also applies to seasonally wetted areas that provide fish habitat such as shorelines, stream banks, floodplains, intermittent tributaries and privately owned land. The Act includes provisions for stiff fines and imprisonment to ensure compliance.

The purpose of this Act is to provide a framework for (a) the proper management and control of fisheries; and (b) the conservation and protection of fish and fish habitat, including by preventing pollution.

This Act was updated in 2019 and now empowers the Minister to make regulations for the purposes of the conservation and protection of biodiversity.

The definition of fish habitat is: "water frequented by fish and any other areas on which fish depend directly or indirectly to carry out their life processes, including spawning grounds and nursery, rearing, food supply and migration areas". The quantity, timing and quality of the water flow that are necessary to sustain fish habitat are also deemed to be a fish habitat. Furthermore, serious harm to fish includes the death of fish or any permanent alteration to, or destruction of, fish habitat.

Provisions of the *2019 Fisheries Act* relevant to agricultural operations include:

- Protection for all fish and fish habitats;
- Prohibition against the death of fish or the 'harmful alteration, disruption or destruction of fish habitat';
- A permitting framework and codes of practice to improve management of large and small projects impacting fish and fish habitat;
- Protection of fish and/or fish habitats that are sensitive, highly productive, rare or unique; and
- Consideration for the cumulative effects of development activities on fish and fish habitat.

Specific SECTIONS of the Act include:

SECTION 34.2(1) The Minister may establish standards and codes of practice for:

(a) The avoidance of death to fish and harmful alteration, disruption or destruction of fish habitat;

(b) The conservation and protection of fish or fish habitat; and

(c) The prevention of pollution.

SECTION 34.4(1) No person shall carry on any work, undertaking or activity, other than fishing, that results in the death of fish.

SECTION 35 (1) No person shall carry on any work, undertaking or activity that results in the harmful alteration, disruption or destruction of fish habitat.

Every person who contravenes subsection 34.4(1) or 35(1) is guilty of an offence and liable.

Notifying authorities about serious harm to fish or deposit of a deleterious substance:

SECTION 38 (4.1) Every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations of a harmful alteration, disruption or destruction of fish habitat that is not authorized under this Act, or of a serious and imminent danger of such an occurrence, if the person at any material time

(a) Owns or has the charge, management or control of the work, undertaking or activity that resulted in the occurrence or the danger of the occurrence; or

(b) Causes or contributes to the occurrence or the danger of the occurrence.

SECTION 38 (5) If there occurs a deposit of a deleterious substance in water frequented by fish that is not authorized under this Act, or if there is a serious and imminent danger of such an occurrence, and detriment to fish habitat or fish or to the use by humans of fish results or may reasonably be expected to result from the occurrence, then every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations.

SECTION 38 (7) As soon as feasible after the occurrence or after learning of the danger of the occurrence, the person shall provide an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations with a written report on the occurrence or danger of the occurrence.

INDOOR POULTRY AND LIVESTOCK HOUSING BENEFICIAL MANAGEMENT PRACTICES

Comply with applicable indoor housing related legislation, including the above, and where appropriate, implement the following beneficial management practices to protect the environment.

Protection of Water Quality

Comply with applicable indoor housing related legislation, including the above, and where appropriate, implement the following beneficial management practices to protect the environment.

An indoor structure allows for convenient collection and containment of livestock manure and waste feed. However, inappropriate barn location, improper construction practices or improper management can contribute to pollution from wastes or leachate. Implement the following practices for indoor facilities:

- Locate facilities away from yard drain inlets, ditches, wells and watercourses:
  - At least 30 m from wells (*Health Hazards Regulation*);
  - At least 15 m from watercourses (*Code of Practice for Agricultural Environmental Management*);
  - 30 m or more from a water intake used for domestic purposes (suggested).
- Locate facilities so that an adequate buffer can be established and maintained between indoor housing and watercourses.
- Keep wastes or leachate from entering a watercourse.
- Construct floors to contain all wastes.
- Deposit waste feed into manure storages or store separately to prevent leachate generation.
- Place berms around buildings or grade landscapes near structures to keep snow melt or other water flow from entering the indoor facility.

➔ see Buildings and Roads, **page 2-2**

Milkhouse Waste. Collect and deposit milkhouse waste into a manure storage facility for eventual land spreading as a fertilizer. Alternative disposal systems require a permit from ENV.

Building Drains. Buildings are often surrounded by perimeter drains to carry clean roof water and soil moisture away from the foundation. If the barn or barnyard also has drains collecting contaminated water, implement the following practice:

- Test that these drains are not cross connected to the clean water drains.
- Add a ENV-approved dye into the contaminated water drain, and check that the dye does not show up in the clean drain line discharge.

Protection of Air Quality

Air Quality BC website

Indoor poultry and livestock housing can impact air quality by emitting dust, particulate and gaseous compounds. These emissions can be a nuisance as well as impact human and environmental health.

Particulate Emissions Reduction. Implement the following practices to reduce particulates and dust from livestock housing:

- Practice dust suppression techniques and implement dust suppression technology.
- Clean up dust accumulations inside the barn.
- Use clean, low dust litter for bedding.
- When loading bedding into barns, use methods that result in minimal dust production.
- Incorporate a program of washing down both the interior and exterior of barns to remove dust accumulations.
- Clean fans, hoods and screens regularly to avoid dust build up.
- Properly locate ventilation exhaust fans.
- Direct discharge away from other buildings and neighbours.
- Equip fans with hoods that deflect exhausted air towards the ground (the ground cover acts as a filter), or install chimney fans with discharge openings at least 4 m (suggested) above ground level (to maximize dilution).
- Take advantage of prevailing winds to carry particulates away from sensitive areas.
- Maintain foliage or implement vegetative filters near exhaust fan discharges to trap a proportion of dust exiting the barn.

➔ see Buffers, **page 11-4**

Siting and Management of Poultry Barns

Ammonia Emissions Reduction. To reduce ammonia emissions that contribute to the formation of secondary particulate and cause odour concerns, implement the following practices:

- Balance the diet to maximize feed efficiency to minimize excreted nitrogen.
- Use enzymes when possible to enhance feed efficiency and reduce phosphate excretion.

➔ see Manure Gas Emissions Reduction, **page 3-42**, and refer to Nutrition and Ration Management

Odour Reduction. Odours often result from livestock housing due to manure, enteric fermentation, and the release of ammonia, and dust.

➔ see Odours, **page 10-17**

Exhaust Filters. Mechanical air filtration systems trap approximately 45% of fine particulate and 80% of coarse particulate from animal housing areas.

- Install mechanical filters on ventilation exhaust fans.
- Ensure filters are cleaned and maintained at regular intervals.

Biofilters. Biofilters result in approximately an 80% reduction in ammonia and 95% reduction in hydrogen sulphide emissions and can be used as an alternative to mechanical filters. Mechanical filters trap particles and emissions, whereas biofilters trap particles and emissions and also provide an environment for aerobic biological degradation of trapped compounds that results in a reduction of odour emissions.

- Install biofilters to reduce odorous emissions.
- Biofilters are proven effective for use on deep pit manure exhaust; swine, dairy and mushroom facilities; and are minimally effective in poultry facilities.
- **Caution:** dust and dander in certain types of poultry housing can cause exhaust filters and biofilters to backup.

Vegetative Filters. Vegetative buffers trap a portion of dust from barns exhaust fans, reduce the visual impacts of agriculture, and decrease odour. In a vegetative buffer, wind is channelized from the barn exhaust through a planting of trees, allowing particulates to be caught in the vegetation. Vegetative buffers also sequester carbon, offsetting some of the greenhouse gas emissions from other components of the livestock operation.

➔ see Buffers, **page 11-4,**

Vegetative Buffers BC website

Electrostatic Precipitators for Dust Reduction. Reduce dust emissions from indoor livestock facilities by applying a safe electric charge to the air space. Electrostatic precipitators reduce dust in the air by charging the airspace to force particles to come together and fall out of the air. This reduces the impacts to both indoor and outdoor air quality.

- Implement electrostatic precipitators in livestock housing at beginning of the livestock cycle.
- Clean up dust accumulations to ensure the technology remains effective.

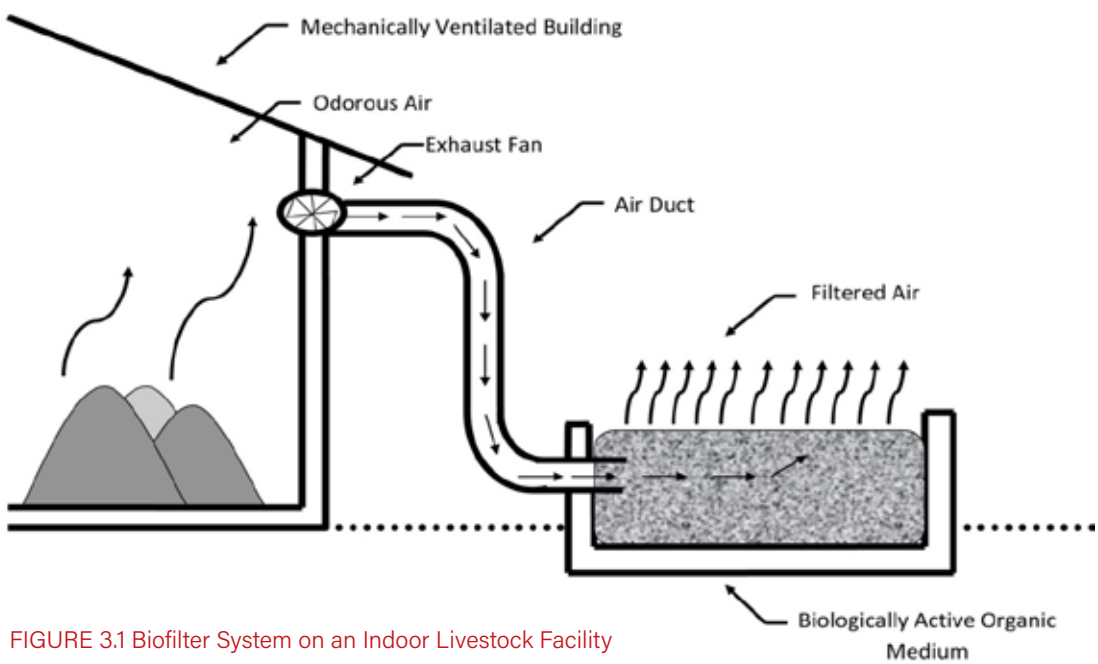


FIGURE 3.1 Biofilter System on an Indoor Livestock Facility

OUTDOOR LIVESTOCK AREAS

OUTDOOR AREA ENVIRONMENTAL CONCERNS

Primary environmental concerns related to outdoor livestock areas are:

- Livestock manure and feed that results in soil, water, air pollution and/or greenhouse gas emissions.
- Livestock grazing that results in loss of wildlife habitat and weed transmission, or results in soil compaction or erosion, or water pollution.
- Livestock grazing practices and manure generation that increase the release of greenhouse gas emissions contributing to climate change, or reduce the resilience of the farm to adapt to a changing climate.

For information on these concerns:

➔ see Impacts on Biodiversity and Habitat, **page 7-7**, and refer to Impacts of Agriculture on Biodiversity and Habitat

➔ see Soil Quality Factors, **page 8-1**, and refer to Compaction, and to Contaminants

➔ see Water Quality and Quantity Factors, **page 9-1**, and refer to Contaminants, and to Oxygen Demand

➔ see Air Quality Factors, **page 10-1**, and refer to Contaminants, and Odours

➔ see Climate Change Factors, **page 12-1**

OUTDOOR AREA LEGISLATION

The following is a brief outline of the main legislation that applies to outdoor livestock areas.

➔ see **page A-1** for a summary of these and other Acts and Regulations

Drinking Water Protection Act

This Act and Regulations have requirements regarding the protection of drinking water quality and regulate domestic water systems (those serving **more** than one single-family residence).

- SECTION 23(1): subject to subsection (3), a person must not (a) introduce anything or cause or allow anything to be introduced into a domestic water system, a drinking water source, a well recharge zone or an area adjacent to a drinking water source, or (b) do or cause any other thing to be done or to occur if this will result or is likely to result in a drinking water health hazard in relation to a domestic water system

Animal Health Act

This Act provides the authority for the *Game Farm Regulation*, which lists the farming of bison, fallow deer, and reindeer as a regulated activity. Farm operators working with bison and deer are therefore require licensing. The Act requires producers to take preventive measures to reduce the risk of introducing and spreading disease; ensure employees are trained to prevent and respond to disease; maintain records of animal origin; abide by inspector's orders and report any incidents of disease or unusual illness.

Game Farms. Farming of bison, fallow deer and reindeer have unique management requirements under the *Animal Health Act* and associated *Game Farm Regulations*.

- British Columbia Farm Practices – Game Farms
- British Columbia Game Farm Practices – Bison
- British Columbia Fallow Deer Fact Sheet
- British Columbia Farm Practices - Fur Farms

Environmental Management Act

This Act regulates industrial and municipal waste discharge, pollution, hazardous waste and contaminated site remediation. It provides the authority for introducing wastes into the environment, while protecting public health and the environment.

The *Code of Practice for Agricultural Environmental Management* requires persons to use environmentally responsible and sustainable agricultural practices when carrying out agricutural operations, for the purpose of minimizing the introduction of waste into the environment and preventing adverse impacts to the environment and human health. The AEM Code includes requirements for building setbacks from water sources and property boundaries in Part 4 of the AEM Code.

The *Code of Practice for Agricultural Environmental Management* defines and regulates confined, seasonal feeding and grazing areas.

Confined Livestock Area. This is an outdoor, non-grazing area in which livestock are confined by structures or topography.

SECTION 62:

- Livestock and poultry must not have direct access to a drinking water source or watercourse;
- Contaminated runoff, leachate, solids, and air contaminants do not enter a watercourse, cross a property boundary, or go below the water table;
- Accumulation of manure, animal bedding, and feed within the area must be managed so as to prevent contaminated runoff, leachate, and solids from escaping;
- Any runoff, leachate, or solids that escapes must be collected and contained.

Feedlots. This is an area in which livestock are confined solely for the purpose of growing or finishing and fed other than by grazing.

SECTION 63:

- The self-sealing layer that forms under the feedlot must be maintained so as to prevent leachate from entering groundwater;
- Runoff must be diverted away from the feedlot;
- A feedlot must be decommissioned when no longer in use by removing the manure pack that accumulated over the self-sealing layer and cleaning out the pens in a manner that prevents leachate from entering groundwater or a watercourse and allows nutrients from the manure to be stored and applied to land in accordance with the AEM Code.

Seasonal Feeding Area. This is an area used for both crop production and for seasonal feeding of livestock. Most of the feed is brought to the site and manure nutrients do not usually exceed crop needs.

SECTION 64:

- If the animals have direct access to a watercourse, ensure that effective controls are in place to minimize trampling and erosion of soil into the watercourse and minimize contaminated runoff, leachate, and solids from entering the watercourse.
- Move livestock from areas that are flooded or where flooding is imminent and during the flood season from areas that are prone to annual seasonal flooding.
- Ensure that on-ground feeding locations and mobile feeding bins are not located in areas that are flooded or where flooding is imminent or during the flood season in areas that are prone to annual seasonal flooding. Ensure they are distributed evenly over the feeding area in a manner that prevents the accumulation of manure near feeding locations or bins.
- Livestock or poultry must not be held in a temporary holding area for more than 72 hours.

Grazing Areas. This is pasture that is fenced, or rangeland, where livestock and poultry feed primarily by directly consuming plants growing on the pasture or rangeland.

Fur Farms. SECTION 32 (d) of the *Code of Practice for Agricultural Environmental Management* permits on-ground under-pen storage of manure and bedding from fur bearing animals for up to 7 months.

For information on manure.

➔ see Manure Beneficial Management Practices, **page 3-30**

Public Health Act

Administered by the Ministry of Health, this Act has a specific prohibition that "a person must not willingly cause a health hazard, or act in a manner that the person knows, or ought to know, will cause a health hazard". This prohibition would apply to farm practices that may result in a health hazard, such as when nutrients, contaminants or pathogens are discharged to land, water or air to pose a public health problem. Any situation that entails a health hazard will enable health officers to investigate using their powers under the Act. Under the *Public Health Act*, the local Health Authority must investigate any health hazard and has authority to order that a person prevent or stop a health hazard, or mitigate the harm or prevent further harm from a health hazard amongst other powers. Similar regulatory provisions exist for addressing health hazards to drinking water supplies under the *Drinking Water Protection Act.*

- Part 3, Division 1: Preventing Disease and other Health Hazards.
- SECTION 15: A person must not willingly cause a health hazard, or act in a manner that the person knows, or ought to know, will cause a health hazard.

The Act also has conditions under the *Health Hazards Regulation* to regulate the distance of wells from possible source of contamination:

- SECTION 8 (1) A person who installs a well, or who controls a well installed on or after July 20, 1917, must ensure that the well is located at least
  - (a) 30 m from any probable source of contamination,
  - (b) 6 m from any private dwelling, and
  - (c) Unless contamination of the well would be impossible because of the physical conformation, 120 m from any cemetery or dumping ground.

  (2) A person who controls a well installed before July 20, 1917, must
  - (a) Remove any source of contamination within the distances set out in subsection (1), or
  - (b) Subject to subsection (3), close the well in accordance with SECTION 6 of the Code of Practice under the *Ground Water Protection Regulation, B.C. Reg. 299/2004*.

  (3) Subsection (2) (b) does not apply to a well located within 6 m of a private dwelling unless it can be shown that the well should be abandoned for a reason other than proximity to a private dwelling.

  (4) A well that does not meet the requirements of this section is prescribed as a health hazard.

Water Sustainability Act

The right to divert and use surface water or groundwater is authorized by a licence or approval. Licences and approvals are granted in accordance with the statutory requirements of the *Water Sustainability Act*. For example, cattle drinking out of a stream would be considered "diverting" water. If you use surface water or groundwater for any non-domestic purpose, you require a water licence under the *Water Sustainability Act*. The requirement for groundwater licensing came into force on February 29, 2016 and applies to new groundwater users as well as those who began using groundwater prior to February 29, 2016. Apply for a water licence at FrontCounter BC.

Approval is also required for any work in or about a stream.

Apply for a Water Licence website

Wildlife Act

The provincial *Wildlife Act* protects wildlife designated under the Act from direct harm, except as allowed by regulation (e.g., hunting or trapping), or under permit. Legal designation as Endangered or Threatened under the Act increases the penalties for harming a species. The Act also enables the protection of habitat in a Critical Wildlife Management Area.

Riparian Areas Act

This Act establishes directives regarding the protection and enhancement of riparian areas that may be subject to residential, commercial or industrial development through the associated *Riparian Areas Regulation*. RAR requires local governments to include in its zoning and land use bylaws riparian area protection provisions and ensure that the bylaws provide a level of protection to the riparian area such that it can provide natural features, functions and conditions that support fish life processes.

Fisheries Act

Administered by both Fisheries and Oceans Canada and Environment and Climate Change Canada, this Act is established to manage Canada's fisheries resources, including fish habitat. The Act can also be administered provincially by FLNRORD and ENV. The Act applies to all Canadian waters that contain fish, including ditches, channelized streams, creeks, rivers, marshes, lakes, estuaries, coastal waters and marine offshore areas. It also applies to seasonally wetted areas that provide fish habitat such as shorelines, stream banks, floodplains, intermittent tributaries and privately owned land. The Act includes provisions for stiff fines and imprisonment to ensure compliance.

The purpose of this Act is to provide a framework for (a) the proper management and control of fisheries; and (b) the conservation and protection of fish and fish habitat, including by preventing pollution.

This Act was updated in 2019 and now empowers the Minister to make regulations for the purposes of the conservation and protection of biodiversity.

The definition of fish habitat is: "water frequented by fish and any other areas on which fish depend directly or indirectly to carry out their life processes, including spawning grounds and nursery, rearing, food supply and migration areas". The quantity, timing and quality of the water flow that are necessary to sustain fish habitat are also deemed to be a fish habitat. Furthermore, serious harm to fish includes the death of fish or any permanent alteration to, or destruction of, fish habitat.

Provisions of the *2019 Fisheries Act* relevant to agricultural operations include:

- Protection for all fish and fish habitats;
- Prohibition against the death of fish or the 'harmful alteration, disruption or destruction of fish habitat';
- A permitting framework and codes of practice to improve management of large and small projects impacting fish and fish habitat;
- Protection of fish and/or fish habitats that are sensitive, highly productive, rare or unique; and
- Consideration for the cumulative effects of development activities on fish and fish habitat.

Specific sections of the Act include:

SECTION 34.2(1) The Minister may establish standards and codes of practice for:

(a) The avoidance of death to fish and harmful alteration, disruption or destruction of fish habitat;

(b) The conservation and protection of fish or fish habitat; and

(c) The prevention of pollution.

SECTION 34.4(1) No person shall carry on any work, undertaking or activity, other than fishing, that results in the death of fish.

SECTION 35 (1) No person shall carry on any work, undertaking or activity that results in the harmful alteration, disruption or destruction of fish habitat.

Every person who contravenes subsection 34.4(1) or 35(1) is guilty of an offence and liable.

Notifying authorities about serious harm to fish or deposit of a deleterious substance:

SECTION 38 (4.1) Every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations of a harmful alteration, disruption or destruction of fish habitat that is not authorized under this Act, or of a serious and imminent danger of such an occurrence, if the person at any material time:

(a) Owns or has the charge, management or control of the work, undertaking or activity that resulted in the occurrence or the danger of the occurrence; or

(b) Causes or contributes to the occurrence or the danger of the occurrence.

SECTION 38 (5) If there occurs a deposit of a deleterious substance in water frequented by fish that is not authorized under this Act, or if there is a serious and imminent danger of such an occurrence, and detriment to fish habitat or fish or to the use by humans of fish results or may reasonably be expected to result from the occurrence, then every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations.

SECTION 38 (7) As soon as feasible after the occurrence or after learning of the danger of the occurrence, the person shall provide an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations with a written report on the occurrence or danger of the occurrence.

Species at Risk Act

The purposes of this Act are to prevent wildlife species from becoming extirpated or extinct, to provide for the recovery of wildlife species that are extirpated, endangered or threatened as a result of human activity and to manage species of special concern to prevent them from becoming endangered or threatened. Once a species is legally listed, the Act requires that recovery strategies be developed for extirpated, endangered and threatened species, and that action plans be developed where recovery is feasible.

Schedule 1 of the Act sets out the legal list of species at risk (extirpated, endangered, threatened and special concern) in Canada.

Where the Act applies, it makes it illegal to kill, harm, harass, capture or take a species at risk, or to possess, collect, buy, sell or trade any individual or parts of an individual that is at risk. The Act also prohibits the damage or destruction of either the residence (for example, the nest or den) or the critical habitat of any species at risk. Critical habitat is legally identified in a posted recovery strategy or action plan.

While the Act applies to all land and waters in Canada, these prohibitions only apply to areas of federal jurisdiction including migratory birds, all waters (sea and fresh) in Canada, as well as to all federal lands, including Indian reserves and national parks, and the airspace above them.

On private land, unless an order is made by the government, the SARA prohibitions apply only to:

- Aquatic species at risk; and
- Migratory birds listed in the *Migratory Birds Convention Act*, 1994 and also listed as endangered, threatened or extirpated in Schedule 1 of the Act.

The provisions of the *Species at Risk Act* (known as the 'safety net') could be invoked on BC crown and private lands using a federal order under the Act if provincial action is not sufficient to protect listed species.

While SARA prohibitions do not apply to species of special concern, the Act does require management plans to be developed for these species.

More information about how the Act applies on private land can be found on the

Species at Risk Public Registry

OUTDOOR AREA BENEFICIAL MANAGEMENT PRACTICES

Comply with applicable outdoor area related legislation, including the above, and where appropriate, implement the following beneficial management practices to protect the environment.

Broad environmental concerns of outdoor livestock areas are expressed in this rule-of-thumb:

Keep clean water away from manure;
Keep manure away from clean water

The *Code of Practice for Agricultural Environmental Management* defines three outdoor livestock areas. Common terms used for these areas are outlined in Table 3.1.

TABLE 3.1	Typical Outdoor Area Terms for Livestock Groupings		
Livestock Type	Outdoor Areas (as defined by the *Code of Practice for Agriculture Environment Management*)		
	Confined	Seasonal	Grazing
Beef Cattle	feedlot handling corral calving pen	overwintering calving areas	pasture range
Bison	feedlot handling corral calving pen	overwintering calving areas	pasture
Chickens & Turkeys	free range	free range	—
Dairy Cattle	yard	—	pasture
Fallow Deer & Reindeer	—	overwintering fawning areas	pasture
Fur farms	—	—	—
Game Birds (e.g., pheasant)	free range	free range	—
Goats	yard	—	pasture
Horses	arena paddock	overwintering foaling areas	pasture range
Laying Hens	free range	free range	—
Llamas & Alpacas	pen	—	pasture
Ostriches & Emus	pen	—	—
Hogs	yard	—	pasture
Rabbits	—	—	—
Sheep	handling corral lambing pen	overwintering lambing areas	pasture range - cut blocks
Water Fowl	free range	free range	—

Horse Riding Arenas

Horse riding arenas are considered to be confined livestock areas and must be managed as such. Ideal arena footing materials should have a low potential for producing leachate, for instance sand is better than wood residue. If wood residue is used its leachate must be managed.

➔ see Wood Residue, **page 2-40**.

Dry areas with good drainage will provide a more serviceable, easily maintained facility regardless of the type of footing chosen. Do not locate arenas in wet areas, that by nature pose the highest pollution potential when wood residue, manure, or urine are in contact with water. Divert water around the arena to ditches or streams to minimize pollution.

Building an Environmentally Sound Outdoor Riding Ring

Horse Farm Best Practices BC

Outdoor Calving Areas

Cattle calving areas can be either confined livestock areas or seasonal feeding areas. Where contaminated runoff is at risk of reaching watercourses, give special attention to runoff control. Calf manure often contains *Cryptosporidium parvum*, a protozoan pathogen that can cause illness in humans if ingested in drinking water.

Confined Livestock and Outdoor Poultry Areas

Commonly called pens, yards, loafing areas, free range, or exercise areas, confined livestock areas may be used either for many months to house livestock or for short periods of time to give indoor-housed livestock fresh air and sunshine. They may be used for feeding, watering or confinement purposes.

There are a number of ways to manage confined livestock areas to reduce the likelihood of depositing deleterious substances into water frequented by fish or of causing water pollution. Implement the following practices:

- Locate facilities away from yard drain inlets, ditches, wells and watercourses.
- At least 30 m from wells (*Health Hazards Regulation*).
- At least 30 m from a drinking water source. 5-30 m from a watercourse (depending on the number of animal units and if they are being fed) and 1.5 m from a property boundary *(Code of Practice for Agricultural Environmental Management*).
- Install a hard surface (e.g., concrete, asphalt) around water supply systems and feed bunks, as well as in soil based yards, as indicated by **Worksheet #1**, next page.
- Install a water supply system as watercourse access is not permitted from confined livestock areas (a conditional exception is allowed for a rangeland holding area).

➔ see Livestock Watering, **page 9-16**

- Establish and maintain an adequate buffer between the outdoor area and any watercourse to keep wastes, or leachate from the wastes, from entering a watercourse.

➔ see Buffers, **page 11-4**

- Handle, process, and store feed properly.

➔ see Crop Processing, and Forage Crop Storage, **page 4-13**

- Divert upland area "clean water" away from confined livestock areas.
- Collect confined livestock area contaminated runoff ("dirty water") or use sites where contaminated runoff is prevented from reaching watercourses.

➔ see Runoff, **page 9-50**

- If contaminated runoff is collected;
  - Estimate the volume to be collected using **Worksheet #11**, **page 9-56.**
  - Use the water appropriately.

    ➔ see Contaminated Water Collection, Storage and Use , **page 9-55**
  - Prevent the escape of manure from the area and collect and spread it as a fertilizer (*Code of Practice for Agricultural Environmental Management* requirement).

WORKSHEET #1
Determining Suitability and Size

Workbook Question 96

Question: **Is a soil-based yard suitable and what is the minimum yard space required for continuous use?**

Information:

Precipitation from Oct 1 to April 30 (indicate site)	Merritt	280	1	mm
Risk of leachate movement in soil (refer to table 8.1)	☐ low ☐ high	Low	2	risk
Number of livestock		100	3	head
Average weight of livestock		350	4	kg

Minimum space for soil-based yards

continuous use	6m² per 100 kg	5
day use only	2m² per 100 kg	6

Calculation: Step 1

Determine if a soil-based yard is suitable.

Is Box 1 less than 600 mm, and is Box 2 low risk?

If YES, continue to step 2 or 3

If NO, Soil-based yard is generally not suitable. Outside yards should be hard-surfaced.

Step 2

Determine the size of the soil-based yard if it is continuous use.
(A soil-based yard area of 6 m² /100 kg or greater is suitable for continuous use)

EQUATION: Soil-Based Space Yard Size

Number of Livestock	x	Average Weight	x	Minimum Space 6 m²/100 kg	=	Soil-based Yard Size
100 (3) head	x	350 (4) kg	x	0.06 (5)	=	2100 (7) m²

Step 3

Determine the size of the soil-based yard if it is day use only.

EQUATION: Soil-Based Space Yard Size

Number of Livestock	x	Average Weight	x	Minimum Space 2 m²/100 kg	=	Soil-based Yard Size
100 (3) head	x	350 (4) kg	x	0.02 (6)	=	700 (8) m²

Answer: For this Merritt farm example, a soil-based confined livestock area is suitable, with a continuous use yard for 100 cattle averaging 350 kg requiring a minimum area of 2,100 m²

Question. Is a soil-based yard suitable and what is the minimum yard space required for continuous use?

Sample Outcome. Yes

Note: 1 m² = 10.76 ft² 350 kg = 1 head

Soil-Based vs. Hard-Surfaced Yards. In general, extensive use for more than 72 hours continuously of soil-based, confined livestock area is best suited to sites that have **all** of the following:

- Are located in low precipitation climates, less than 600 mm October 1st to April 30th inclusive.

  ➔ see Appendix **Figure B.1**, **page B-2**

- **And** have soil with a low risk of contaminant movement.

  ➔ see **Table 8.1**, **page 8-16**

- **And** have low-density livestock use, requiring the following minimum areas:
  - For **continuous use**, an area of 6 m^2 or greater per 100 kg of livestock.
  - For **day-only use**, an area of 2 m^2 or greater per 100 kg of livestock.

Use hard surface confined livestock areas if **any one of the above conditions are not met**. Refer to **Worksheet #1**, previous page, for an example of determining suitability and sizing a soil-based confined livestock area.

Confined Soil-Based Yards. Heavy traffic and sustained use of soil-based confined livestock areas, especially in wet conditions, either destroys plant cover totally or leaves a cover that is sparse and weedy. In addition, soil compaction prevents precipitation from infiltrating the soil, causing ponding and increased runoff flow that could cause erosion.

Non-vegetated, wet and muddy confined livestock areas do not provide many of the benefits for which they are intended. High moisture conditions contribute detrimentally to the health of animals. Mud can increase the breeding of flies, reduce the ability to dissipate excess heat, and also create challenges in detecting lameness. As well, excessive amounts of manure and other waste accumulate, increasing the risk of contaminated runoff.

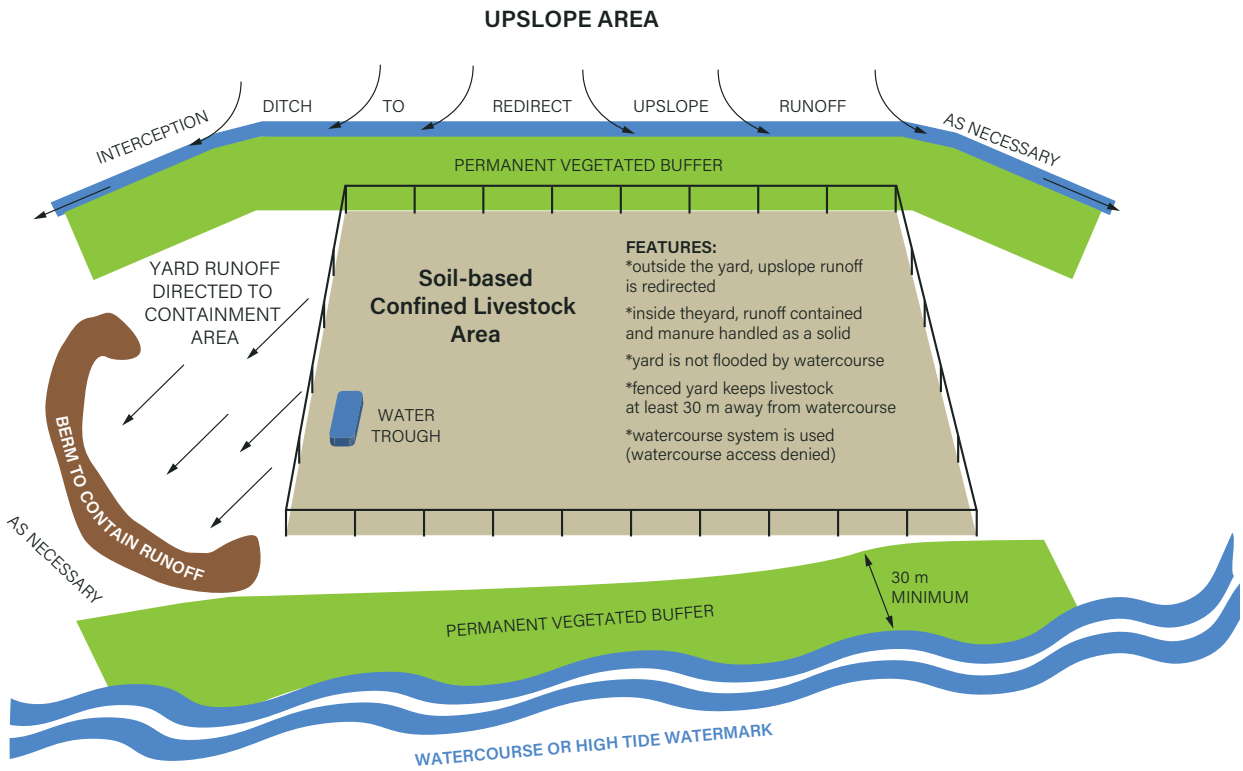


FIGURE 3.2 An Environmentally-Sound Confined Livestock Area – Soil-Based Yard

For soil-based yards, shown in **Figure 3.2**, previous page, include the general confined area beneficial management practices, and implement the following practices:

- Align bedded mounds to drain runoff to collection areas, then use the water appropriately.

  ➔ see Contaminated Water Collection, Storage and Use , **page 9-55**

- Install hard surfacing to heavy livestock traffic areas and to areas along feed bunks (feeding apron) and adjacent to waterers.
  - A concrete or shale packed apron should be 3.5 to 4 m next to feedbunks.
  - A concrete pad or wood should be 3 m around waterers.
- Make sure the soil base is maintained by ensuring there is a gleyed layer in place. A gleyed layer is also referred to as a protective base or "self-sealing layer", this is a layer of soil, or soil mixed with manure that forms between the manure pack and the underlying soil that acts as a barrier for liquids to pass through.
- Moderate pen density to adjust moisture content, odour and dust.
- Manage pen slope to ensure rapid pen drying after rainfall and to minimize mud and odour generation provide windbreaks.
- When cleaning yards, ensure that the self-sealing layer is not removed by scraping the area too deeply, maintaining this layer will restrict the liquid from the yard from passing into the soil under the yards and reaching the water table.
- Management methods to reduce mud are:
  - Appropriate pen slope and removing potholes,
  - Lowering stock density and
  - Insuring adequate mounds.
- Poor drainage and wet conditions can double space requirements
- Management methods for controlling dust are:
  - Increasing stock density,
  - Using sprinklers,
  - Scraping off the top few cm of dry layer manure from the pen surface.

Confined Concrete or Hard-Surfaced Yards. For concrete or hard-surfaced yards, shown in **Figure 3.3,** below, include the general confined area points on **page 3-11**, and implement the following practices:

- Minimize the yard area to reduce the amount of precipitation that mixes with manure, and to reduce the labour needed to keep the area clean.
- Divert roof water and clean water from surrounding areas to prevent mixing with contaminated water within the yard.
- Regularly clean the open yard area by scraping wastes to storage structures suitable for either semi-solid or liquid manure.

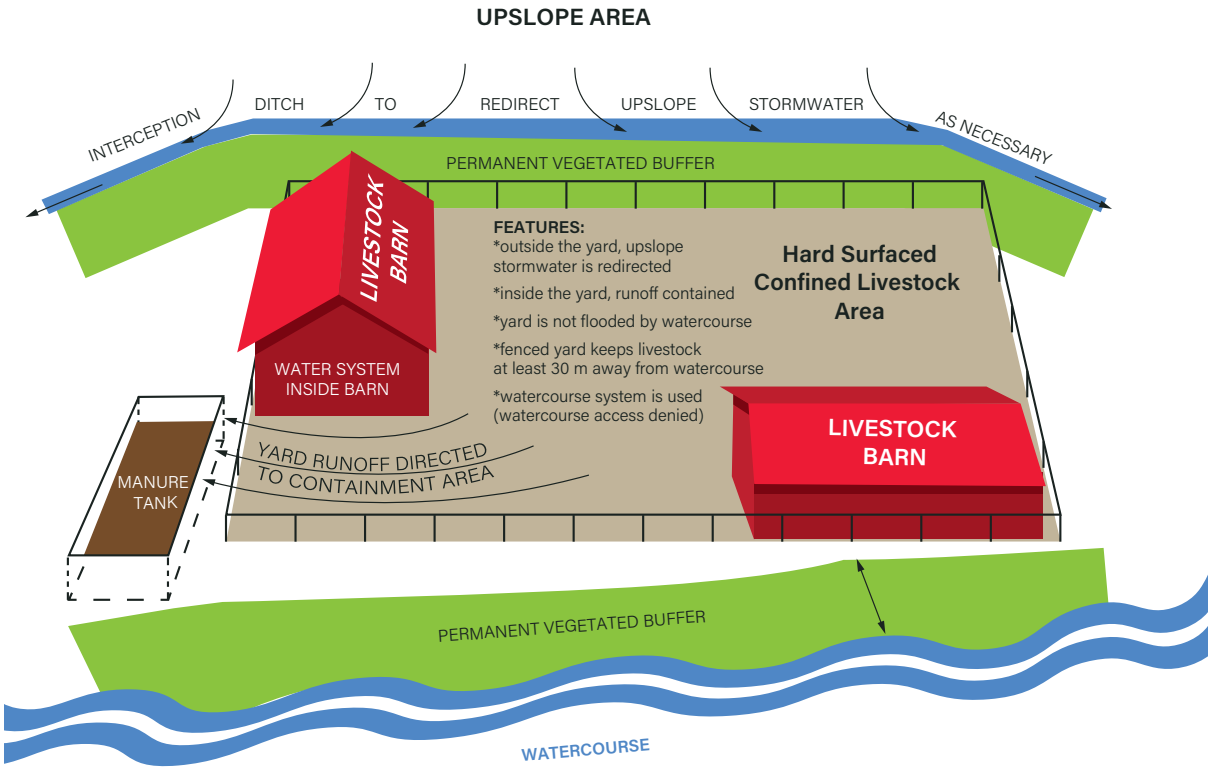


FIGURE 3.3 An Environmentally-Sound Confined Livestock Area – Hard-Surfaced Yard

Estimating Confined Livestock Area Runoff Volume. Use Worksheet #11, **page 9-56**, to estimate runoff volume:

- The formula uses a design storage capacity based on the most winter precipitation expected in 25 years (recommended by ENV).
- The winter storage period (either 6 or 7 months) depends on when the storage can be emptied in the spring.
- During the cropping season (May to October) any contaminated runoff can be directly applied to cropland for utilization.

Seasonal Feeding Areas

Seasonal feeding areas are unique for two reasons:

- They are used for crop production and
- For feeding livestock.

As seasonal feeding areas are used during the non-growing season, (not a preferred time to be spreading manure), the risk of runoff causing pollution is high.

Runoff protection measures will be required for:

- High precipitation climates (precipitation is greater than 600 mm from Oct 1st to April 30th inclusive).
- Areas where snow melting on frozen ground causes runoff.

Distinguishing between Confined Feeding Operations and Seasonal Feeding & Bedding Sites for Cattle Operations

Managing Seasonal Feeding Areas

Selecting Seasonal Feeding Areas

Wintering Site Assessment Tool

General Considerations. Implement the following practices:

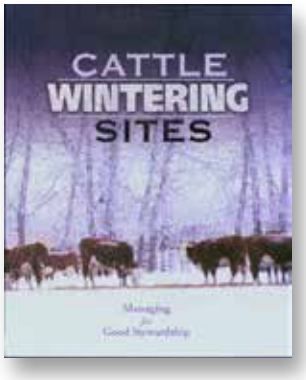
- Have stocking densities that do not cause soil compaction.
- Handle, store, and process feed properly.

➔see Forage Crop Storage, **page 4-14**

- Harrow manured areas in the spring to break manure clods.
- Collect and spread manure that is generated near fixed feed bunks as a fertilizer.
- Monitor watercourses for impacts from livestock watering and bedding by:
  - Checking visually for channel instability caused by hoof action from livestock having access to watercourses.
  - Lab testing for chemical and bacteriological contamination of watercourses caused by runoff or direct livestock access.
- Maintain runoff controls (e.g., ditches, berms, etc...).
- Before using a feeding area, and where practical and appropriate, remove snow to reduce contaminated runoff.
- Limit livestock use of wet pastures to prevent soil compaction by keeping livestock in confined areas.
- Limit access to riparian areas by using fencing and off-stream watering.
- When used as cow calving areas, give special attention to runoff flows.

➔see Outdoor Calving Areas, **page 3-14**

Cattle Wintering Sites: Managing for Good Stewardship and Site Risk Evaluation Sheet



Site Considerations. For seasonal feeding areas, shown in **Figure 3.4**, next page, implement the following practices:

- Locate facilities away from yard drain inlets, ditches, wells and watercourses:
  - At least 30 m from wells (*Health Hazards Regulation*);
  - At least 30 m from a watercourse (*Code of Practice for Agricultural Environmental Management*).
- Locate such that contaminated runoff cannot reach adjacent watercourses.
- Locate where feeding site leachate cannot reach groundwater.
- Do not choose sites where groundwater is near the surface or that have soils that will allow leachate to easily move to groundwater.
- Locate in areas that are not subject to flooding nor receive significant runoff.
- Locate in such a way that upslope water can be diverted away from the feeding area:
  - This will minimize the volume of contaminated water to contain;
  - Livestock may also benefit by having a drier site.
- Locate in such a way that all contaminated runoff can be contained.
- Implement downslope diversion to direct contaminated water onto adjacent established perennial forage for containment to allow nutrients to be used by the crop in the next growing season.
- For small volumes, berm to direct or contain contaminated water onsite.
- For large volumes, construct an impervious pond to contain the contaminated water.

Watering. When watering livestock outdoors, implement the following practices:

- Use an off-stream watering system to ensure low risk (**A in Figure 3.4**).

➔ see Livestock Watering, **page 9-16**

- Where an off-stream watering system is not feasible, use an access to a watercourse that is low impact. **(B in Figure 3.4)**

➔ see Watering Livestock Directly from Watercourses, **page 9-17**

Remote Winter Watering

Bedding. When bedding livestock outdoors, implement the following practices:

- Situate bedding sites to keep manure accumulations away from surface water and riparian areas.
- Provide windbreaks that lure livestock away from treed riparian areas.
- Locate water and feed sites to minimize the use of problem bedding areas.
- If used, collect wood residue bedding at least once a year (preferably in the spring) and handle appropriately.

➔ see Wood Residue, **page 2-41**

Feeding. When feeding outdoors, implement the following practices:

- Clean up wasted or spilled feed before it becomes a pollution risk.
- Locate feeders to ensure that manure build up around feeders does not pollute watercourses.
- Meet crop needs by moving feeding locations or portable feeders around the site as required to provide good manure distribution.
- Get approval for location of permanent feeders from ENV.

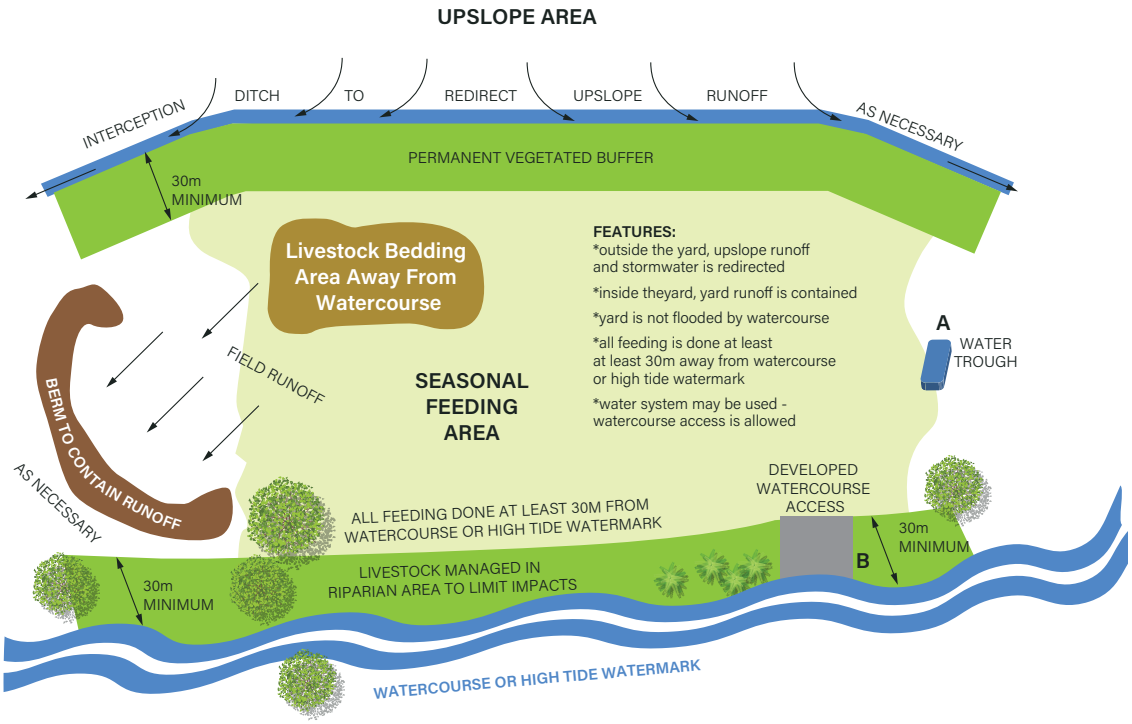


FIGURE 3.4 An Environmentally-Sound Seasonal Feeding Area

Perennial vs. Annual Crops on Seasonal Feeding Areas.

For seasonal feeding areas with perennial forage crops, feeding intensity is normally low to prevent damage to the crop. Generally, the practices suggested above provide appropriate environmental protection. However, where a perennial crop is going to be plowed under the following year and feeding intensity is to be high, treat the feeding site as an annual crop site (see below).

For seasonal feeding areas with **annual** forage crops, feeding intensity may not be governed by crop damage concerns. It is possible for these sites to take on some characteristics of confined feeding areas (e.g., dense manure pack, bare soil). In these cases, manage the areas similar to confined areas.

➔ see Confined Livestock Areas, **page 3-14**

BC Rangeland Seeding Manual

Grazing

Grazing areas vary from intensively-managed pastures to rangelands. Maintain the health of grazing areas by following the practices outlined in the:

Grazing Management Guide publication

The following factsheets can be found through the Grazing Management Guide:

- Improving Livestock Distribution,
- Grazing Frequency and Utilization,
- Seasonal Considerations for Grazing,
- Pasture Design,
- Riparian Pasture Design,
- Watering Livestock Directly from Watercourses,
- Monitoring Grazing Levels,
- Managing Grazing Lands During Drought,
- Pasture Management.

Grazing Management Guide is a publication that forms a part of the Environmental Farm Plan series on Beneficial Management Practices. Its purpose is to provide a checklist and guidelines for protecting pasture and range health. Is recommended to be used by producers having either pastures or private rangelands or who graze Crown land under a grazing lease. **Table 3.3** gives four basic pasture and range assessment questions that direct producers to the use of this publication

Manure Nutrients. If rainfall is adequate or if irrigation is used, pastures may have high productivity, and could support high stocking rates for long periods. Because grazing animals do not excrete more nutrients than they consume, manure nutrients produced during grazing will not exceed amount needed by the crop being grazed. As a result, collection and storage of manure will not be required and effective management will move livestock to distribute manure evenly over the grazed area. Manage sites experiencing contaminated runoff to ensure that nutrients stay on the pasture.

If manure distribution is uneven, as is possible around supplemental feeding areas, manure may have to be redistributed. If fertilizer is applied in addition to manure excreted during grazing, care must be used to not exceed crop needs.

With intensively-managed pastures, such as grazing livestock on irrigated pastures, implement the following practices:

- Use livestock waterers where feasible.
- Although access to watercourses is allowed, it is recommended that livestock waterers be installed on intensively managed pastures and that accessible portions of the watercourse be fenced off where appropriate.

  Watering Livestock Directly From Watercourses
- Prevent stream banks from being trampled upon to protect fish habitat and stream banks from erosion.

  ➔ see Watering Livestock Directly from Watercourses, **page 9-17**
- Ensure that contaminated pasture runoff does not enter any watercourse.

  ➔ see Runoff, **page 9-50**
- Ensure no leachate is allowed to reach groundwater.
- Do not graze livestock on saturated soils because they are easily compacted and manure deposited on wet soil release higher levels of nitrous oxide, a powerful greenhouse gas contributing to climate change.
- Manage grazing to maintain a crop stubble that will filter runoff and hold soils in place.
- Place salt and mineral blocks or sources to lure livestock away from watercourses and sensitive areas.
- Harrow pastures regularly to break up manure clods, particularly in drier regions.

For information on rangelands, refer to:

- Rangeland Handbook for BC (printed book only)
- Grassland Monitoring Manual for British Columbia: A Tool for Ranchers
- Managing BC Grasslands: An Overview
- Rangeland Health Brochure 13: The Four Principles of Range Management
- Rangeland Health Brochure 14: A Different Form of R&R
- Best Management Practices on Crown Range in Community Watersheds
- Water Quality and Livestock Grazing on Crown Rangeland in BC
- Land Management Guide for Horse Owners and Small Lot Farmers

Invasive Species and Weeds. Invasive species and weeds may be spread by grazing livestock. Control weeds before they become a problem.

➔ see Weeds, **page 5-12**

TABLE 3.2 Basic Pasture and Range Assessment Questions ★

1. Do Desirable Plants Make Up More Than One-half of the Vegetation Cover or Weight?

Desirable plants are those that contribute positively to the management objectives of your site, plants that:

- Are readily consumed and persistent;
- Provide consistent amounts of forage (high tonnage);
- Are perennial, except in tame pastures that are specifically being managed for annual species;
- Prohibit the introduction or spread of invasive plants; and
- Provide enough litter and residue to conserve soil moisture and maintain soil stability.

Undesirable plants can include those that are invasive, poisonous and those that crowd out desirable species. In tame pasture, undesirables may include woody invaders (rose, aspen, snowberry etc.) and those that are typically not eaten by most livestock or cause undesirable side effects when eaten.

Examples of Desired Plant Communities

A Southern Interior grassland composed primarily of low growing, relatively non-productive and non-desirable grasses.

A Southern Interior grassland composed of more than one-half highly productive and desirable large bunchgrasses.

An example of a Peace River aspen stand showing the removal of desirable tall forbs, grasses and shrubs. All that remains are low growing forbs that provide little forage value.

Peace River aspen stand with an abundance of desirable plants including highly productive grasses, forbs and shrubs.

2. Does Leaf Length, Seed Production, Colour, and Overall Productivity of Desirable Plants Indicate Strong Vigour?

Plant vigour is reflected primarily by the size of a plant and its parts in relation to its age and the environment in which it is growing. However, periodic drought in dry land environments will lower the apparent vigour and annual productivity of desired plants. Plants with low vigour have a greater potential to be replaced by weedy invasive and low quality or poisonous plants.

Examples of Plant Vigour

Peace River aspen stand showing poor vigour, productivity and a loss of desirable tall forbs and shrubs.

Peace River aspen stand showing excellent vigour, productivity and a mixture of desirable tall forbs, grasses and shrubs.

Southern Interior bunchgrass grassland showing poor vigour, productivity and a lack of desirable large bunchgrasses.

Southern Interior bunchgrass grassland showing excellent vigour, productivity and a dominance of large, more robust bunchgrasses.

3. Is Litter and Plant Residue Fairly Abundant and is Some of it Composed of Desirable Plants?

Litter and standing plant residue (dead material), in various states of decay, provides additional surface cover that:

- Promotes nutrient cycling by providing organic matter to the soil.
- Reduces soil erosion by wind and water including reducing raindrop impact.
- Increases water infiltration into the soil by slowing runoff and providing a pathway into the soil profile.
- Promotes moisture retention by reducing evaporation.

In order for litter and plant residue to be rated as fairly abundant, approximately 25 percent of the standing forage mass should either be dead or consist of dying leaves and stems:

- On tame pastures, less than 25 percent should either be dead or consist of dying leaves and stems.
- Anything greater than 25 percent may be excessive – too much litter and standing plant residue dead material will reduce the feed of the forage consumed and animal intake, as well as inhibits new plant shoot growth and seedling emergence.

Examples of Plant Litter

Southern Interior grassland with relatively little litter.

Southern Interior bunchgrass grassland with fairly abundant litter and plant residue (>25%), some of which is composed of desirable plants.

Is the Area Free of Evidence Indicating Soil Movement or Loss?

When managing your grazing lands it is extremely important to prevent human caused soil movement or loss by maintaining adequate plant cover and minimizing the amount of exposed (bare) soil. Any loss of soil will lower the productivity of a site by removing finer soil particles like clays, silts and organic matter all of which are integral in maintaining soil fertility and a sites moisture holding capacity.

- Soil compaction should be minimized as it decreases the amount of water available to plants by reducing water infiltration into the soil profile.

Evidence of soil compaction:

- Push a metal rod, pencil, or knife into the soil and interpret the ease of penetration.
- Compare in-field resistance to penetration with resistance found at a grazed fenceline.
- Compacted soil layers will increase the amount of resistance encountered.
- The more noticeable the difference in resistance, the greater the compaction is in that pasture.

Evidence of soil movement or loss includes:

- The presence of debris dams of plant residue that build up at obstructions or span between obstructions (sheet erosion).
- The presence of rills, which are small incised channels that run parallel to one another down a slope, indicate that serious soil loss is occurring.
- The deposition of heavier soil particles downwind of obstructions such as fencelines, buildings and vegetation.

Examples of Soil Movement or Loss - Rills and Gullies

Example of rills on a Southern Interior grassland.

Example of a gully on a Peace River pasture.

★ Pastures and ranges that do not have these features should refer to the Grazing Management Guide publication for assistance in more detailed assessment and management ideas to improve conditions.

MANURE HANDLING AND STORAGE

Manure is a valuable by-product of livestock operations. However, to realize its potential value and to avoid pollution problems, well-planned manure handling and storage systems are essential.

MANURE HANDLING AND STORAGE ENVIRONMENTAL CONCERNS

Primary environmental concerns related to manure handling and storage are:

- Manure handling, spillage, storage facility leakage, or overtopping that results in soil or water pollution, or impacts to habitat.
- Insufficient storage that requires manure spreading during high-risk seasons that results in water pollution.
- Inappropriate field storage that results in water pollution.
- Release of methane (CH_4) and nitrous oxide (N_2O), greenhouse gases that contribute to climate change.
- Release of ammonia (NH_3), volatile organic compounds (VOC) and nitrogen oxides (NO_x) which can chemically produce secondary particulate that results in pollution, human health concerns and visibility reduction.
- Release of odours associated with ammonia and other contaminants.
- Release of hydrogen sulphide and other air contaminants that result in air pollution.

➔ see **Chapter 6**, Nutrient Application, regarding manure application to land

For information on these concerns:

➔ see Impacts on Biodiversity and Habitat, **page 7-7**, refer to Farm Activities and Impacts

➔ see Soil Quality Factors, **page 8-2**, refer to Contaminants, to Micronutrients and Metals, and to Salts

➔ see Water Quality and Quantity Factors, **page 9-1,** refer to Contaminants, and to Oxygen Demand

➔ see Air Contaminants, **page 10-1**, refer to Dust and Particulates

➔ see Climate Change Factors, **page 12-1**

MANURE HANDLING AND STORAGE LEGISLATION

The following is a brief outline of the main legislation that applies to manure handling and storage.

➔ see **page A-1** for a summary of these and other Acts and Regulations

Drinking Water Protection Act

This Act and Regulations have requirements regarding the protection of drinking water quality and regulate domestic water systems (those serving **more** than one single-family residence).

- SECTION 23(1): Subject to subsection (3), a person must not (a) introduce anything or cause or allow anything to be introduced into a domestic water system, a drinking water source, a well recharge zone or an area adjacent to a drinking water source, or (b) do or cause any other thing to be done or to occur if this will result or is likely to result in a drinking water health hazard in relation to a domestic water system

Environmental Management Act

The *Code of Practice for Agricultural Environmental Management* has specific requirements regarding manure storage and use.

The AEM Code introduces the term "protective base," which means:

a) A layer or soil that is at least 30 cm thick with a saturated hydraulic conductivity less than or equal to 10^{-7} cm/s, or

b) Any material that does not allow for leaks or liquids to soak through

- SECTION 17: Field storage under 2 weeks and permanent storage structures must be set back 30 m from drinking water sources, 15 m from watercourses, and 4.5 m from property boundaries, whereas field storage 2 weeks and over must be set back 30 m from drinking water sources, watercourses, and 4.5 m from property boundaries
- SECTION 32: A person may store and use solid agricultural by-products, or carry out agricultural composting on their land base only as follows:
  - The solid by-products produced, on or off the farm, may be stored or composted on the farm.
  - If solid by-products are produced off-farm and stored or composted on the farm, the stored or composted material must be used on the farm.
  - Solid by-products must be stored as temporary field storage or in a permanent structure.
  - Manure and bedding from fur bearing animals may be stored in on-ground under pen storage for a maximum of 7 months.
- SECTION 33: A person may store liquid manure only as follows:
  - Liquid manure may only be stored on-farm if it was produced or stored on-farm and will be used on the farm.
  - Liquid manure must be stored in a permanent storage structure.
  - In an emergency, liquid manure may be stored in a non-permanent storage structure if:
    - The director is notified immediately;
    - The director is notified within 5 days of the plan to apply or store the manure in a manner that applies with the AEM code;
    - The plan is implemented, taking any director-required directions or modifications into account;
    - The structure is monitored for leaks and immediately fixed if leaks are found.
- SECTION 34: A person who stores agricultural by-products must ensure the following:
  - Leachate is contained and collected until it can be land applied.
  - Runoff is diverted away from storages.
  - Storage structure and area is maintained so as to prevent contaminated runoff, leachate, wastewater and solids from escaping.
  - If any of the above do escape, that they do not cross a property boundary, enter a watercourse or go below the water table.
  - Air contaminants from stored by-products do not cross property boundaries.
  - By-products are stored in a manner to deter the attraction and access of pets, wildlife, and

- SECTION 35: A person who uses a permanent storage structure must ensure there is sufficient capacity to store agricultural by-products until they are either applied as a fertilizer or soil conditioner, or transported away.
- SECTION 36 (1): A person who stores liquid manure must ensure the structure is an existing permanent storage structure, a modified storage structure designed by a qualified professional and built according to the design, or a new permanent storage structure designed by a qualified professional and built according to the design.
- SECTION 36(2): Design plans for a modified or new permanent storage structure must be kept along with confirmation from a qualified professional which indicates the structure was constructed as designed.
- SECTION 36(3): A person who stores liquid manure must ensure that there is a 30 cm of freeboard at all times, the structure must have a protective base to prevent the manure from leaking from the structure, the protective base must be maintained to prevent leakage, and that the stored manure does not leak or overflow from the structure.
- SECTION 37: A person who uses temporary field storage to store solid manure, must ensure:
  - Field storage is not located in an area with standing water or saturated soil and that is prone to seasonal flooding;
  - Field storage is monitored once per week;
  - All field stored manure is used within 7 months, or either moved to a permanent storage facility or transported away;
  - If stored for more than 2 weeks, the same location must not be used for 3 years;
  - Vegetation is grown on the storage location after the by-products are used, moved or transported
  - Records must be kept of the field storage pile, including: type and source of material, location or storage, and weekly monitoring results.
- SECTION 38: In addition to SECTION 34, a person who uses on-ground, under-pen manure storage must ensure:
  - Runoff is diverted away from stored materials and that if contaminated leachate, runoff, solids, or agricultural by-products escape from storage, steps are immediately taken to collect and contain them;
  - A record must be kept of the steps taken, if any, to collect and contain any escaped material.

The following applies in vulnerable aquifer recharge and/or high precipitation areas:

- SECTION 22: If a person is required to have a protective base, the person must ensure:
  - The base is maintained to prevent leakage and keep a record of maintenance;
  - Assess the base for leakage at least once every 6 months;
  - Corrective action is taken to stop any leakage found on assessment and prevent further leaks;
  - For every assessment conducted, a record of the date and results of the assessment, as well as any corrective actions taken, must be kept.
- SECTION 23: A person who uses a modified or new permanent storage structure, they must ensure:
  - There is a protective base under the storage;
  - If the structure is to store liquid manure:
    - The structure is designed by a qualified professional and built according to that design;
    - Either, the structure has a vertical distance of at least 1 m from the bottom of the protective base to the seasonal high-water table, or leak detection measures demonstrate that the structure is not leaking;
    - The person must keep the design plans and a statement signed by the qualified professional indicating that the structure was constructed as designed;
    - Modified or new on-ground under-pen storage in a vulnerable aquifer recharge area must ensure that there is a protective base under the storage vectors.

- SECTION 24: A person who began, before February 28, 2019, to store liquid manure in an earthen basin must do the following:
  - Have a qualified professional assess the storage basin for leaks of stored materials before February 28, 2021;
  - Until a protective base is installed, a qualified professional assesses the basin least every 5 years or more often if required;
  - If any leaks are found on assessment, take immediate corrective action to stops the leaks and prevent further leaks, and take steps as soon as possible to install a protective base on the bottom and sides of the earthen basin;
  - Keep a record of the date and results of each assessment conducted and all corrective actions;
  - Install a protective base on the bottom and sides of the storage basin before February 28, 2029.
- SECTION 25(1): temporary field storages in high precipitation areas must be covered from October 1 to April 1 of the following year.
- SECTION 25(2): A person who uses temporary field storage for 2 weeks or more in a vulnerable aquifer recharge area must not locate the storage directly on or over coarse-textured soil.
- The *Spill Reporting Regulation* requires spills of a polluting substance (including manure) be reported immediately to Provincial Emergency Program (EMBC) at 1-800-663-3456 (24 hour service). Report spills of manure greater than 200 kg or 200 litres.

Report a spill website

Farm Practices Protection Act

The FPPA provides that a farmer is not liable in nuisance to any person for any odour, noise, dust or other disturbance resulting from that farm operation. However, for this protection to apply, the farmer must comply with the *Environmental Management Act* (EMA), among other things.

Public Health Act

Administered by the Ministry of Health, this Act has a specific prohibition that "a person must not willingly cause a health hazard, or act in a manner that the person knows, or ought to know, will cause a health hazard". This prohibition would apply to farm practices that may result in a health hazard, such as when nutrients, contaminants or pathogens are discharged to land, water or air so as to pose a public health problem. Any situation that entails a health hazard will enable health officers to investigate using their powers under the Act. Under the *Public Health Act*, the local Health Authority must investigate any health hazard and has authority to order that a person prevent or stop a health hazard, or mitigate the harm or prevent further harm from a health hazard amongst other powers. Similar regulatory provisions exist for addressing health hazards to drinking water supplies under the *Drinking Water Protection Act*.

- SECTION 15: a person must not willingly cause a health hazard, or act in a manner that the person knows, or ought to know, will cause a health hazard.

The Act also has conditions under the *Health Hazards Regulation* to regulate the distance of wells from possible source of contamination.

SECTION 8 (1) A person who installs a well, or who controls a well installed on or after July 20, 1917, must ensure that the well is located at least

(a) 30 m from any probable source of contamination,

(b) 6 m from any private dwelling, and

(c) Unless contamination of the well would be impossible because of the physical conformation, 120 m from any cemetery or dumping ground.

(2) A person who controls a well installed before July 20, 1917, must

(a) Remove any source of contamination within the distances set out in subsection (1), or

(b) Subject to subsection (3), close the well in accordance with SECTION 6 of the Code of Practice under the *Ground Water Protection Regulation, B.C. Reg. 299/2004*.

(3) Subsection (2) (b) does not apply to a well located within 6 m of a private dwelling unless it can be shown that the well should be abandoned for a reason other than proximity to a private dwelling.

(4) A well that does not meet the requirements of this section is prescribed as a health hazard.

Fisheries Act

Administered by both Fisheries and Oceans Canada and Environment and Climate Change Canada, this Act is established to manage Canada's fisheries resources, including fish habitat. The Act can also be administered provincially by FLNRORD and ENV. The Act applies to all Canadian waters that contain fish, including ditches, channelized streams, creeks, rivers, marshes, lakes, estuaries, coastal waters and marine offshore areas. It also applies to seasonally wetted areas that provide fish habitat such as shorelines, stream banks, floodplains, intermittent tributaries and privately owned land. The Act includes provisions for stiff fines and imprisonment to ensure compliance.

The purpose of this Act is to provide a framework for (a) the proper management and control of fisheries; and (b) the conservation and protection of fish and fish habitat, including by preventing pollution.

This Act was updated in 2019 and now empowers the Minister to make regulations for the purposes of the conservation and protection of biodiversity.

The definition of fish habitat is: "water frequented by fish and any other areas on which fish depend directly or indirectly to carry out their life processes, including spawning grounds and nursery, rearing, food supply and migration areas". The quantity, timing and quality of the water flow that are necessary to sustain fish habitat are also deemed to be a fish habitat. Furthermore, serious harm to fish includes the death of fish or any permanent alteration to, or destruction of, fish habitat.

Provisions of the *2019 Fisheries Act* relevant to agricultural operations include:

- Protection for all fish and fish habitats;
- Prohibition against the death of fish or the 'harmful alteration, disruption or destruction of fish habitat';
- A permitting framework and codes of practice to improve management of large and small projects impacting fish and fish habitat;
- Protection of fish and/or fish habitats that are sensitive, highly productive, rare or unique; and
- Consideration for the cumulative effects of development activities on fish and fish habitat.

Specific sections of the Act include:

SECTION 34.2(1) The Minister may establish standards and codes of practice for:

(a) The avoidance of death to fish and harmful alteration, disruption or destruction of fish habitat;

(b) The conservation and protection of fish or fish habitat; and

(c) The prevention of pollution.

SECTION 34.4(1) No person shall carry on any work, undertaking or activity, other than fishing, that results in the death of fish.

SECTION 35 (1) No person shall carry on any work, undertaking or activity that results in the harmful alteration, disruption or destruction of fish habitat.

Every person who contravenes subsection 34.4(1) or 35(1) is guilty of an offence and liable.

Notifying authorities about serious harm to fish or deposit of a deleterious substance:

SECTION 38 (4.1) Every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations of a harmful alteration, disruption or destruction of fish habitat that is not authorized under this Act, or of a serious and imminent danger of such an occurrence, if the person at any material time

(a) Owns or has the charge, management or control of the work, undertaking or activity that resulted in the occurrence or the danger of the occurrence; or

(b) Causes or contributes to the occurrence or the danger of the occurrence.

SECTION 38 (5) If there occurs a deposit of a deleterious substance in water frequented by fish that is not authorized under this Act, or if there is a serious and imminent danger of such an occurrence, and detriment to fish habitat or fish or to the use by humans of fish results or may reasonably be expected to result from the occurrence, then every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations.

SECTION 38 (7) As soon as feasible after the occurrence or after learning of the danger of the occurrence, the person shall provide an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations with a written report on the occurrence or danger of the occurrence.

Migratory Birds Convention Act

This Act has a section of importance to manure management:

This Act protects migratory birds and their eggs and nests.

- SECTION 5.1: prohibits the deposit of substance(s) harmful to migratory birds in any area frequented by migratory birds, or in a place where the substance(s) can enter these areas
- SECTION 33: no person shall introduce into Canada for the purpose of sport, acclimatization or release from captivity a species of migratory bird not indigenous to Canada except with the consent in writing of the Director
- SECTION 35(1): prohibits the deposit of any substance harmful to migratory birds to any area frequented by migratory birds

MANURE HANDLING AND STORAGE BENEFICIAL MANAGEMENT PRACTICES

Comply with applicable manure related legislation, including the above, and where appropriate, implement the following beneficial management practices to protect the environment.

➔ see **Chapter 6**, Soil Amendments, regarding manure use (i.e., application to land)

Manure Handling

Minimize the risk of causing pollution when manure handling during cleanup of pens or barns and moving to or from storage facilities by implementing the following practices:

- Contain manure during transport within equipment to avoid spills
- Ensure manure is not carried onto public roads by equipment tires
- Limit the amount of manure handling near watercourses
- In case of a pipe break when piping manure near watercourses, have a containment method, such as a double-walled pipe within 10 m of the watercourse (suggested) and a low pressure switch to turn off the pump
- Where manure is moved from barns or pens to storage facilities by scraping over outside hard surfaces, ensure runoff from these surfaces is collected
- Have a manure spreading plan

  ➔ see Nutrient Application, **page 6-9**
- Where possible, use air emission and odour-reduction practices

  ➔ see Air Emissions, **page 10-6**,

  ➔ see Odours, **page 10-17**

Manure Storage

Storage of manure is necessary during times of the year when manure cannot be applied to cropland, either because the crop will not be able to utilize the nutrients, or the risk of causing pollution is too high.

Storage Facilities. A storage facility is a permanent structure designed and operated to contain manure and other agricultural by-products in an environmentally sound manner and sized to hold wastes until they can be used as a fertilizer or soil conditioner. New or modified permanent storage structures in vulnerable aquifer recharge areas must have a protective base.

Implement the following practices for all manure storage structures:

- Only store manure produced, or that will be used, on the farm (do not store manure produced off the farm that will be used off the farm, *Code of Practice for Agricultural Environmental Management*).
- Have facilities designed by a professional engineer whether of earthen, concrete or metal construction.
- size facilities to provide storage for the manure, any contaminated water that may enter, and if not roofed, precipitation.
- Size to allow the by-products to be stored until they can be spread as a fertilizer or soil conditioner.

➔ see Manure Storage Sizing , **page 3-35**

- Cover solid or semi-solid manure storages and locate storage areas to keep manure cool, to minimize the release of methane).

➔ see **Appendix B.1** for a map showing high and low precipitation areas, **page B-1**

- Incorporate leak detection with semi-solid and liquid storages as shown in **Figure 3.5**, next page.
- Incorporate secondary containment with liquid storages.
- Locate on a well-drained graded site, to divert clean runoff away (collecting clean water is an expense to be avoided).
- Protect from 100-year flood events.
- Establish and maintain an adequate buffer between manure storage and watercourses to prevent wastes or leachate from polluting.

➔ see Buffers, **page 11-4**

Leak Detection. Good management of semi-solid and liquid manure storages requires a means of monitoring for leaks. If a storage facility is built on fine-textured or "clayey" soil, install a tile line draining to a dry observation well underneath the structure. Check the observation well for the presence of leachate at least four times a year. Implement the following practices (see **Figure 3.5,** next page):

- Install a tile line under the middle of the facility, and
- Under the facility at the toe of the sloping wall for lagoon type, or
- About 1 m (suggested) inside the perimeter for concrete or steel walled type facilities;
- Install a tile line for every 3,000 m^2 of floor area (suggested).

In coarse-textured soils, lines underneath storages may not detect leakage because percolation paths tend to be more vertical than in less permeable soils. Complete monitoring would include regular testing for ammonia and nitrate levels in groundwater around the facility.

Secondary (Failure) Containment. If a structural failure of a liquid manure storage facility would result in manure entering a watercourse, install some form of secondary containment. Secondary containment can be as simple as a berm away from the manure storage located and sized such that any manure that might escape from the failed structure could be contained behind the berm. Sizing will normally be equal to the volume of manure stored.

Manure Storage Structures Factsheet BC

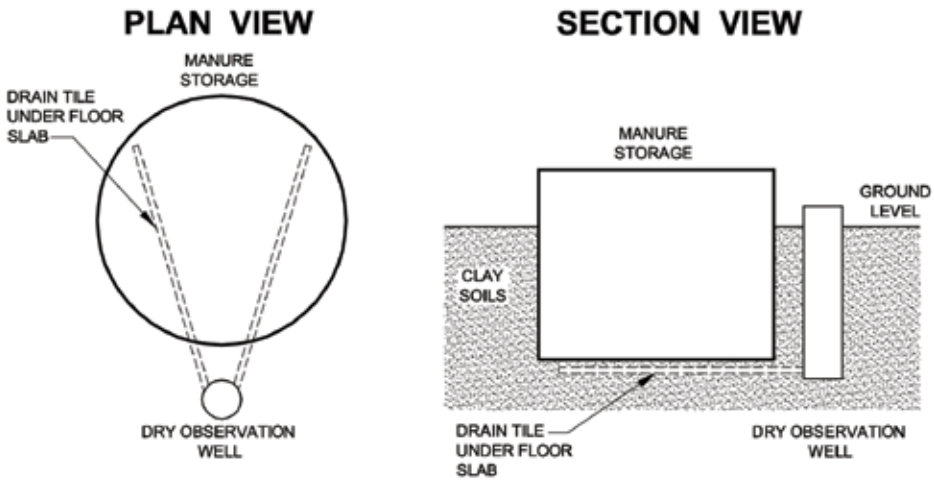


FIGURE 3.5 Leak Detection Under a Manure Storage Facility

Solid Manure Storage

Solid manure has a solid matter content of more than 18% (by mass) and will not flow when piled. Uncovered solid manure structures are suitable only if contaminated runoff from such storages is prevented from entering a watercourse, crossing a property boundary or going below the water table. Typical features of solid manure storage are shown in **Figure 3.6**. In addition to the practices described in Manure Storage, implement the following practices:

- Construct a concrete base and a curbed sidewall along at least one side to allow easy unloading of the facility.
- In high rainfall climates, construct a sump to collect and store the contaminated leachate for future land spreading.

Field Storage of Solid Agricultural By-Products. Temporary field storage is one of two ways to store solid manure, composts or other solid agricultural by-products. Compared with the alternative of storage in a permanent storage structure, temporary field storage offers flexibility, convenience and time savings to farmers. Temporary field storage is short-term, usually in or near the fields where the manure will be applied, and may change location from year to year with a crop rotation.

However, precautions need to be taken to reduce environmental risks. Field storage is not meant to replace a storage facility. In some cases, particularly when there are few suitable field locations for storage or if the manure is nutrient-rich (e.g., poultry manure), it makes more sense to have a permanent storage structure to more easily manage risks to the environment and to comply with the *Code of Practice for Agricultural Environmental Management*.

According to the *Code of Practice for Agricultural Environmental Management*, field stored materials must be utilized within 7 months of when storage begins. If the by-products cannot be used within the timeframe, move the by-products to a suitable permanent storage facility.

For field storage of solid manure, follow the requirements of the *Code of Practice for Agricultural Environmental Management* and read the following factsheet for a description of risk factors, rationale, and beneficial management practices:

- Health of our Air: Toward sustainable agriculture in Canada
- Health of our Soil: Toward sustainable agriculture in Canada
- Health of our Water: Toward sustainable agriculture in Canada

The beneficial management practices include the following:

- Cover the pile with a rain-shedding tarp, anchored against wind removal. The tarp also provides a barrier between the material and wind or wildlife.
- Consider adding materials such as wood shavings or bedding to increase the amount of water that the pile will absorb, if the pile is not covered.
- Consider importing materials for field storage that are lower in nitrogen and phosphorus content if they are available.
- Plan to use the material as quickly as possible after the pile is established.
- Move the pile from year to year between suitable locations, especially if the material is nutrient-rich (e.g., poultry litter).
- Increase the distance that runoff must travel to reach receiving waters.
- Avoid field storage on soils with rapid infiltration rates and high permeability.
- Try to stay at least 3 m (10 ft, horizontally) from sites with bedrock within 0.9 m (3 ft) of the surface. The risk is high if the bedrock is within 0.3 m (1 ft) of the site.
- On sites with poorly drained soil, place piles on relatively flat land (i.e. less than 3% slope) if overland flow of water from the storage site will enter a watercourse. Alternatively, locate on a graded site to intentionally divert contaminated runoff for collection (in a liquid storage facility).
- Floodplain maps can be found online, such as:

  Floodplain Maps by Region
- The *Code of Practice for Agricultural Environmental Management* refers to requirements to cover a field-stored manure pile from October 1 to April 1 in a high-precipitation area. See **Appendix B** for a description of these areas.
- The *Code of Practice for Agricultural Environmental Management* also requires that field-stored manure piles must not be located over a specific subset of "coarse-textured soils" in vulnerable aquifer recharge areas. **Chapter 8**, provides guidance to help determine if a location is over such soils, and the guidance can be used with soil maps that can be accessed using the Soil Information Finder Tool.

  SIFT: Soil Information Finder Tool

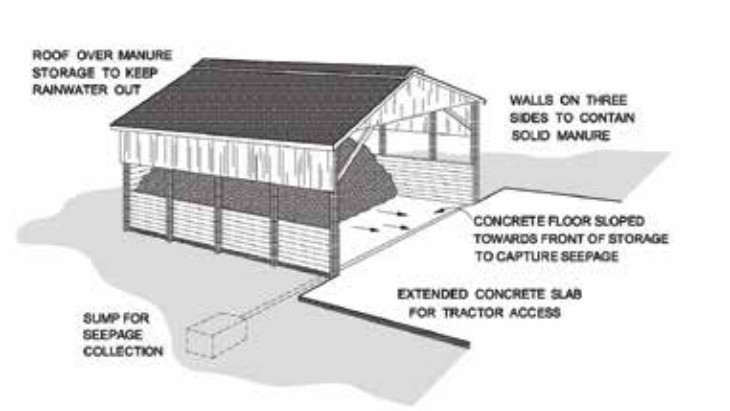
  Nutrient Losses to Soil from Field Storage of Solid Poultry Manure

Semi-Solid Manure Storage

Semi-solid manure has less than 18% solids by mass, but does not flow freely as liquid manure. In addition, the practices described in Manure Storage, implement all of the following practices:

- Construct reinforced concrete walls or adequately strong wooden walls along at least three sides, to contain manure.
- Construct concrete floor sealed at the walls to provide manure tight storage and prevent the entrance of groundwater or runoff.
- In areas with high water table, construct entirely above ground to minimize inward seepage of groundwater.
- Construct an adequate roof to keep out rain and snow particularly in areas with high annual or seasonal precipitation (unless extra size is less expensive than the roof or extra dilution is of value).
- In drier interior regions, an uncovered storage structure may be suitable.
- In high rainfall climates, construct a sump to collect and store the contaminated leachate for future land spreading.
- If roofed or enclosed, have ventilation to prevent any accumulation of hazardous gases and to aid in the drying of wastes.
- Construct access doors or bulkheads of tight fitted tongue-and-groove pressure treated timbers and collect any seepage.
- Have a system to detect leaks.
- Construct a suitable concrete slab area for tractor and manure spreader activity, sloped away from the building so that water on the slab does not enter the storage area.
- If runoff becomes contaminated.
  ➔ see Runoff, **page 9-51**

For High Rainfall Areas



For Low Rainfall Areas

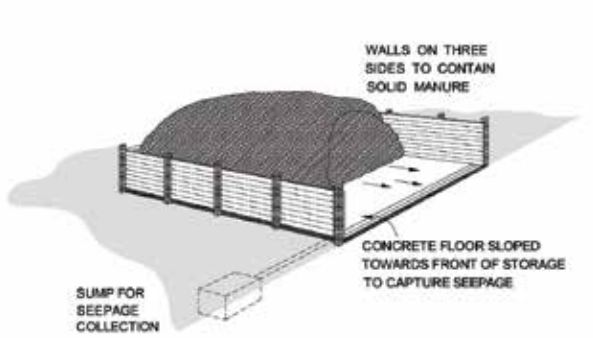


FIGURE 3.6 Typical Solid Manure Storage Facilities

Liquid Manure Storage

Liquid manure storage structures are used for containing liquid wastes such as manure or contaminated water. Liquid manure storages must have a minimum freeboard of 30 cm at all times, for all individual structures.

Modified or new liquid manure storages that are located in vulnerable aquifer recharge areas are required to be designed by qualified professionals who are able to take aquifer protection into consideration of the design, and subsequently built it to the design. Each new or modified liquid manure storage must either have a vertical distance of at least 1 m from the bottom of the protective base to the water table, or a leak detection system in place to demonstrate that the structure is not leaking.

In addition to the practices described in Manure Storage, implement the following practices:

- Construct of sulphate-resistant concrete with a compressive strength of 20 MPa or greater (suggested), plastic, glass-lined metal, etc.
- If very large, construct cross walls and/or baffles to facilitate agitation.
- If constructed entirely or partially above grade:
  - Ensure valves close tightly and install backup valves;
  - Install a manure level indicator that is readable from the ground.
- If constructed entirely below grade and covered:
  - Install childproof access ports weighting 20 kg or more (suggested);
  - Divert clean runoff away from the tank.
- Have a system to detect leaks.
- Install an auto shut off for manure transfer tanks.
- Have secondary containment.
- Limit uncovered surface area to reduce odour and fly problems.
- A system that collects and stores winter precipitation that could be added into the manure storage in the drier months would decrease overall environmental risks and increase opportunities to use manure beneficially.

  Report on an Efficient Liquid Manure Application Study

Earthen Storage Basins. As of February 28, 2019, additional requirements came into effect for earthen storage basins in vulnerable aquifer recharge areas that began to store liquid manure prior to February 28, 2019.

All existing storage basins in a vulnerable aquifer recharge area are required to have a qualified professional assess the basin for leaks prior to February 28, 2021, and assessed at least every 5 years thereafter. If it is determined that the basin is leaking, a protective base must be installed as soon as possible. Regardless if a basin is leaking or not, a protective base must be installed by February 28, 2029.

Manure Storage Sizing

Size a storage facility to allow all manure generated on the farm to be used as a fertilizer with little chance of causing pollution. Note that manure storage sizing assumes the facility will be empty, or near empty, at the start of the no-spread season.

Estimating Daily Manure Volume. The average daily livestock waste volumes produced by livestock type or class may be obtained using the standard values listed in **Table 3.3.** More accurate estimates can be obtained by measuring actual manure volume produced.

Determining Storage Duration. Manure storage requirements vary depending on location of the farm. The *Code of Practice for Agricultural Environmental Management* stipulates that manure cannot be spread from November to January. While this dictates all farmers must have at least 3 months of storage, it is highly encouraged in high-precipitation areas that farmers have 6 months of storage due to the likelihood of unsuitable conditions for land application in the shoulder months. Other parts of BC may need 7 months (210 days) or more of storage. Variations within regions depend on crops grown and field accessibility factors such as soil type, soil temperature, and local rainfall. Storage requirements are reduced on farms where manure is spread on grasslands on well drained soils.

➔ see Appendix B.1, **page B-2**, for BC map showing recommended storage periods

Determining Manure Storage Size. Size storages using **Worksheet #2**, for liquid manure or **Worksheet #3**, for solid manure. Using the appropriate worksheet, follow the steps below:

- **STEP 1:** estimate daily manure volume.
- **STEP 2:** determine manure storage required.
- **STEP 3:** determine total storage required.
- To determine contaminated runoff to be collected for the duration of time that manure spreading is not possible, use **Worksheet #11.**
- Estimate the amount of other contaminants, such as silage leachate.
- **STEPS 4 and 5:** determine the effective depth and size of the storage facility.

Note that if a chosen width and depth does not give the preferred length, choose different width(s) and/or depth(s) until the calculated length is acceptable. For the same depth, a wider width will reduce the length; a narrower width will increase the length.

Sizing Dairy Manure Storage Facilities

TABLE 3.3	Average Daily Livestock Waste Production and Suggested Storage			Worksheets #2, #3	
Class of Animal		Waste Production Litres/day	Liquid[1] Manure Storage Litres/day	Solid Manure Storage [2]	
				Solid [3] Litres/day	Liquid Leachate Litres/day
Beef Cattle	Cows, including Calves (avg. 590 kg)			34.0	
	Backgrounding to Grass (180-270 kg)			12.7	
	Backgrounding to Feedlot (180-385 kg)			15.0	
	Finishing – Yearling (385-630 kg)			28.3	
	Finishing – Feeders (250-565 kg)			21.5	
	Finishing – Short Keep (405-590 kg)			28.3	
Dairy Cattle	Dairy Calves (0 to 3 months old)	6	6		
	Dairy Calves (3 to 6 months old)	8	11		
	Heifers (6 to 15 months old)	16	22	19	4
	Heifers (15 to 26 months old)	24	35	25	7
	Dairy Cow – free stall (avg. 640 kg)	60	75	63	12
	Dairy Cow – tie stall (avg. 640 kg)	60	67	65	10
	Dairy Cow – loose housing (avg. 640 kg)	60		75	
	Milk centre wastes per milking cow	22 to 45 [4]			
Ducks	(avg. 1.4 kg)	0.15			
Goats	(avg. 64 kg)	2.6			
Horse	(avg. 450 kg)	26.1		56.6	
Poultry Eggs	Pullets – cage housing	0.039		0.039	
	Pullets – floor housing	0.039		0.059	
	Layer	0.13		0.13	
	Broiler Breeder Layer – cage housing	0.14		0.14	
	Broiler Breeder Layer – floor housing	0.14		0.18	
Poultry Meat	Broiler Breeder Pullets	0.049		0.077	
	Broiler Chicken	0.054		0.096	
	Roaster Chicken	0.057		0.090	
	Turkey Broiler	0.20		0.29	
	Turkey Heavy Hen	0.29		0.41	
	Turkey Heavy Tom	0.33		0.47	

Rabbits	Doe and Litter	0.71			
Sheep	Ewe or Ram	2.8	6.8	4.2	
Hogs	Dry Sow, Boar or Gilts	11.3	15.8	13.6	
	Nursing Sow and Litter	16.8	23.5		
	Nursery Pigs (5 to 20 kg)	1.8	2.5		
	Grower Pigs (20 to 60 kg)	4.5	6.3		
	Finisher Pigs (60 to 100 kg)	8.6	12.0		
	Grower Finisher Pigs (20 to 100 kg)	7.2	10.1	10.1	
Veal	(avg. 91 kg)	5.6			
Alpaca/ Llamas	Average 130lbs	2.5			

1 Liquid manure production includes typical spilled drinking water and wash water.
2 Some solid manure storages will have a liquid leachate which must be stored separately.
3 Including bedding.
4 This is a typical range – less milking centre waste is produced per cow for large milking herds compared to small herds.

WORKSHEET #2
Sizing Liquid Manure Storage

Workbook Question 138

Question: **What size of liquid manure storage is required for this livestock operation?**

Information:

Desired storage duration (identify site) (Table B.1*)	Enderby	180	1	days
Precipitation on the site from Oct 1 to April 30 (refer to Table B.1*)		0.456	2	m
Storage depth		3	3	m
Storage width		20	4	m
Check if storage is roofed: ☐		No		
Runoff to be stored from roofs and confinement yards - from Worksheet 11		512	5	m^3
Other liquid wastes to be stored		35	6	m^3

Calculation:

Step 1 **Establish daily manure volume**

EQUATION: Daily Manure Production for type and Class of Class of Livestock

Number of Animals x Animals Daily Manure Production Rate = Daily Manure Production for type and Class of Class of Livestock

Class of Animal	7 Average Number on Farm		8 Liquid Manure Storage litres/day/animal		9 Total Storage Required litres/day
DAIRY – CALVES (0–3 months old)	10	x	6	=	60
DAIRY – CALVES (3–6 months old)	10	x	11	=	110
DAIRY – HEIFERS (6–15 months old)	28	x	22	=	616
DAIRY – HEIFERS 15–26 months old)	33	x	35	=	1155
DAIRY – COWS, free stall(avg. 640kg)	20	x	75	=	1500
DAIRY – COWS, free stall(avg. 640kg)	100	x	75	=	7500
DAIRY – milk center wastes/milking cow	100	x	30	=	3000
		x		=	

Farm Daily Manure Volume

EQUATION: Farm Daily Manure Production

Sum of the Daily Manure Production For Each Livestock Type or Class = Farm Daily Manure Production

	13941	10	litres/day
Converted to m^3	13.9	11	m^3/day

Step 2 **Determine manure storage required**

EQUATION: Manure Storage Required

Farm Daily Manure Production x Days of Storage Required = Manure Storage Required

13.94 (11) m^3/day x 180 (1) days = 2509.38 (12) m^3

Step 3 **Determine total storage required**

EQUATION: Total Storage Required

Manure Storage Required + Contaminated runoff (liquid storage only) + Other liquid wastets = Total Storage Required

2509 (12) m^3 + 512 (5) m^3 + 35 (6) m^3 = 3056.38 (13) m^3

Step 4 **Determine effective storage facility for rectangular tanks**
NOTE: If calculated length is unsuitable, choose different width or depth until size is suitable

EQUATION: Effective Storage Depth

Storage depth	-	Precipitation at the site (0 if roofed)	-	Safety freeboard (normally 0.2 m)	=	Effective Storage Depth
3 [3] m	-	0.456 [2] m	-	0.2 m	=	2.3 [14] m

EQUATION: Storage Length

Total storage required	÷	Effective Depth of Storage	÷	Storage Width	=	Storage length
3056 [13] m^3	÷	2.3 [14] m	÷	20 [4] m	=	65.2 [16] ft^2

Answer: An uncovered manure storage facility for this farm should be 3.0 m deep by 20.0 m wide and 65.0 long to hold precipitation that falls directly into the storage and 3,056 m^3 of waste.

WORKSHEET #3
Sizing Solid Manure Storage

Workbook Question 138

Question: **What size of solid manure storage is required for livestock operation?**

Information:

Desired storage duration (indicate site, see Table B.1*)	Abbotsford	180	1	days
Storage Depth		3	2	m
Storage Width		20	3	m
Other solid wastes to be stored		0	4	m^3

Calculation:

Step 1 **Establish Daily Manure Volume**

EQUATION: Daily Manure Production for type and Class of Class of Livestock

Number of Animals x Animals Daily Manure Production Rate = Daily Manure Production for type and Class of Class of Livestock

Class of Animal	5 Average Number on Farm		6 Solid Manure Storage litres/day/animal		7 Total Storage Required litres/day
Eggs – Layer	50000	x	0.13	=	6500
Eggs – pullets – floor housing	25000	x	0.059	=	1475
		x		=	
		x		=	

Farm Daily Manure Volume

EQUATION: Farm Daily Manure Production

Sum of the Daily Manure Production For Each Livestock Type or Class = Farm Daily Manure Production

Farm daily manure volume	7975	8	litre/day
Converted to m^3	8.0	9	m^3/day

Step 2 **Determine Daily Manure Storage**

EQUATION: Manure Storage Required

Farm Daily Manure Volume x Days of Storage Required = Manure Storage Required

8.0 (9) m^3/day x 180 (1) days = 1435.5 (10) m^3

Step 3 **Determine Total Storage Required**

EQUATION: Total Storage Required

Manure Storage Required + Other Solid Wastes = Total Storage Required

1435.5 (10) m^3 + 0.0 (4) m^3 = 1435.5 (11) m^3

Step 4 **Determine effective storage facility for rectangular tanks**
NOTE: If calculated length is unsuitable, choose different width or depth until size is suitable

EQUATION: Effective Storage Depth

Storage depth - Safety freeboard (normally 0.2m) = Effective Storage Depth

3.0 (2) m - 0.2 m = 2.8 (12) m

EQUATION: Storage Length

Total Storage Required ÷ Effective Depth of Storage ÷ Storage Width = Storage Length

1435.5 (11) m^3 ÷ 2.8 (12) m ÷ 20.0 (3) m = 25.6 (13) m

Answer: An uncovered manure storage facility for this farm should be 3.0 m deep by 20.0 m wide and 25.6 m long to hold 1,436 m^3 of waste. Note: an uncovered solid manure storage is not recommended do to risk of spontaneous combustion. Also precipatation falling in this manure storage facility would generate contaminated runoff that would need to be collected and handled as a liquid waste. A roof on the storage facility to exclude precipitation is recommended.

Manure Gas Emissions Reduction

Carefully plan and manage the handling, composting, spreading or storage of all wastes to avoid the creation of gas emissions and nuisance conditions.

Implement the following practices to minimize the release of emissions from manure:

- Choose manure storage options that will reduce the release of emissions, such as:
  - Using dry rather than wet storage methods when there is the option;
  - Use enclosed storages that reduce air movement across the surface of manure storage.
- Minimize the handling and agitation of manure during storage.
- Minimize amount of bedding in manure, such as straw or woodchips.
- Keep storage tanks cool by either insulating or placing below ground.
- For liquid manures, separate urine and feces immediately upon excretion to reduce ammonia emissions.
- Dewater manure before storage to reduce N_2O emissions.
- Do not wet or re-wet solid manure to avoid N_2O emissions.
- Incorporate vegetative buffers around manure storage facilities.

➔ see Buffers, **page 11-4**

- Use methane collection and utilization techniques such as anaerobic digestion.

➔ see Climate Change Mitigation Beneficial Management Practices, **page 12-9**

Farm Practices - Manure Storage and Use

Covered Storage. Cover storages, particularly for liquid manure, to reduce gaseous emissions that are air contaminants and can lead to odours. Liquid systems can also be covered with permeable covers, such as mineral oil, straw or peat on tanks or lagoons. A secondary but major benefit in covering storages for all types of waste is that snow and rain are excluded, thereby reducing the amount of material needed to be both handled and stored. In addition, covers keep solid manure dry, which is necessary to prevent anaerobic conditions from occurring and to reduce the risk of leachate generation.

To reduce emissions from covered storage, use the following as guidelines:

- For solid manure storages install an impermeable cover, impermeable base, and run-off control.
- For tanks and lagoons for liquid manure storage, install either an impermeable or permeable cover.
- Install an air-inflated fabric roof system or floating cover on an open tank.
- Use bottom loading tanks for liquid manure storage to minimize aeration.

Caution should be taken and safety considerations must be given when covering manure. Hydrogen sulfide (H_2S) and methyl groups (CH_3) can form when manure is covered.

Confined Space Safety in BC Agriculture: A resource guide

Ammonia Emissions and Safety

Safe Work Practices for Dairy Farmers in BC

Table 3.4 shows effectiveness of manure cover options in reducing emissions for various air contaminants.

TABLE 3.4 Efficacy of Covered Manure Storage Options for Emission Reduction

Cover	Type	Effectiveness (%)				
		Odour	H_2S	NH_3	Life Expectancy	Relative Capital Cost (1 = most expensive)
	Inflatable plastic	95	95	95	10 years	1
	Floating plastic	95	95	95	10 years	2
	Natural crust	10 – 90**	10 – 90**	10 – 90**	2 to 4 months	5
	Straw	40 - 90	80 - 95	25 - 85	Up to 6 months	4
	Geotextile (non-woven, 6.35 mm thick)	15 - 75	0 - 100	25 - 50	3 - 5 years	3

Adapted from University of Kentucky, College of Agriculture, Using Covers to Minimize Odor and Gas Emissions from Manure Storages, José R. Bicudo, David R. Schmidt, and Larry D. Jacobson

**depends on thickness and other physical characteristics of the natural crust.

Nutrition and Ration Management. Nitrogen in manure and greenhouse gas emissions can be controlled through nutrition and ration management by formulating diets as close as possible to the requirements of the animal. For optimal growth, animals are often overfed crude proteins to meet the intake levels needed of valuable amino acids. In this case, other amino acids are supplied in excess and excreted in urine as ammonia or in manure as undigested protein. Controlling the amount of nitrogen uptake, particularly in non-ruminants, including poultry and swine, can significantly reduce nitrogen losses as ammonia, during land application or as N_2O emissions from wet soil. This can be done by:

- Reducing protein in diets and formulating diets closer to the animals needs.
- Feed less frequently and use phase feeding to match nutritional needs to sex, age and stage of production.
- Chop, grind, pellet or use concentrates to improve the digestibility of feed.
- Supplementing diets with synthetic amino acids to allow the dietary protein (nitrogen component) to be minimized.
- Have a nutrition analysis done on your feeding practices.

  Feeding strategies to lower nitrogen and phosphorus levels in manure

Anaerobic Digestion. The decomposition of manure in the absence of oxygen, known as anaerobic decomposition, results in the release of many odorous and often dangerous gases, including ammonia, hydrogen sulphide, and methane, a greenhouse gas contributing to climate change. Gas release is increased when manure is disturbed or spread. Anaerobic conditions occur within one hour when wet manure is stored in piles or as little as 15 minutes when liquid manure is stored in tanks. Manure odours from solid manure can be minimized by:

- Keeping manure sufficiently dry to allow air movement and aerobic conditions through the pile to occur.
- Using appropriate manure timing and application techniques:
  - Anaerobic digestion is a natural process in which bacteria break down carbon rich material in the absence of oxygen. This process, popularly called the "biogas process", generates a mixture of methane and carbon dioxide - the biogas. On-farm biogas production facilities typically utilize manure as the main substrate, but other materials such as food processing waste and crop residues can be added to increase biogas production. Anaerobic digestion technology is commonly employed as an integrated part of farming in Europe, the USA, and Asia.
  - Due to the relative low cost of electricity and natural gas, scrubbing and injecting biogas into the pipeline is typically the best option on an economic basis.
  - A manure management plan must be in place in order for a farm operator to use anaerobic digestion practices.

    On-Farm Biogas Development Handbook: For Farmers in British Columbia

Manure Treatment

Manure management refers to capture, storage, treatment, and utilization of animal manures in an environmentally sustainable manner. Manure treatment practices can be used to separate the solid and liquid components or to reduce the amount of moisture in a solid manure. The treatment allows the manure to be more readily used as a farm resource.

Manure Management website

Solid Liquid Separation. Solid/liquid manure separation, or de-watering, involves the partial removal of solids from liquid manure (slurry). The process converts the initial slurry manure product into two streams: solids and liquids. Solid/liquid manure separation is generally conducted using a gravity system or mechanical separation system. The gravity separation system involves the use of settling basins where solids settle to the bottom and the liquid portion remains at the top and is pumped out to a separate tank for storage or application. The mechanical separation system uses some form of mechanical process to separate liquids from solids. A variety of systems are available on the market such as vibrating screens, roller systems, rotary centrifuges, and screw presses. The appropriate type of mechanical separation system will depend on the specifics of the manure and farm in question. With all types of mechanical separation systems, the solid component is separated from the liquid component and the streams are stored separately.

The possible advantages of Solid/Liquid Separation Equipment include:

- Liquid stream of solid/liquid manure separation is less likely to plug transfer pipes and requires less power to pump;
- Solid component of solid/liquid manure separation is more cost effective to transport due to lower moisture content;
- Liquid component is easier to apply/irrigate due to reduced viscosity;
- Liquid component requires less agitation time relative to untreated slurry;
- The odours associated with separated liquids and solids is reduced compared to unprocessed slurry; and
- N:P ratios of the solid and liquid components are different (solid component has higher P while liquid component has higher N). Thus, the separation allows for more accurate application of nutrients based on the needs of each field. (Only applicable to centrifuges from the list above).

The possible disadvantages of Solid/Liquid Separation equipment include:

- High initial cost associated with implementation;
- Ongoing maintenance costs;
- The system results in two waste streams and farms may not be set up to manage two streams of manure;
- Solid/liquid manure separation adds an additional step to the manure management system, which requires attention; and
- The system may require modification to existing facilities such as the construction of new buildings to house the equipment or new electrical systems.

The solid component can have a variety of uses:

- Land application;
- Green bedding (i.e., not-composted bedding);
- Soil amendments; or
- Solids can be composted for use or sale.

Alternative uses for the liquid component include:

- Use in in-barn flushing systems; or
- A source of irrigation water.

Risks of Using Recycled Drywall for Animal Bedding. Recycled drywall is made mostly of gypsum that reacts with organic matter and water (including liquid manure) to produce hydrogen sulfide (H_2S) and other gases that can be harmful. Older drywall materials might also contain foreign substances such as fire retardants, metals, and asbestos. Regardless of whether the use of drywall or gypsum is permitted, there are serious risks of using it in manure handling systems that are wet or anaerobic.

Manure Treatment for Odours. In situations where well-managed manure storages or field spreading practices are not enough to control odours, manure treatment options can be considered. These could include:

- Aerobic treatment and carbon reduction for liquid manure systems.
- Composting for solid manure.
- Using additives to manure or bedding for odour reduction.
- Using emission and odour control technology on housing or storage facilities, such as scrubbers or electrostatic precipitators.

Manure Additives. Ammonia emissions can be controlled by using additives when moving manure farm yards, feedlots manure piles or when applying manure to land. Additives to control ammonia emissions function by binding ammonia, by inhibiting the enzyme that breaks urea down to ammonia, or a pH balancing. Additives can be incorporated in manure slurries, manure piles or in livestock holding areas.

- Use manure additives to reduce ammonia from liquid or dry manure.
- Additives to inhibit nitrous oxide emissions are available, but are cost-prohibitive for most operations.
  - Manure additives are effective for the following systems:
    - Storage slurry, storage dry pile or onsite in livestock holding areas.

Manure Uses

Manure produced on the farm can be used on-farm, by other farmers, or by the public.

Land Application. The best current option for manure disposal is in its application to crops as a fertilizer to provide nutrients or to improve soil conditions.

➔ see **Chapter 6**, Nutrient Application

Manure Injection. Injection of manure directly into the soil can be used to minimze emissions and maximize nutrient potential.

Currently there are five Efficient Liquid Manure Application (EMA) technologies available to BC producers and custom applicators. They consist of:

- Aeration system (Aerway),
- Trailing hose,
- Trailing shoe,
- Shallow injection,
- Deep injection,
- Or immediate incorporation by the producer

➔ see **Chapter 6**, Nutrient Application

Efficient Liquid Manure Application Systems

Nutrient Recovery. Nutrient recovery is a process that enables the removal and concentration of nutrient by-products from agricultural manures or anaerobic digestate (the output from anaerobic digesters) (**Figure 3.7**). Nutrient recovery technologies (NRTs) can facilitate improved nutrient management on agricultural operations with excess nutrients. NRTs produce a concentrated nutrient by-product that may more easily be transported off-farm and/or potentially transformed into a commercially saleable nutrient product.

Nutrient recovery efforts can help to meet nutrient management plan goals.

Evaluation of Nutrient Recovery Technologies

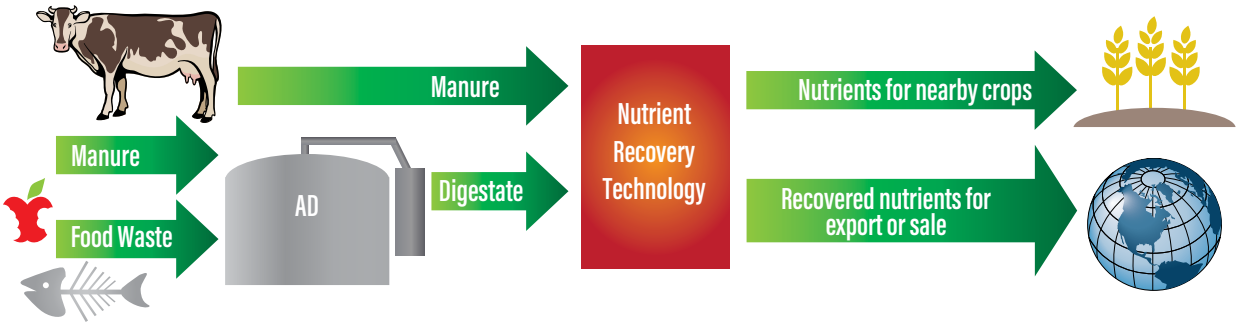


FIGURE 3.7 Nutrient recovery process on the farm (Source: Hallbar Consulting, 2016).

Compost. On-farm manure can be composted and then used on the farm or sold off the farm. Sections 39 – 43 of the *Code of Practice for Agricultural Environmental Management* specifies composting conditions. If a producer wants to take in manure from other farms to compost and then market the compost off the farm, approvals from ENV and the Provincial Agricultural Land Commission are required.

➔ see Compost, **page 2-44**

On-farm Composting in British Columbia: a Step -by-Step Guide for small to Medium-sized Farm Operations

Soilless Media Production. Untreated manure can be used along with other materials such as sand or sawdust to create a suitable media for landscaping or nurseries. However, in most cases composted manure is the preferred choice. Separated solids, or solids with finely chopped bedding, can also be used.

Refeeding. Recycling of some types of manure to livestock as a feed ingredient is permitted under the federal *Feeds Act*. Agriculture and Agri-Food Canada requires the registration of all feed ingredients and their sources. Because consumer opinion towards refeeding is generally adverse, it is recommended that this practice not be implemented for livestock feeds in BC.

Bedding Recovery. Bedding Recovery Systems take the manure from a dairy operation and convert a portion of it into bedding material for cows through a composting process. A bedding recovery system is a two-step process:

STEP 1. Liquid/slurry manure is separated into solid and liquid streams using a solid/liquid manure separator, such as a screw press (Figure 1). The purpose is to reduce the separated solid component to approximately 65% to 68% moisture content. Solids can be separated from manure as well as anaerobic digestate.

STEP 2. The separated solids are fed into a drum that rotates and draws in fresh air to feed the aerobic bacteria creating ideal conditions for composting. The composting solids can reach temperatures of 65 to 70 degrees Celsius, which kills most pathogens in the manure. The solid material will remain in the drum for between one and three days. When the composting process is complete, the solids are ready to be used as livestock bedding. It is recommended that the bedding is to be used fresh. If the bedding is stored for two or three days, it may begin to compost again.

The possible advantages of Bedding Recovery Systems include:

- Producers may realize savings related to reduced bedding expenses;
- Bedding recovery systems ensure producers have a reliable source of bedding;
- Producers can realize additional revenue;
  - Producers may process other dairy farms' manure for bedding either for a fee or for use on their farm;
  - Producers may sell excess bedding to other farms; or
  - Producers may sell composted materials as soil amendments or fertilizer;
- Some aspects of animal health, such as hock sores, abrasions and mastitis, may improve with the use of manure bedding.

The possible disadvantages of Bedding Recovery Systems include but are not limited to:

- Bedding can reheat if stored for too long prior to use, leading to new bacterial growth which in turn could increase environmental mastitis, therefore bedding should be used when fresh;
- Potential for higher disease incidence when used for calves, in sick pens or maternity pens; and
- Initial investment costs and ongoing operating costs.

Manure Spills

Develop a contingency plan when storing any amount of manure. The plan should outline a timely and effective response to any emergencies involving the release of manure products into the environment from:

- Accidental spills, such as when transporting, storing, applying or dispensing;
- Equipment failures;
- Release due to building fires or vandalism;
- Release due to natural events, such as forest fires, floods, or earthquakes.

Contingency Plan

Emergency Plan Template for Farms

Emergency Management Plan for Small BC Farms

REPORTING REQUIREMENT

Under the ***Spill Reporting Regulation***, manure spills greater than 200 kg or 200 litres must be reported immediately to the Provincial Emergency Program (PEP) at 1-800-663-3456 (24hr service).

Manure Contingency Plan

Develop a contingency plan when storing any amount of manure. The plan should outline a timely and effective response to any emergencies involving the release of manure products into the environment from:

- Accidental spills, such as when transporting, storing, applying or dispensing;
- Equipment failures;
- Release due to building fires or vandalism;
- Release due to natural events, such as forest fires, floods, or earthquakes.

Contingency Plan

MORTALITY DISPOSAL

MORTALITY DISPOSAL ENVIRONMENTAL CONCERNS

Primary environmental concerns related to dead animal disposal are:

- Death of livestock due to disease that results in disease spread;
- Holding or burial sites that result in surface or groundwater or air pollution;
- Flies or rodents that results in a nuisance and disease transfer to people, livestock or wildlife;
- Attraction of predators to the site that may be undesirable for wildlife;
- Decomposition of buried livestock releases methane, a powerful greenhouse gas contributing to climate change.

For information on these concerns:

➔ see Water Quality and Quantity Factors, **page 9-1**, and refer to Contaminants, and to Oxygen Demand

➔ see Air Quality Factors, **page 10-1**, and refer to Odours

➔ see Impacts on Biodiversity and Habitat, **page 7-9**, and refer to Farm Activities and Impacts

MORTALITY DISPOSAL LEGISLATION

The following is a brief outline of the main legislation that applies to mortality disposal.

➔ see **page A-1** for a summary of these and other Acts and Regulations

Drinking Water Protection Act

This Act and Regulations have requirements regarding the protection of drinking water quality and regulate domestic water systems (those serving **more** than one single-family residence).

- SECTION 23(1): subject to subsection (3), a person must not (a) introduce anything or cause or allow anything to be introduced into a domestic water system, a drinking water source, a well recharge zone or an area adjacent to a drinking water source, or (b) do or cause any other thing to be done or to occur if this will result or is likely to result in a drinking water health hazard in relation to a domestic water system

Forest and Range Practices Act

This Act has conditions under the *Range Planning and Practices Regulations*:

- SECTION 35: requires dead livestock within 100 m of a watercourse in a community watershed be removed as soon as the holder becomes aware of the dead livestock

Environmental Management Act

The *Code of Practice for Agricultural Environmental Management* makes provisions for on-farm mortality disposal through composting, burial and incineration provided that the disposal activities are carried out on the farm where the animal died.

- SECTION 17: The required setbacks for various mortality disposal methods are as follows:
  - Composting in a permanent structure: 30 m from drinking water, 15 m from watercourses, and 4.5 m from property boundaries.
  - Composting in an outdoor pile: 30 m from both drinking water and watercourses, and 4.5 m from property boundaries.
  - Incineration: 15 m from both drinking water and watercourses, and 4.5 m from property boundaries.
- SECTION 67(1): A person may dispose of mortalities that died on their land through burial, incineration or composting.
- SECTION 67(2): A person may only dispose of mortalities that died on the person's agricultural land base.
- SECTION 67(3): A person may dispose of processing waste only if it comes from livestock or poultry that were reared, kept or slaughtered on the person's agricultural land base.
- SECTION 67(4): A person must not dispose more than 5 tonnes of livestock processing waste or 1.5 tonnes or more of poultry, determined on a live weight basis.
- SECTION 68: People who dispose of mortalities on their land base must ensure:
  - Mortalities do not enter a watercourse, but if this occurs, the owner must immediately remove said mortality.
  - Processing waste does not enter a watercourse.
  - Odours, particulate matter and vector attraction is minimized.
- SECTION 69: Mortalities must be stored in a manner that prevents putrefaction and the escape of leachate, whereas processing waste must be stored in a completely enclosed structure on the agricultural land base from which processing waste and leachate cannot escape
- SECTION 70: Mortalities may be transported in containers in which the mortalities and leachate cannot escape
- SECTION 71: A person who disposes of mortalities through composting must ensure:
  - Composting occurs in a permanent structure or outdoor agricultural composting pile.
  - Leachate and solids do not enter a watercourse, cross a property boundary or go below the water table.
  - Air contaminants do not cross a property boundary.
  - Vectors, wildlife and domestic pets are deterred from the composting pile.
  - Mortalities and processing waste are completely decomposed before application to land.
  - Composted livestock mortalities are only applied to land on which the composting occurred.
  - A person must not dispose of more than 5 tonnes of mortalities in any 30-day period.
- SECTION 72: Outdoor composting piles must not be located in areas prone to seasonal flooding and that have standing water or saturated soils
  - The pile cannot be left for more than 15 months and another pile must not be erected in the same spot for 3 years.
- SECTION 73(2): A person who applies wastewater to land must ensure that the wastewater:
  - Contains no solid waste or visible tissue.
  - Is applied only on the agricultural land base on which the wastewater was generated.
  - Is not applied to land used to grow crops for human consumption or to graze domestic ruminants.
- SECTION 73(4): Compost containing specified risk material cannot be applied to land used to grow crops for human consumption or to graze domestic ruminants

- SECTION 74: A person who buries mortalities must ensure:
  - No more than 2.5 tonnes are buried in a single pit.
  - That burial pits are not located:
    - Within 60 m of each other.
    - In, over or in the vicinity of coarse-textured soil.
    - In standing water or on saturated soil.
    - In areas prone to seasonal flooding or within a 200-year flood plain.
  - The bottom of the pit is 1.5 m from the high water table.
  - That the burial pit is covered with at least 1 m of soil that is compacted and mounded.
  - Records must be kept of the pit location, type and amount of mortalities, and the date the pit was closed.
- SECTION 75: A person who incinerates mortalities must ensure that the incinerator is:
  - Designed and manufactured to incinerate mortalities.
  - Designed such that under standard conditions, an O_2 reference level of 11%, at 25°C and 101.3 kPa, does not exceed the following limits:
    - 180 mg/m^3 for an existing incinerator.
    - 175 mg/m^3 for new incinerators of capacities less than 181 kg.
    - 155 mg/m^3 for new incinerators of capacities 181 kg or more.
- SECTION 75(2): A person who incinerates mortalities must:
  - Visually assess the opacity of the emissions from the incinerator at least once every 12 hours and during every burn cycle.
  - Immediately take corrective action if opacity levels exceed 20% for existing and new incinerators with a chamber capacities less than 181 kg and 10% for new incinerators with a chamber capacity greater than 181 kg.
- SECTION 76: Records must be kept for the type and quantity of mortalities incinerated, the date of incineration, inspection and maintenance of the incinerator, opacity results, and if opacity limits were exceeded.

REPORTING REQUIREMENT

The ***Spill Reporting Regulation*** requires spills of a polluting substance (including mortalities) be reported immediately to Provincial Emergency Program (PEP) at 1-800-663-3456 (24 hour service). Report spills of mortalities greater than 200 kg or 200 litres or report any amount, if the mortality spill contains organisms that are reasonably believed to be infectious.

Public Health Act

Administered by the Ministry of Health, this Act has a specific prohibition that "a person must not willingly cause a health hazard, or act in a manner that the person knows, or ought to know, will cause a health hazard". This prohibition would apply to farm practices that may result in a health hazard, such as when nutrients, contaminants or pathogens are discharged to land, water or air so as to pose a public health problem. Any situation that entails a health hazard will enable health officers to investigate using their powers under the Act. Under the *Public Health Act*, the local Health Authority must investigate any health hazard and has authority to order that a person prevent or stop a health hazard, or mitigate the harm or prevent further harm from a health hazard amongst other powers. Similar regulatory provisions exist for addressing health hazards to drinking water supplies under the *Drinking Water Protection Act*.

- This Act prohibits activities that may cause a health hazard:
- SECTION 15: a person must not willingly cause a health hazard, or act in a manner that the person knows, or ought to know, will cause a health hazard.

The Act also has conditions under the *Health Hazards Regulation*:

SECTION 8 (1) A person who installs a well, or who controls a well installed on or after July 20, 1917, must ensure that the well is located at least 120 m from any cemetery or dumping ground, unless contamination of the well would be impossible because of the physical conformation.

(a) unless contamination of the well would be impossible because of the physical conformation, 120 m from any cemetery or dumping ground.

Wildlife Act

The provincial *Wildlife Act* protects wildlife designated under the Act from direct harm, except as allowed by regulation (e.g., hunting or trapping), or under permit. Legal designation as Endangered or Threatened under the Act increases the penalties for harming a species. The Act also enables the protection of habitat in a Critical Wildlife Management Area.

The Act makes it an offence to feed dangerous wildlife (e.g., bear, cougar, coyote, wolf). However exemptions are made for landowners to allow for the removal of nuisance pests that are not listed as endangered or threatened (e.g. raccoons, skunks).

- SECTION 33.1: makes it an offence to feed dangerous wildlife (bear, cougar, coyote or wolf) unless as approved hunting or trapping

Health of Animals Act

The Health of Animals Act enables regulatory control over Specified Risk Material (SRM), so that it does not enter the animal feed system. Regulations under this Act (enhanced feed ban) require that producers do not feed any animal products containing SRM to livestock and that abattoirs properly identify SRM to ensure that it is removed from the feed system. A permit from the Canadian Food Inspection Agency (CFIA) is required to handle, transport or dispose of cattle carcasses and certain cattle tissues if they are moved off of the farm of origin. Composting processes do not destroy SRM, therefore composted mortalities must be handled in accordance with CFIA regulations as the compost is still considered to contain SRM.

MORTALITY DISPOSAL BENEFICIAL MANAGEMENT PRACTICES

Comply with applicable mortality disposal related legislation, including the above, and where appropriate, implement the following beneficial management practices to protect the environment.

Livestock Mortality Disposal

Dispose of mortalities in a manner that protects surface and groundwater. For livestock of all classes and types implement the following practices:

- Remove dead animals from buildings and fields as soon as possible.
- Dead animals may be carriers of disease and, if not promptly removed, will attract wildlife, rodents and flies, and produce offensive odours.
- Dispose of dead animals in an approved manner within one day.
- Where this is not possible, freeze or store in a covered container for disposal at a more convenient time.
- Know the cause of death of an animal in order to select an appropriate disposal option as shown in **Table 3.5**.

Do not dispose of dead animals into manure pits or onto land during manure spreading operations. If experiencing excessive death losses, contact ENV immediately for acceptable site-specific mortality disposal options.

Off-Farm Disposal. The default for disposal of farm animals is to manage the disposal on the farm where the animal died. If off-farm disposal is needed it should be done at an authorized facility or through an authorized service provider. Options for off farm ruminant mortality disposal must meet the regulatory requirements of the Canadian Food Inspection Agency and ENV for the handling of specified risk materials (SRM).

On-Farm Mortality Disposal. By following the beneficial management practices referred to on the next page for on farm disposal of any livestock species, producers should not contravene the Canadian Food Inspection Agency and ENV regulatory requirements.

Secondary Users. In BC a few rendering plants or secondary user operations accept dead animals. For information regarding the closest operation, contact your respective livestock association. Dead animals should be stored in either airtight containers or freezers until they can be picked up by a rendering company or deadstock collection service provider. Deadstock collectors may only accept dead animals within 24 hours of their death.

Composting. Composting of smaller dead animals is commonly practised. Research has demonstrated the ability to safely compost larger livestock, if properly monitored. When composting mortalities, implement the following practices:

- Follow general composting guidelines

  ➔ see Compost, **page 2-48**
- Install moisture control options for compost piles. A roof is necessary in high precipitation areas to control moisture.
- Use absorbent materials for the compost base and cover mortalities with a minimum of 30 cm (suggested) of woodchips, litter or straw – top and sides
- Space layers of small dead animals with organic matter
- Larger animals may need to be cut into small pieces for efficient composting. Opening the hide and stomach chambers have shown to accelerate the decomposition
- Specified Risk Material regulatory requirements must be followed when composting bovine mortalities
- CFIA Specified Risk Material Transport Permit is required to move compost offsite.
- The following videos provide guidance and best practices for disposing of routine mortalities:

  Disposing of Routine Mortalities - Video.

TABLE 3.5 Mortality Disposal Options Based on Cause of Death

Cause of Death	← Most Preferred Method				Least Preferred Method →
	Rendering	Composting	Municipal or Private Refuse Site	Incineration	On-farm Burial
Disease 1 (withdrawal time of medication not met)	✓[2]	✓[2]	✓	✓	✓[3]
Disease 1 (no medication, or withdrawal time met)	✓	✓	✓	✓	✓[3]
Poisoning	X	X	✓	✓	✓[3]
Weather (hot or cold)	✓	✓	✓	✓	✓[3]
Flood, Earthquake, and Forest or Building Fire	✓	✓	✓	✓	✓[3]
Starvation	✓	✓	✓	✓	✓[3]

✓ means this disposal option is recommended, subject to any footnote
X means this disposal option is not recommended
[1] Depends on disease: check with veterinarian
[2] Depends on medication used: check with veterinarian
[3] On-farm burial only at suitable sites. ➔ see Livestock Mortality Disposal, page 3-30

Landfills. In some cases, approved landfills operated by municipalities, regional districts, or private owners are made available for the disposal of dead animals. Contact site managers prior to delivering carcasses. Take large animal mortalities to landfills within one day of death. Small animal mortalities, such as poultry, may be stored in a frozen state in airtight containers for as long as required prior to disposal.

Landfills must be permitted by the CFIA in order to be able to accept SRM.

Incineration. Farm mortalities or processing waste can be incinerated on the farm that the mortalities died or the preprocessing waste that was generated by the animals and poultry reared, kept and slaughter on the farm. Generally, a single-chamber two-burner incinerator, or equivalent, is required.

- Approximately half of all poultry farms in BC have onsite small scale incinerators as incineration is the best option for the small amount of waste produced by poultry operators (less then 5 tonnes of live weight livestock or 1.5 tonnes poultry). Currently, there are no incinerators on cattle, dairy and hog farms in BC. Similarly, no known incinerators are operating at slaughter houses and poultry processing facilities. Where dedicated incinerators are employed for small animal disposal, implement the following practices:
  - Locate the incinerator away from residential areas.
  - Always operate the incinerator according to manufacturers instructions.
  - Use best available technology to help meet the best emission standards possible.
  - When purchasing a new incinerator, choose one with a secondary burner to achieve optimal emission reductions.
  - Do not overload. Incinerators are legally require to burn at or below 50 kg per hour. Overloading creates inefficient combustion and emits high levels of particles, Volatile Organic Compounds (VOC), and CO gas.
  - Ensure that the burner and after-burner temperatures are operating at correct levels.
  - The use of after-burners is essential to minimize emissions of VOC, CO, and particulate. The burner and the after-burner should be both switched on for the full combustion cycle to ensure minimum pollutant emissions.
  - Regular de-ashing of the incinerator chamber is important and should be disposed of safely.

Burial. Consider burial pits for dead animals as the least preferred method for disposal. Contact ENV if considering on-farm burial. Decomposition of buried livestock can release methane, a powerful greenhouse gas contributing to climate change.

If burial pits are the only option, locate them at least 30 m from any source of water used for drinking water (*Code of Practice for Agricultural Environmental Management*), and 30 m from a well (*Health Hazards Regulation*). Burial sites must be at least 60 m apart from each other, unless each pit has not been used for 10 years. The pit must be covered immediately with 0.6 m of soil and covered with at least 1 m of compacted and mounded soil so as to minimize infiltration of precipitation, divert runoff away from the pit and deter vectors, wildlife and pets. Alternatives to on-farm burial will likely be necessary during the winter season in cold climates.

- Animal Disposal – On-Farm Burial Option
- Large Animal Disposal – On-Farm Composting Option

It is highly unlikely that on-farm sites suitable for burial are available within the Lower Mainland and other flood plains throughout BC.

Place no more than 2,500 kg of mortalities in a single burial pit. Locate only where the water table or bedrock is at least 1.5 m below pit bottom and where soil type is dense. Do not dig pits on floodplains or in low-lying areas prone to seepage.

Natural Disposal. The deliberate disposal of livestock mortalities by natural disposal is not permitted under Section 6(3) of the *Environmental Management Act*. For any mortalities that are known to have occurred on crown or private land the farmer or rancher must make every reasonable effort to recover and properly dispose of the mortality through accepted methods (see Table 3.5). It is an offence under the *Wildlife Act* to feed dangerous wildlife (bear, cougar, coyote and wolf).

Mass Mortality Contingency Plan

Develop a contingency plan for mass mortalities. The plan should provide a timely and effective response to any emergencies involving the unexpected impact to the environment, from:

- Unusually high numbers of mortalities resulting from disease, vandalism, loss of electrical power, severe weather events, etc.
- Accidental spills of livestock or livestock mortalities.
- Impacts due to building fires or natural events, such as forest fires, floods, or earthquakes.
- Impacts due to vandalism, such as poisonings.

Contingency Plan

Emergency Plan Template for Farms

Emergency Management Plan for Small BC Farms

CHAPTER 4 METRIC CONVERSIONS

Metric		Imperial Equivalent	
600	mm	24	inches
1	cm	0.4	inches
15	m	50	feet
30	m	100	feet

Conversions in this table are rounded to a convenient number.
See Appendix E for exact conversion factor.

Values from tables and examples are not included in Metric Conversions

CHAPTER 4 TABLE OF CONTENTS

CHAPTER 4

CROPS

INTRODUCTION

This chapter discusses crop management practices for protection of the environment. It contains introductory information on the relationship between crops and the environment. It also contains information on crop production environmental concerns, legislation and beneficial management practices related to

- Outdoor crops,
- Indoor and container nursery crops.

CROPS AND THE ENVIRONMENT

The primary role of agricultural crops is to provide a food source for humans and livestock. Other important categories include fibre, oil, ornamental, industrial and secondary crops. Environmental concepts related to crops are listed in alphabetical order below.

Buffers

Buffers on farms are generally defined as specially managed areas used to separate farm activities from sensitive areas that may be impacted by those activities. The objective of a buffer is to intercept and retain contaminants, preventing them from reaching a sensitive area or to deliver other agricultural or environmental benefits.

➔ see Buffers, **page 11-4**

Carbon Sequestration

Plants and soil organic matter play an important role in removing carbon dioxide from the air and storing (sequestering) it. Carbon is the main component in plant material and soil organic matter. Any uptake of carbon dioxide from the air by plant material or soil mitigates the effects of climate change. Following other beneficial practices recommendations for cropping can aid in carbon sequestration and help farming operations and help farming operations adapt to climate change by building the resiliency.

➔ see Climate Change, **page 12-1**

Cover Crops

Cover cropping and relay cropping are practices that can aid in the management of pests, nutrients and soil tilth. Such practices also benefit wildlife and provide additional forage yield. Cover crops are used to protect against soil erosion, to improve soil structure and soil fertility, to suppress some insect pests and weeds, and to promote higher populations of some beneficial insects. They accelerate the movement of rainwater into the soil and toward drainage systems, reducing the time free water remains on the field surface.

Cover crops include crops such as fall rye, barley or annual rye grass grown between plowdown and reseeding of perennial forage or hay crops or between plantings of annual crops.

Relay cropping is a form of cover cropping used by forage producers. It involves planting a second crop before the first crop is harvested. Relay cropping is practiced to reduce weed growth during the growing season, to provide an active crop available for fall manure application after corn is harvested, to protect soil from erosion, and to provide additional forage yield.

Optimizing crop uniformity and yield can assist in avoiding under-utilization of nutrients.

Flood Management

Most crops grown in B.C. are intolerant of flooding. Flooding depletes soils of oxygen and increases nitrogen losses. Flooding often leads to erosion or deposition of soil and sediments resulting in land loss or crop smothering, respectively. Flooding frequently results in higher levels of plant disease that reduce stands and yields. Soil remediation would likely be required after a flood, and crop production may be reduced for several years.

Grasses

Forage grasses offer a unique opportunity to producers for improved nutrient management and environmental protection. Healthy grass stands build soils with good tilth and help protect soil from erosion by wind and water by binding soil particles and covering the soil surface. If soil moisture conditions are appropriate, grass can take up significant amounts of nutrients.

The timing of forage harvest and the cutting height of the grass also play a critical role in the capture and filtration of runoff. Leaving longer plant stands late in the season near watercourses will help to filter suspended solids from runoff.

Integrated Pest Management

The use of Integrated Pest Management in crop cultivation enhances populations of beneficial organisms, such as native pollinators, predators, and parasitoids of crop pests. It is a decision-making process for managing pests in an effective, economical and environmentally sound way. Techniques used range from preventative and cultural measures to the use of biological, physical, behavioural and chemical controls.

Nutrient Cycle

Crops play an integral role in nutrient cycling. For example, some crops remove excess nutrients from the soil, some capture nutrients for soil recycling that would otherwise have been lost and others capture nitrogen from the air. The nutrient cycle provides valuable sources of food and energy to the soil biota (bacteria, fungi and insects), plants and animals.

Under certain soil and climatic conditions, crops can take up or transform nutrients in such a way that the plant tissue can be harmful to animals. For example, grasses will "luxury consume" potassium which can lead to grass tetany in dairy cattle. In addition, nitrate-nitrogen can accumulate in plant tissue and cause nitrate toxicity to livestock and wildlife.

Soil Erosion Control

Plant roots bind soil particles together by exerting pressure and releasing glue-like organic compounds, resulting in aggregates that are more resistant to soil erosion. Plants protect soil from the erosive impact of raindrops and wind as well as from the erosive effects of overland flow by reducing the velocity of water runoff.

Soil Structure

Good soil structure increases soil permeability, resulting in reduced runoff flow. The growth and decay of crop roots and organic residues enhance microbial activity and growth of soil microbes. Microbial activity improves soil structure and organic matter content.

Runoff Filtration

Standing crops, or crop residue attached to the soil, will decrease water velocities, resulting in fewer suspended solids and dissolved chemicals being carried by runoff water to watercourses. Crops and crop residue allow water to infiltrate the soil more rapidly than bare soil, as well as reduce runoff and erosion. An added benefit is that water is filtered by the soil and reduces pollution entering groundwater.

Wildlife Habitat

Crops can provide wildlife with feed and habitat. Some crops may be specifically planted as 'lure' or 'sacrifice' vegetation for migrating birds. In addition, shelterbelts or windbreaks may provide soil and water conservation benefits as well as habitat for beneficial birds or insects. Riparian plantings offer such benefits in addition to enhancing fish habitat and improving water quality.

➔ see Riparian Areas, **page 11-15**

OUTDOOR CROPS

This section discusses outdoor crop practices common to these crops:

- Berries,
- Bulbs,
- Christmas trees,
- Fiber,
- Field grown flowers and nursery stock,
- Field vegetables (including corn),
- Forage seeds,
- Forages,
- Ginseng,
- Grains and oilseeds,
- Grapes,
- Medicinal and herb,
- Nuts,
- Pastures,
- Tree fruits,
- Sod,
- Specialty crops.

➔ see Indoor Crops and Container Nurseries, **page 4-16**, for outdoor container nurseries

OUTDOOR CROP ENVIRONMENTAL CONCERNS

Primary environmental concerns related to outdoor crop management are:

- Poor crop establishment or harvesting annual crops that leave the soil bare for extended periods and results in soil erosion.
- Harvesting of crops that results in excessive soil removal.
- Leachate from stored crops (e.g., silage) that results in water pollution.
- Crop processing dust or crop residue burning that results in air pollution.
- movement of invasive plants, exotic pests or infected plant material that results in biodiversity impacts and/or threats to other crops.
- Conversion of land to agricultural production that results in loss of habitat and release of greenhouse gas to the atmosphere.
- Conversion or development of cropping areas that decrease the carbon storage capacity of the system through the loss of tree and shrub components.
- Non-point source pollution due to over-fertilization of soils and excess nutrients leaching to groundwater and surface water.

For detailed information on these concerns:

➔ see Impacts on Biodiversity and Habitat, **page 7-7**, and refer to Farm Activities and Impacts

➔ see Soil Quality Factors, **page 8-1**, refer to Compaction

➔ see Soil Loss by Harvest, **page 8-15**

➔ see Water Quality and Quantity Factors, **page 9-2**, refer to Contaminants

➔ see Air Contaminants, **page 10-1**, refer to Dust and Particulates and to Open Burning

➔ see Farm Activities and Impacts related to Climate Change, **page 12-5**, and refer to Land Clearing

OUTDOOR CROP LEGISLATION

The following is a brief outline of the main legislation that applies to outdoor crops.

➔ see **page A-1** for a summary of these and other Acts and Regulations

Agricultural Land Commission Act

The *Agricultural Land Commission (ALC) Act S.B.C. 2002, c. 36, and Agricultural Land Reserve (ALR) Regulations* are the legislative framework for the establishment, administration, and procedures of BC's agricultural land preservation program. The ALC Act takes precedence over, but does not replace other legislation and bylaws that may apply to the land. Local and regional governments, as well as other provincial agencies, are expected to plan in accordance with the provincial policy of preserving agricultural land.

The *ALR General Regulation, B.C. Reg. 171/2002*, identifies the procedures for submitting applications and notices of intent.

The *ALR Use Regulation, B.C. Reg. 30/2019* specifies land uses permitted in the ALR.

The policies of the Commission provide interpretation and clarification of the regulations; outline guidelines, strategies, rules or positions on various issues and provides clarification and courses of action consistently taken or adopted, formally or informally.

ALC Policies and Bylaws

Drinking Water Protection Act

This Act and Regulations have requirements regarding the protection of drinking water quality and regulate domestic water systems (those serving **more** than one single-family residence).

- SECTION 23(1): subject to subsection (3), a person must not (a) introduce anything or cause or allow anything to be introduced into a domestic water system, a drinking water source, a well recharge zone or an area adjacent to a drinking water source, or (b) do or cause any other thing to be done or to occur if this will result or is likely to result in a drinking water health hazard in relation to a domestic water system

Environmental Management Act

The *Open Burning Smoke Control Regulation* regulates the burning of waste materials in the treefruit and grape industries and relevant legislation.

The *Code of Agricultural Environmental Management* has specific requirements regarding the collection, storage, and use of agricultural by-products. Agricultural vegetative debris from crop production is considered an agricultural by-product under the AEM Code.

SECTION 30: solid agricultural by-products may be stored only in a permanent storage structure or as temporary field storage.

General storage requirements for agricultural by products in Section 34 require that:

- Any leachate generated during storage must be collected or contained until it can be used in applying nutrients to the land.
- Runoff must be diverted away from the storage structure or storage area.
- The storage structure or storage area must be maintained so as to prevent contaminated runoff, leachate, wastewater, and solids from escaping, and if they do they must not enter a watercourse, cross a property boundary, or go below the water table.
- Air contaminants from stored agricultural by-products must not cross a property boundary.
- Agricultural by-products must be stored in a manner that will deter the attaction of animals and vectors.

Plant Protection Act

Administered by AFF, this Act is the provincial counterpart to the federal *Plant Protection Act* that focuses on plant protection issues affecting Canada. It provides for the prevention of the spread of pests destructive to plants in BC. Inspectors have powers to enforce the provisions of the Act, including the authority to establish quarantine areas. To assist in the enforcement of the Act, the BC Plant Protection Advisory Council advises and co-ordinates the actions of provincial and federal officials to deal with potential hazards to BC agriculture and forestry from insects, plant diseases, weeds or other biotic agents. The Council's power comes from the mandates of the agencies whose members sit on committees struck to deal with plant protection issues in specific commodity sectors.

The purpose of this Act is to prevent the deleterious spreading of insects, pests, or diseases that are destructive to plants. Under this Act, inspectors may enter premises at any reasonable time for an inspection of the premises. They can order the treatment, confiscation, or destruction of plants. Regulations under this Act include:

- *Bacterial Ring Rot Regulation,*
- *Blueberry Maggot Control Regulation,*
- *Domestic Bacterial Ring Rot Regulation,*
- *Golden Nematode Regulation,*
- *Little Cherry Control Regulation,*
- *Northern American Gypsy Moth Eradication.*

Public Health Act

Administered by the Ministry of Health, this Act has a specific prohibition that "a person must not willingly cause a health hazard, or act in a manner that the person knows, or ought to know, will cause a health hazard". This prohibition would apply to farm practices that may result in a health hazard, such as when nutrients, contaminants or pathogens are discharged to land, water or air to pose a public health problem. Any situation that entails a health hazard will enable health officers to investigate using their powers under the Act. Under the *Public Health Act*, the local Health Authority must investigate any health hazard and has authority to order that a person prevent or stop a health hazard, or mitigate the harm or prevent further harm from a health hazard amongst other powers. Similar regulatory provisions exist for addressing health hazards to drinking water supplies under the *Drinking Water Protection Act*.

Weed Control Act

Administered by AFF, this Act places the responsibility for the control of noxious weeds on the occupiers of the land. It provides for the appointment of inspectors to ensure compliance and, failing that, for a method by which they can control weeds and recover the costs from the occupier. Weed Control Committees may be established by municipal councils to administer the Act within a municipality. Committees report to the municipal council and the Minister. This Act imposes a duty on all land occupiers to control designated noxious plants.

Wildlife Act

The provincial *Wildlife Act* protects wildlife designated under the Act from direct harm, except as allowed by regulation (e.g., hunting or trapping), or under permit. Legal designation as Endangered or Threatened under the Act increases the penalties for harming a species. The Act also enables the protection of habitat in a Critical Wildlife Management Area. .

Fisheries Act

Administered by both Fisheries and Oceans Canada and Environment and Climate Change Canada, this Act is established to manage Canada's fisheries resources, including fish habitat. The Act can also be administered provincially by FLNRORD and ENV. The Act applies to all Canadian waters that contain fish, including ditches, channelized streams, creeks, rivers, marshes, lakes, estuaries, coastal waters and marine offshore areas. It also applies to seasonally wetted areas that provide fish habitat such as shorelines, stream banks, floodplains, intermittent tributaries and privately owned land. The Act includes provisions for stiff fines and imprisonment to ensure compliance.

The purpose of this Act is to provide a framework for (a) the proper management and control of fisheries; and (b) the conservation and protection of fish and fish habitat, including by preventing pollution.

This Act was updated in 2019 and now empowers the Minister to make regulations for the purposes of the conservation and protection of biodiversity.

The definition of fish habitat is: "water frequented by fish and any other areas on which fish depend directly or indirectly to carry out their life processes, including spawning grounds and nursery, rearing, food supply and migration areas". The quantity, timing and quality of the water flow that are necessary to sustain fish habitat are also deemed to be a fish habitat. Furthermore, serious harm to fish includes the death of fish or any permanent alteration to, or destruction of, fish habitat.

Provisions of the *2019 Fisheries Act* relevant to agricultural operations include:

- Protection for all fish and fish habitats;
- Prohibition against the death of fish or the 'harmful alteration, disruption or destruction of fish habitat';
- A permitting framework and codes of practice to improve management of large and small projects impacting fish and fish habitat;
- Protection of fish and/or fish habitats that are sensitive, highly productive, rare or unique; and
- Consideration for the cumulative effects of development activities on fish and fish habitat.

Specific sections of the Act include:

SECTION 34.2(1) The Minister may establish standards and codes of practice for:

(a) The avoidance of death to fish and harmful alteration, disruption or destruction of fish habitat;

(b) The conservation and protection of fish or fish habitat; and

(c) The prevention of pollution.

SECTION 34.4(1) No person shall carry on any work, undertaking or activity, other than fishing, that results in the death of fish.

SECTION 35 (1) No person shall carry on any work, undertaking or activity that results in the harmful alteration, disruption or destruction of fish habitat.

Every person who contravenes subsection 34.4(1) or 35(1) is guilty of an offence and liable.

Notifying authorities about serious harm to fish or deposit of a deleterious substance:

SECTION 38 (4.1) Every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations of a harmful alteration, disruption or destruction of fish habitat that is not authorized under this Act, or of a serious and imminent danger of such an occurrence, if the person at any material time:

(a) Owns or has the charge, management or control of the work, undertaking or activity that resulted in the occurrence or the danger of the occurrence; or

(b) Causes or contributes to the occurrence or the danger of the occurrence.

SECTION 38 (5) If there occurs a deposit of a deleterious substance in water frequented by fish that is not authorized under this Act, or if there is a serious and imminent danger of such an occurrence, and detriment to fish habitat or fish or to the use by humans of fish results or may reasonably be expected to result from the occurrence, then every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations.

SECTION 38 (7) As soon as feasible after the occurrence or after learning of the danger of the occurrence, the person shall provide an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations with a written report on the occurrence or danger of the occurrence.

Plant Protection Act

Administered by Agriculture and Agri-Food Canada, this Act is to protect plant life and the agriculture and forestry industries by preventing the importation, exportation, and spread of injurious pests.

Species at Risk Act

This Act has sections that protect listed species, their residence and critical habitat. It applies to federal lands, internal waters (i.e., all watercourses), territorial seas of Canada, and the air space above them.

The provisions of the *Species at Risk Act* (known as the'safety net') could be invoked on BC crown and private lands using a federal order under the Act if provincial action is not sufficient to protect listed species.

OUTDOOR CROP BENEFICIAL MANAGEMENT PRACTICES

Comply with applicable outdoor crop related legislation, including the above, and where appropriate, implement the following beneficial management practices to protect the environment.

Outdoor Crop Soil Management

Improper crop management practices can cause soil degradation. Bare soils are prone to erosion and compacted soils will contribute to reduced crop yield and quality. Both conditions carry a greater risk of runoff flows transporting sediments into watercourses. Follow the same beneficial management practices outlined under protecting soil quality when cultivating for crop production.

➔ see **Chapter 8, Soil**

Cover Crops

Cover cropping and relay cropping are practices that can aid in the management of pests, weeds, nutrients and soil tilth, while benefiting wildlife and providing additional forage yield. Cover cropping can also be an important practice in adapting to climate change by increasing the resilience of cropping systems to floods or drought. Implement the following practices:

- Plant annual cover crops following crop harvest (e.g., oats after carrots).
- Plant annual cover crops to fill gaps between perennial crop rows (e.g., barley between raspberry rows).
- Plant perennial cover crops to fill gaps between perennial crop rows (e.g., grasses between orchard rows).
- If fall manure application is planned, plant cover crops early enough to ensure that sufficient growth has occurred to utilize nutrients (emergence by mid September is typically necessary).

Relay Crops. Relay cropping is a form of cover cropping used by forage producers (e.g., the use of Italian ryegrass between the rows of silage corn). Relay cropping uses cover crops planted between rows of the main crop (typically corn), which remain in the field after the main crop is harvested. Relay cropping is practiced to reduce weed growth during the growing season, to provide an active crop available for fall manure application after corn is harvested, to protect soil from erosion, and to provide additional forage yield. Implement the following practice:

- Plant a relay crop instead of a fall-planted cover crop if fall manure application is planned to ensure better nutrient uptake.

Catch Crops. Catch crops are a specific type of cover crop. The primary goal of a catch crop is to utilize nutrients that would otherwise be leached from bare soil during the fall and winter. In spring, catch crop nutrients

can be removed from the field as a livestock feed or recycled by cultivation into the soil for use by a subsequent crop. Implement the following practices:

- Following crop harvest, test the soil for residual nutrient levels to determine the need for a catch crop.
- Plant a catch crop if there are unused nutrients in the soil.

Plowdown of Cover Crops. When cover crops are plowed down, the decomposition of plants, shoots and roots releases a flush of nutrients, particularly nitrogen, into the soil. In high precipitation areas, spring is the preferred season for plowdown to reduce the risk of nitrogen leaching to watercourses or groundwater.

Contour Cropping

On long sloping fields, crops grown in strips on the contour will minimize the effects of concentrated water flow. This will encourage water to infiltrate into the ground, reducing soil erosion.

Crop Rotation

Crop rotation refers to the practice of growing two or more crops with different growth habits and that are hosts for different problem pests on a given field during different time periods. For example, in the dairy industry a perennial grass or grass-legume mix can be grown for a period of time after which the crop is plowed down with an annual silage corn crop replacing it. The two crops have different rooting characteristics, and varying nutrient and cultivation requirements. Crop rotation can provide an environmental benefit by improving soil structure and nutrient management by reducing erosion and by allowing greater flexibility in the management of pests.

Buffers

Establish and maintain an adequate vegetative buffer between outdoor crop activities and sensitive areas to avoid noise, minimize dust, and reduce odours from causing a nuisance or pollution. Buffers and hedgerows also sequester carbon, mitigating the impacts of agricultural activities on climate change. Agroforestry practices, such as alley cropping, offer options to blend buffer functions with crop production.

➔ see Buffers, **page 11-4**

Outdoor Crop Nutrient Management

The management of nutrients for crops is necessary to achieve a desired yield and uniformity. Nutrient requirements for every crop will be different. Forage grasses, for example, are greater nitrogen users than silage corn. It is important to know the nutrient requirements of a given crop to prevent the waste of nutrients, prevent pollution or greenhouse gas emissions. Nutrients that are not utilized by the crop may leach into groundwater and/or be transported by surface runoff.

Nutrient management refers to the balancing of nutrients removed by a crop during growth with the nutrients available to it from all sources in a manner that protects the environment.

➔ see **Chapter 6,** Nutrient Application

Planting Date. Planting dates will impact nutrient uptake. While crops are usually planted when climate, soil or market conditions are suitable, nutrients only become available in response to specific weather, soil conditions and to human activity. As a result, planting and growth do not always mirror optimum nutrient availability.

- Choose crop variety and planting dates appropriate to the climate and soil conditions of the site to optimize nutrient availability.

Outdoor Crop Water Management

Water management is critical to most crops. A high watertable or drought conditions will reduce the yield of a crop, resulting in reduced utilization of applied nutrients. Where possible, base irrigation decisions on the level of moisture in the soil, crop needs and the growing conditions.

➔ see Irrigation, **page 9-21**

➔ see Drainage, **page 9-42**

Noxious and Invasive Species Management

Noxious and invasive species include insects, plant diseases, and weeds. Transfer is common in areas where farm equipment and farm products moveback and forth between fields and farms. Bacteria, fungi or other organisms growing on the crop or in the soil are readily picked up by equipment. Plant disease and weed infestations can result in significant losses in crop quality and/or yield. Severe contamination may even reduce the range of crops that can be grown on a site.

➔ see **Chapter 7**, Biodiversity

To ensure that pests, diseases and weeds are not spread, implement the following practices:

- Purchase certified plant material or seed, and visually inspect plant material for pests upon receipt and prior to planting.
- When using equipment in fields with known disease or weed problems, rinse equipment thoroughly before moving out of the field.
- Use strategic management and available mitigation guidelines when removing and disposing of dead or diseased plant material (i.e., pruning waste) and trees to prevent the spread of harmful agricultural pests.

➔ see **Chapter 5**, Pest Management

Invasive Pests and Biosecurity

Invasive Species Council of BC

Fraser Valley Agricultural Pest Assessment project

Outdoor Crop Management

Annual Crops. Production and harvesting of annual crops (e.g., carrots, sweet corn) can result in soil erosion when soil is left bare over winter. Harvesting of certain crops can result in significant soil loss. Crop residues from annual crops can generate leachate if they come in contact with water, resulting in a risk of pollution.

➔ see Soil Loss by Harvest, **page 8-15**

Cranberries. Water management for cranberries differs markedly from that of other berries and crops due to the variety of ways that water is used in cranberry production. Water is used for irrigation, disease and insect control, frost protection, and harvesting. Growers impound water near cranberry beds to address the crops' extensive water requirements.

The extensive use of water in cranberry production creates the potential to place fertilizers, pesticides, and other chemicals (such as wood residue) in solution or suspension and to carry them into adjacent waterways. Implement the following practices to prevent water pollution:

- Recover and recycle flood water used in cranberry production.
- After application of a pesticide, impound the affected runoff within the boundaries of the farm for the period of time specified on the pesticide label.
  - When discharging water.
  - Screen debris from water used for harvesting prior to discharge.
  - If unsure about discharge water quality, test it prior to discharge to meet the water quality objectives of the watercourse.

  BC Water Quality Website

  - If the water quality is acceptable, release it from impoundment areas gradually to avoid excessive rise in the water table and/or flooding of downstream neighbours.
  - If the water quality is unacceptable, obtain authorization from ENV before discharge.

Forage Areas Used by Livestock. Implement the following crop practices for fields that are grazed or used as livestock overwintering sites:

- Leave sufficient plant cover to protect the soil from compaction and erosion.
- Manage grazing levels to ensure carbon reserves in forage roots and the soils are maintained or increase, to buffer and adapt to climate change.
- This may require increased crop residue to be left in the fall on affected areas or reduced stocking rates to prevent excessive trampling.
- Account for the nutrient content of manure deposited by livestock to match the affected area's need for fertilizer.

➔ see Outdoor Livestock Areas, **page 3-8**

➔ see Nutrient Application, **page 6-10**

Forage Grass. Potassium levels in forage grass grown on dairy farms have been increasing to cautionary levels in recent years. Potassium is the only major nutrient associated with the concept of 'luxury consumption.' Luxury consumption of potassium is strongly associated with the intensive production of grass forages and refers to the uptake of a nutrient well in excess of a plant's requirement for growth. Grass tetany may result from cows eating grass grown on high potassium soils.

Nitrate-nitrogen can, if the concentration in soil is high enough or if there are rapid changes in moisture or temperature, accumulate in plant tissue and cause nitrate toxicity to livestock.

Soil and forage testing are essential to monitor both potassium and nitrate levels on intensive operations. Potassium leaches very slowly which can result in accumulation in the soils if application exceeds crop needs.

➔ see Nutrient Management Planning, **page 6-30**

Forage Plowdown. When perennial forage stands are plowed down, the decomposition of plants, shoots and roots releases a flush of nutrients, particularly nitrogen, into the soil. In high precipitation areas, spring is the preferred season for plowdown to reduce the risk of nitrogen leaching to watercourses or groundwater.

Medicinal and Herb Crops. Medicinal and herb crops are generally grown indoors. Care should be taken not to plant invasive herbs outdoors.

Growing Industrial Hemp Outdoors

Good Agriculture and Collection Practices

Nursery Stock - Field Grown. Implement the following practices to minimize soil loss:

- When planting container nursery stock into a field use the largest feasible pot size to reduce the amount of native soil lost during harvest.
- Practice root pruning for all ball and burlap plant material to minimize root ball size– do not exceed industry standards for root balls to preserve soil.
- After nursery crop harvest, rest the soil with a seeded cover crop for one year.
- Work cover crop into the soil after it has grown to trap nutrients and provide more organic matter to the soil.
- Replace soil removed in the root ball by the addition of soil amendments such as compost.

➔ see **Chapter 6**, Nutrient Application

- Rinse vehicles and equipment before leaving a field to drive on a local road.

To burn prunings and culled plants, follow the burn decision flowchart.

➔ see Open Burning, **page 10-22**

Canadian Landscape Standard 2016

Sod. Implement the following practices to minimize soil loss:

- Reduce harvest to once every 15 months (suggested).
- Optimal harvest sod soil thickness is 1 cm (suggested).
- Use netting material (biodegradable, if possible) to reduce the volume of soil harvested.
- Apply organic and/or mineral material to the soil between harvests.

Tree Fruit and Berry. If burning of prunings is practiced, follow the burn decision flowchart.

➔ see Open Burning, **page 10-22**

Crop Residue

There are possible disadvantages to using plant materials (e.g., crop residues) as mulch to protect the soil or for nutrient management. These include the possibility of introducing invasive pests or plant pathogens; providing refuge for plant pests; tying up soil nutrients; and labour required in managing the residues.

Crop residue that is not managed properly, can be an environmental concern. However, retaining crop residues can be an effective tool in adapting croplands to a changing climate. Implement the following practices for crop residue:

- Incorporate residue into the soil that is easily moved or transported by wind or water (e.g., can be washed or blown to watercourses), but maintain residue that will protect the soil from wind or water erosion.
- Manage leachate from residue piles to prevent water pollution.

➔ see Leachate, **page 9-57**

Forage Seed Production. If burning of stubble is practiced, follow the open burning regulations.

➔ see Open Burning, **page 10-22**

New Crop Development

When developing new cropland, protect critical fish and wildlife habitat.

➔ see Wildlife and Wildlife Habitat Protection, **page 7-22**

➔ see Riparian Areas, **page 11-15**

➔ see Climate Change Factors, **page 12-1**

Stewardship Crops

There are many crop and non-crop plantings that exist for land and/or stewardship purposes, including:

- Lure or sacrifice crops grown to draw wildlife away from feeding on forage cash crops.
- Field margins, shelterbelts, timberbelts, and hedgerows dedicated to wildlife use or providing refuge for wildlife and domestic livestock during harvesting or inclement weather.
- Grass fields normally used for annual cropping but which have been set aside for the sole purpose of providing a benefit to soil biota and to enhance soil structure and fertility.
- Purpose grown bioenergy crops (e.g., hybrid willow plantations) that can provide a source of renewable farm energy and also serve as buffers and provide wildlife refuge.

Roadsides, field corners and riparian areas can also be planted with stewardship crops. Such areas can be managed for limited harvest as well as to provide cover for wildlife. Stewardship crops are increasingly being placed as buffers for overland water flow to capture nutrients and sediments.

➔ see **Chapter 11** Stewardship Area

Crop Handling

Harvested crops may be lost (spilled) in the field, during handling to and from storage, and while in storage. To prevent surface water or groundwater contamination, implement the following practices:

- Keep crops contained during transport to eliminate losses.
- Clean up spills before water sources are negatively impacted.
- Remove waste feed promptly to reduce odours and rodent activity.

Crop Processing

For concerns related to disposal of crop wash water, crop drying (e.g., grain) and feed mills

➔ see On-Farm Processing and Sales, **page 2-66**

Livestock Feed.

- Contain raw materials and processed feeds. Uncontained feed has the potential to contaminate surface water or groundwater.
- Select a site with good drainage, preferably elevated and easily accessible.
- Divert roof water and clean runoff away from the site.
- Clean up spilled feed as soon as possible to reduce odour, discourage rodent activity, and to prevent contamination of surface water.
- Collect, store and handle feed-contaminated surface water.

➔ see Runoff, **page 9-50**

➔ see Leachate, **page 9-57**

- Install dust collection or suppression equipment to prevent the dispersion of feed dusts.
- Establish and maintain an adequate buffer between feed processing areas and neighbours to mitigate noise and dust from causing nuisance or pollution.

➔ see Buffers, **page 11-4**

➔ see Dust and Particulate, **page 10-12**

Crop Waste Disposal

Crop wastes such as culls and procesing wastes are considered agricultural by-products under the AEM Code and need to be managed so that they are stored and composted in a way that the leachate generated is collected and contained. Run off, leachate and solids are not to enter a watercourse, cross property boundaries or enter the water table.

Where appropriate from a pest management standpoint, manage culled or spoiled unusable crops as soil amendments. Do not bury crop waste or dispose of at landfills: buried organic matter releases methane as it decomposes, contributing to climate change.

If insect or disease issues dictate field sanitation measures for mitigation, use recommended strategic management and mitigation guidelines to remove and dispose of dead or diseased crop and pruning waste, plant material and trees to prevent the spread of harmful agricultural pests.

Available resources include:

- BC Tree Fruits Production Guide Insects Management Chapter – Spotted Winged Drosophila – Cultural Management
- Technical Report on Eastern Filbert Blight in hazelnut orchards from BC – Section 4 – Disposal Guidelines

➔ see **Chapter 6** for use of crop wastes as soil amendments. Water that contains crop waste must be handled as contaminated water.

➔ see Contaminated Water Collection, Storage, and Use, **page 9-54**

Crop Storage

Crops must be stored properly to prevent contamination of water sources. Consider the risks of seasonal flooding or storm runoff when selecting a crop storage location. Most contamination under forage and vegetable storage conditions is caused by nutrient rich leachate leaving crop material or water contacting the stored crop, creating leachate. Store crops on hard surfaces to more easily divert and contain leachate and cover to avoid precipitation contacting the stored crop.

➔ see Buildings and Roads, **page 2-2**

➔ see Runoff, **page 9-50**

➔ see Leachate, **page 9-57**

Forage Crop Storage

The following comments on feed storages are separated based on whether such storages are located in high or low precipitation climates. High precipitation exceeds 600 mm total winter precipitation; low precipitation is less than 600 mm.

➔ see Appendix B.1, **page B-2**

Hay Storage: Low Precipitation. Implement the following practices:

- Choose a well-drained site not subject to seasonal water flow or flooding.
- Lay out the site for convenient clean-up of spillage.
- Divert clean runoff away from the site.

  ➔ see Runoff, **page 9-50**
- Ensure any contaminated runoff leaving the site is controlled and collected.
- Consider covering hay with a tarp or structure to prevent leachate formation.
- Gravel splash pads at the base of hay shed walls for roof stormwater erosion control.

Hay Storage: High Precipitation. Implement the following practices in addition to those listed above for low precipitation areas:

- Cover hay storages to reduce feed losses and to eliminate leachate.
- Use eavestroughs, downpipes and drain piping for roof stormwater control.

Silage Storage: Low Precipitation. Silage leachate poses a great pollution concern. If silage leachate is produced, contain it to prevent entry into watercourses. In low precipitation areas, open pit storages are suitable. Implement the following practices:

- Locate silage storage away from yard drain inlets, ditches and wells and 15 m or more from watercourses (suggested).
- Choose a well-drained site not subject to seasonal water flow or flooding.
- Divert clean runoff away from the site.
- Since silage leachate is expected to be generated, have an impervious floor (e.g., concrete or other material) to contain the leachate.
- Construct silo floors to drain towards the open end to avoid the pooling of rainwater and silage leachate within the silo storage area itself.
- Divert any potentially contaminated flows away from watercourses.
- Direct contaminated flows onto adjacent fields to soak in if pollution will not occur or divert to a liquid storage facility such as a manure pit.

Store silage in plastic bags on sites similar to those above with the following additional practices in place to prevent leachate escape:

- Prepare the site base with fine compacted gravel, concrete, or asphalt to prevent bag puncture.
- Fence to deter livestock and wildlife in order to prevent bags from tearing.
- Keep free of ruts and weeds to discourage rodents.
- Where required, bait the site to control rodents.

Silage bag handling can result in a large amount of waste plastic material which must be disposed of correctly.

➔ see Farm Refuse Disposal, **page 2-23**

Silage Storage: High Precipitation. Implement the following practices **in addition** to those listed above for low precipitation areas:

- Cover storages to reduce silage leachate.
- Use eavestroughs, downpipes and drain piping for roof stormwater control.

INDOOR AND CONTAINER NURSERY CROPS

This section discusses indoor crop practices common to these crops

- Button & specialty mushrooms,
- Container-grown nursery stock,
- Greenhouse-grown crops.

INDOOR AND CONTAINER NURSERY CROPS ENVIRONMENTAL CONCERNS

Primary environmental concerns related to indoor crops and container nursery production are:

- Escape of leachate or spent nutrient solution from the production facility that results in nutrients causing water pollution.
- Increased water flow leaving the site due to the amount of impervious surface that results in soil and watercourse erosion and downstream flooding.
- Emissions from greenhouse boilers that result in air pollution.
- Inappropriate crop residue management that results in soil, water and air pollution.
- Movement of plant material infested with invasive plants or exotic pests or the invasive plants or exotic pests themselves that results in impacts to biodiversity.
- Mushroom media production that results in water or air pollution.
- Emissions from greenhouse lights that result in light pollution.
- Energy use and greenhouse gas emissions; greenhouse operations are among the most energy-intensive agricultural operations in BC.

For detailed information on these concerns:

➔ see Heat Production and Agricultural Boilers, **page 2-54**

➔ see Impacts on Biodiversity and Habitat, **page 7-7**, and refer to Farm Activities and Impacts

➔ see Soil Quality Factors, **page 8-2,** refer to Contaminants

➔ see Water Quality and Quantity Factors, **page 9-1**, refer to Contaminants, and to Overland Flow

➔ see Air Contaminants, **page 10-1,** refer to Dust and Particulates

➔ see Light Emissions, **page 4-23**

➔ see Climate Change Factors, **page 12-1**

INDOOR AND CONTAINER NURSERY CROPS LEGISLATION

The following is a brief outline of the main legislation that applies to indoor crops and container nurseries.

➔ see **page A-1** for a summary of these and other Acts and Regulations

Local Bylaws

Many local governments have specific bylaws on cannabis production, mushroom media (composting) production, greenhouse coverage, heating fuel (emissions) and lighting.

Agricultural Land Commission Act

The *Agricultural Land Commission (ALC) Act S.B.C. 2002, c. 36, and Agricultural Land Reserve (ALR) Regulations* are the legislative framework for the establishment, administration, and procedures of BC's agricultural land preservation program. The ALC Act takes precedence over, but does not replace other legislation and bylaws that may apply to the land. Local and regional governments, as well as other provincial agencies, are expected to plan in accordance with the provincial policy of preserving agricultural land.

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The policies of the Commission provide interpretation and clarification of the regulations; outline guidelines, strategies, rules or positions on various issues and provides clarification and courses of action consistently taken or adopted, formally or informally.

ALC Policies and Bylaws

Drinking Water Act

This Act and Regulations have requirements regarding the protection of drinking water quality and regulate domestic water systems (those serving **more** than one single-family residence).

SECTION 23(1): subject to subsection (3), a person must not (a) introduce anything or cause or allow anything to be introduced into a domestic water system, a drinking water source, a well recharge zone or an area adjacent to a drinking water source, or (b) do or cause any other thing to be done or to occur if this will result or is likely to result in a drinking water health hazard in relation to a domestic water system

There are two regulations under the act that pertain generally to crops and specifically to mushroom media production.

Environmental Management Act

The *Code of Practice for Agricultural Environmental Management requires persons to use environmentally responsible and sustainable agricultural practices when carrying ou*t agricutural operations, for the purpose of minimizing the introduction of waste into the environment and preventing adverse impacts to the environment and human health. Section 52 of the AEM Code contains requirements for the application of nutrient sources other than to land, with specific requirements for container crops.

- The AEM Code requires that nutrient sources or any leacheate produced do not escape during transport or piping;
- During container production, nutrient sources are not to be discharged or applied directly into a watercourse, across property boundaries, or go below water tables, and;
- Contaminated runoff, leacheate, and drift from sprayed nutrient sources does not enter a watercourse, cross a property boundary, or go below water tables;
- The AEM Code specifices that the total amount of available nitrogen from all applied nutrient sources applied in one year of application is equal to or less than the amount of nitrogen needed for optimum crop growth.

Operations that apply nutrient sources to crops but not to land are required to maintain records of crop nutrient requirements, the nutrient application rates and types of nutrient sources applied.

Mushroom Compost Facilites Regulation applies when a farm is producing media that will be sold off-farm. It regulates air and water discharges by requiring an implemented **pollution prevention plan**. The specifications for the plan are identified in the Regulation.

Plant Protection Act

Administered by AFF, this Act is the provincial counterpart to the federal *Plant Protection Act* that focuses on plant protection issues affecting Canada. It provides for the prevention of the spread of pests destructive to plants in BC. Inspectors have powers to enforce the provisions of the Act, including the authority to establish quarantine areas. To assist in the enforcement of the Act, the BC Plant Protection Advisory Council advises and co-ordinates the actions of provincial and federal officials to deal with potential hazards to BC agriculture and forestry from insects, plant diseases, weeds or other biotic agents. The Council's power comes from the mandates of the agencies whose members sit on committees struck to deal with plant protection issues in specific commodity sectors.

The purpose of this Act is to prevent the deleterious spreading of insects, pests, or diseases that are destructive to plants. Under this Act, inspectors may enter premises at any reasonable time for an inspection of the premises, plans, root mediums, or containers. They can order the treatment, confiscation, or destruction of plants. Regulations under this Act include:

- *Bacterial Ring Rot Regulation,*
- *Balsam Woolly Adelgid Regulation,*
- *Blueberry Maggot Control Regulation,*
- *Domestic Bacterial Ring Rot Regulation,*
- *Golden Nematode Regulation,*
- *Little Cherry Control Regulation,*
- *Northern American Gypsy Moth Eradication.*

Public Health Act

Administered by the Ministry of Health, this Act has a specific prohibition that "a person must not willingly cause a health hazard, or act in a manner that the person knows, or ought to know, will cause a health hazard". This prohibition would apply to farm practices that may result in a health hazard, such as when nutrients, contaminants or pathogens are discharged to land, water or air to pose a public health problem. Any situation that entails a health hazard will enable health officers to investigate using their powers under the Act. Under the *Public Health Act*, the local Health Authority must investigate any health hazard and has authority to order that a person prevent or stop a health hazard, or mitigate the harm or prevent further harm from a health hazard amongst other powers. Similar regulatory provisions exist for addressing health hazards to drinking water supplies under the *Drinking Water Protection Act*.

Weed Control Act

Administered by AFF, this Act places the responsibility for the control of noxious weeds on the occupiers of the land. It provides for the appointment of inspectors to ensure compliance and, failing that, for a method by which they can control weeds and recover the costs from the occupier. Weed Control Committees may be established by municipal councils to administer the Act within a municipality. Committees report to the municipal council and the Minister.

Fisheries Act

Administered by both Fisheries and Oceans Canada and Environment and Climate Change Canada, this Act is established to manage Canada's fisheries resources, including fish habitat. The Act can also be administered provincially by FLNRORD and ENV. The Act applies to all Canadian waters that contain fish, including ditches, channelized streams, creeks, rivers, marshes, lakes, estuaries, coastal waters and marine offshore areas. It also applies to seasonally wetted areas that provide fish habitat such as shorelines, stream banks, floodplains, intermittent tributaries and privately owned land. The Act includes provisions for stiff fines and imprisonment to ensure compliance.

The purpose of this Act is to provide a framework for (a) the proper management and control of fisheries; and (b) the conservation and protection of fish and fish habitat, including by preventing pollution.

This Act was updated in 2019 and now empowers the Minister to make regulations for the purposes of the conservation and protection of biodiversity.

The definition of fish habitat is: "water frequented by fish and any other areas on which fish depend directly or indirectly to carry out their life processes, including spawning grounds and nursery, rearing, food supply and migration areas". The quantity, timing and quality of the water flow that are necessary to sustain fish habitat are also deemed to be a fish habitat. Furthermore, serious harm to fish includes the death of fish or any permanent alteration to, or destruction of, fish habitat.

Provisions of the *2019 Fisheries Act* relevant to agricultural operations include:

- Protection for all fish and fish habitats;
- Prohibition against the death of fish or the 'harmful alteration, disruption or destruction of fish habitat';
- A permitting framework and codes of practice to improve management of large and small projects impacting fish and fish habitat;
- Protection of fish and/or fish habitats that are sensitive, highly productive, rare or unique; and
- Consideration for the cumulative effects of development activities on fish and fish habitat.

Specific sections of the Act include:

SECTION 34.2(1) The Minister may establish standards and codes of practice for:

(a) The avoidance of death to fish and harmful alteration, disruption or destruction of fish habitat;

(b) The conservation and protection of fish or fish habitat; and

(c) The prevention of pollution.

SECTION 34.4(1) No person shall carry on any work, undertaking or activity, other than fishing, that results in the death of fish.

SECTION 35 (1) No person shall carry on any work, undertaking or activity that results in the harmful alteration, disruption or destruction of fish habitat.

Every person who contravenes subsection 34.4(1) or 35(1) is guilty of an offence and liable.

Notifying authorities about serious harm to fish or deposit of a deleterious substance:

SECTION 38 (4.1) Every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations of a harmful alteration, disruption or destruction of fish habitat that is not authorized under this Act, or of a serious and imminent danger of such an occurrence, if the person at any material time

(a) Owns or has the charge, management or control of the work, undertaking or activity that resulted in the occurrence or the danger of the occurrence; or

(b) Causes or contributes to the occurrence or the danger of the occurrence.

SECTION 38 (5) If there occurs a deposit of a deleterious substance in water frequented by fish that is not authorized under this Act, or if there is a serious and imminent danger of such an occurrence, and detriment to fish habitat or fish or to the use by humans of fish results or may reasonably be expected to result from the occurrence, then every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations.

SECTION 38 (7) As soon as feasible after the occurrence or after learning of the danger of the occurrence, the person shall provide an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations with a written report on the occurrence or danger of the occurrence.

Plant Protection Act

Administered by Agriculture and Agri-Food Canada, this Act is to protect plant life and the agriculture and forestry industries by preventing the importation, exportation, and spread of injurious pests.

INDOOR AND CONTAINER NURSERY CROPS BENEFICIAL MANAGEMENT PRACTICES

Comply with applicable legislation, including the above, and where appropriate, use the following beneficial management practices to protect the environment.

Implement the following practices for indoor crops and container nursery facilities:

- Locate with proper setbacks from watercourses;

➔ see Farm Building Siting, **page 2-8**

- Locate where contaminated runoff or leachate can be controlled and collected:
  - Fine textured soils (soils with more than 20% clay content) are preferred as leachate does not move as quickly through clays and remain on the surface allowing them to be collected.
- Collect and manage roof water if roof area is more than 10% of a site area (suggested).
- Consider integrating rainwater collection system with irrigation water supply to reduce dependence on surface or groundwater sources.
  - Stormwater flow is increased as impervious roofing or yard areas are increased.

➔ see Buildings and Roads Practices, **page 2-6**

- Implement energy conservation practices in construction, maintenance and operation of indoor crop and nursery facilities see Energy Use, **page 2-57.**
- Establish and maintain an adequate buffer between greenhouse, container nursery and mushroom facilities and neighbours to avoid noise, dust, and odours from causing a nuisance or pollution. Plant buffers with trees or shrubs to sequester C and offset greenhouse gas emissions from the operation.

➔ see Buffers, **page 11-4**

Nursery Production Resource Guide for BC

Greenhouse Vegetable Production

Cannabis Production Best Management Practices Guide

Nutrients Applied Through an Irrigation System (Fertigation)

When nutrients are applied through an irrigation system, implement the following practices:

- Install an efficient and uniform application system.
- Install a device to prevent backflow.
- Match application rates and amounts to crop requirements to reduce over watering and excessive leaching (e.g., a computerized irrigation scheduler controlling a drip system is more efficient than an overhead system).
- For container crops, use drip irrigation when practical to apply water to the crop.
- Avoid areas where crops are not grown to eliminate the need to capture any nutrient-rich water.

Irrigation Management Guide for BC

Leachate. The degree of leaching required to maintain healthy container crops is strongly related to the tolerance such crops exhibit to accumulations of salts within the growing media. Manage salt levels in growing media to minimize the need for leaching and the subsequent discharge of nutrient-rich water. Leachate may account for 10% to 30% of total irrigation water applied. If leachate has nutrient or pesticide levels that could cause pollutionthe water must be captured and recirculated or retained until such time that it can be discharged without causing pollution.

➔ see Leachate, **page 9-57**

Implement the following practices to manage leachate:

- For impervious subsoil, recover irrigation waste water in field drains for storage.
- For pervious subsoil, use concrete floors or polyethylene floor liners in greenhouses or nurseries to collect all leachate.
- In greenhouse or nursery production, use water recirculation techniques to both reuse leachate as a nutrient source and to conserve water.
  - due to disease transfer concerns, recirculation is not feasible on all operations

Spent Nutrient Solution. The concentration of nutrients in recirculated water can be reduced by decreasing the amount of fertilizer added at the end of a production cycle. Dispose of the spent nutrient solution at the end of the cycle by applying to other suitable agricultural crops.

➔ see Nutrient Application, **page 6-1**

Any effluent discharge into the environment, which is not being used as a fertilizer for crop production, requires a permit from ENV.

Noxious Species and Invasive Pests

To ensure that neither diseases nor pests are spread, implement the following practices when purchasing propagative plant material:

- Do not propagate invasive plants.
- Use certified pest-free plant material if available:
  - monitor plants upon arrival to the farm;
  - if possible, isolate new plant material for a period of time prior to moving into production areas.

➔ see **Chapter 5**, Pest Management

Soilless Media

Storage of Media. Store raw materials as well as prepared and spent media in such a way as to prevent their release into the environment.

Use of Media. The choice of growing media in a greenhouse or nursery operation has a significant effect on overall water consumption. Watering efficiency can be increased through the choice of substrates with higher water holding capacity. However, such substrate use may be limited by an often higher potential for root rot.

Disposal of Media. Dispose of unused, spent or waste media in a manner that does not cause pollution. Reuse within the operation or use these materials as a soil conditioner.

➔ see Soil Conditioner Application **page 6-29**

Greenhouse

Cooling. Shade materials such as nettings or curtains are preferred over shading compounds that are sprayed on greenhouse roof or walls. Shading compounds used on the outside of greenhouse structures can contribute to stormwater contamination. Roof venting is also an important component of greenhouse climate regulation. Fans used to pull air out of the structure should be properly maintained to prevent noise.

Capture and appropriately deal with contaminated water that will cause pollution.

➔ see Runoff, page **9-50**

Consider using rainwater collected from greenhouse roof systems as an alternative source of irrigation water.

Crop Residue. Other parts of this Guide address concerns associated with crop residue from greenhouses:

- Crop prunings, plants and waste organic media application to soil.

➔ see Soil Conditioner Application, **page 6-28** organic wastes for compost

➔ see Compost, **page 2-48** plastic clips, strings, pots, rockwool

➔ see Farm Waste, **page 2-19**

Building Drains. Greenhouses may be constructed with perimeter drains to divert clean roof water away from the building foundation. If a greenhouse also has separate drains to collect spent irrigation water or contaminated floor water, implement the following practice:

- Test drains to ensure they are not cross-connected by introducing a ENV-approved dye into the contaminated water drain system and checking that the dye does not show up in the perimeter drain discharge.

Boiler Emissions. Greenhouse operations are among the most energy intensive agricultural operations. Greenhouse boilers may generate air emissions that contribute to climate change or particulatesthat could result in air pollution.

➔ see Heat Production and Agricultural Boilers, **page 2-54**

Light Emissions. Greenhouses may emit light that causes a nuisance to neighbours and excess lighting contributes to energy waste and greenhouse gas emissions. Depending on the intensity of your lights and the light emission reduction desired, consider using the following:

- Do not use supplemental lighting during the evening hours of 6 PM to midnight. (crops need a period of darkness; this will minimize impacts on your neighbours).
- Control light emissions:
  - Use light abatement material such as black-out curtains, light abatement screens or thermal curtains on side walls and overhead if feasible.
- Consider vegetation buffers for very close neighbours (an IPM program may be required to reduce potential insect problems resulting from the buffer). Vegetative buffers sequester carbon helping to offset greenhouse gas emissions from the operation.

Nursery

Wood Residue. The use of wood residue products such as sawdust and hog fuel is regulated under the Environmental Management Act as leachate from this material can be toxic to fish.

➔ see Wood Residue, **page 2-37**

Crop Residue. Other parts of this Guide address concerns associated with crop residue from nurseries:

- prunings, plants and waste organic media application to soil
  ➔ see Nutrient Application, **page 6-1**
- organic wastes for compost
  ➔ see Compost, **page 2-48**
- sheet plastic, pots, trays, fertilizer bags, pesticide containers
  ➔ see Farm Waste, **page 2-19**

Mushroom Media Production. The production of mushroom media is predominantly from organic raw material that, if not handled carefully, may create considerable leachate and odour problems. Beneficial practices specific to mushroom media production include those associated with:

a) Storage of raw materials, final products and by-products;

b) Media preparation, including composting, facility design and operation;

c) Effluent (specifically "goody" or "brown" water) control, storage and recycling;

d) Air emissions management and odor abatement.

Generally speaking, the storage of raw material and of products or by-products of the operation, and the production of mushroom compost must not cause pollution. Minimum standards for composting and the production of mushroom compost (mushroom media) are set in the *Mushroom Compost Facilities Regulation*, the *Code of Practices for Agricultural Environmental Management* and the *Public Health Act* and include:

a) Location of a mushroom compost facility is subject to regulatory minimum setbacks for facilities, for operations and for storage of organic material, products or by-products from water sources and property boundaries. Local governements that have specific mushroom production bylaws may differ from the provincial setbacks. Operations and storage sites must also not be located, even temporarily, in areas prone to annual flooding or otherwise standing water. The careful attention to facility design and site selection will also help to minimize odour nuisance problems.

b) A pollution prevention plan for the mushroom composting facility that respects air, surface and groundwater must be prepared and implemented. It needs to take into consideration all sources of air contaminants and liquid effluencts and includes monitoring and reporting.

c) Control and containment of air emissions and leachate. A mushroom facility must be, and its operations must be conducted, on an impermeable surface that prevents pooling of water and the release of leachate into the environment. Leachate can be effluents from all organic material or water (precipitation or run-on) that has come in contact with organic materials. The leachate (also called "goody" water or "brown" water) must be collected and treated in an enclosed system. Furthermore, all organic materials except for baled straw must be covered.

   Leachate that has been treated and that is not recycled back into the operation may be discharged to land or water. The Ministry of the Environment and Climate Change Strategy has to be notified prior to the release. The disposal to land is usually similar to that designed for a septic field. It is often the least odourous and most environmentally friendly method to manage the remaining leachate.

Air emissions from the composting process and the leachate collection and treatment system can be quite odorous, in particular problem with wet straw-bedded horse manure or poultry litter. Therefore, raw material can be mixed outdoors but must then be moved for composting into an enclosed facility that is under negative pressure with an aerated floor for composting within the same calendar day. Emissions from both, the compost operation and the leachate collection and treatment system, must be collected and treated by a scrubber and a biofilter. Scrubbers produce substantial amounts of waste products such as ammonium sulfate. It is recommended to have a disposal plan.

Air contaminants from forced air ventilation must not enter a watercourse or cross a property boundary. Some odour emissions from mushroom compost facilities may fall into that category.

In addition, the following measures can help to reduce the generation of leachate of run-off.

- Ensuring good moisture content management and the protection of piles by diversion (drains, berms) of run-on can effectively reduce leachate to almost zero.
- Mushroom barns may be constructed with perimeter drains to divert clean roof water away from the roof and building foundation. If a mushroom barn also has separate drains to collect contaminated water, implement the following practice:
  - Test drains to ensure they are not cross-connected by introducing an approved natural food dye into the contaminated water drain system and checking that the dye does not show up in the perimeter drain discharged.
    ➔ see Runoff, **page 9-50**

Fresh Media Storage. Mushroom media is typically stored on a concrete pad near the mushroom house while the beds are filled. During this time, the compost may be exposed to rain, creating leachate and contaminated runoff.

Implement the following practices:

- Locate media storage (fresh and spent) away from yard drain inlets, ditches, wells and watercourses:
  - 15 m or more from watercourses (suggested).
  - 30 m or more from water intake used for domestic purposes (suggested).
- Minimize the amount of runoff:
  - Schedule compost deliveries to arrive as the compost is required.
  - Fill beds as soon as possible after the compost arrives, keeping it out of the rain.
  - Provide a covered storage area for fresh media in high precipitation areas.
  - Clean up debris from receiving and filling areas frequently.
  - Divert run-on away from fresh media piles.
  - Collect all contaminated runoff that can pose a pollution risk.
  - Use controlled infiltration of the the leachate, as it cannot be recycled.
    ➔ see Runoff, **page 9-50**

Compost Facility Requirements Guideline

Spent Media. Once mushrooms have been harvested, the compost is considered "spent media" substrate (SMS). It is a by-product which is usually removed from the mushroom production site and used as soil amender. All pertinent regulatory standards for the storage of organic material apply and it is recommended to remove that substrate as soon as possible from the facility site.

Summary of General Composting Best Management Practices

On-farm Composting in British Columbia: a Step -by-Step Guide for small to Medium-sized Farm Operations

Mushroom Production

Farm Practices for Mushroom Production

Compost Facility Requirements Guideline

Crop Waste Disposal

Manage culled or spoiled unusable crops as soil amendments.

➔ see **Chapter 6** for use of soil amendments.

Water that contains crop waste must be handled as contaminated water.

➔ see Contaminated Water Collection, Storage, and Use, **page 9-60**

CHAPER 5 METRIC CONVERSIONS

Metric	Imperial Equivalent
5 cm	2 inches
7 cm	3 inches
30 cm	1 foot
0.5 m	1.5 feet
10 m	30 feet
15 m	50 feet
30 m	100 feet
30.5 m	100 feet
200 m	650 feet
100 km	62 miles
8 km/hr	4.9 mph
5 kg	11 pounds
1500 kg	3,300 pounds
5 litres	1.3 gallons
6000 litres	1,585 gallons

Conversions in this table are rounded to a convenient number.
See Appendix E for exact conversion factor.

Values from tables and examples are not included in Metric Conversions

CHAPTER 5 TABLE OF CONTENTS

CHAPTER 5

PEST MANAGEMENT

INTRODUCTION

This chapter describes how Integrated Pest Management practices contribute to reduce the impact of managing agricultural pests on the environment. It contains introductory information on the relationship between pest management and the environment. It also contains information on environmental concerns, legislation and beneficial management practices related to:

- Pest management,
- Pesticides.

PEST MANAGEMENT AND THE ENVIRONMENT

Pests are a constant threat to the economical production of food crops and animals. They may also affect food safety and reduce natural biodiversity. The proper implementation of Integrated Pest Management (IPM) practices helps to protect the environment from the potential adverse effects of pests and pest management, and is also a very important component in helping agricultural operations adapt to climate change.

Integrated Pest Management (IPM)

Integrated Pest Management is a decision-making process for pest control. The process contributes to effective, economical and environmentally sound suppression of pests for crop and livestock production. IPM incorporates several methods to achieve pest control (e.g., crop rotation, crop variety selection, soil amendments, pesticides, time of planting and harvest, etc.). IPM will have added importance as pest populations shift in response to climate change.

Noxious weeds

Noxious weeds are typically non-native plants that have been introduced to British Columbia without the insect predators and plant pathogens that normally keep them in check in their native habitats. For this reason and because of their aggressive growth, these plants can be highly destructive, competitive, and difficult to control. Noxious weeds are among the top causes for loss of natural diversity in the environment.

Pesticides

Pesticides are any kind of chemical (organic or synthetic) used to kill, control, or manage pests. Fungicides, insecticides, miticides, herbicides, rodenticides and plant growth regulators are all types of pesticides. Pesticides are chemicals designed to protect crops and animals from pests and can pose risks to the environment. Pesticides are regulated to minimize known and potential risks through prescribed storage, handling, application and disposal practices.

Pests

Pests are organisms that cause undesirable effects to agricultural production and include fungi, bacteria, viruses, nematodes, insects, mites, weeds, slugs, rodents, birds and wildlife. They may occur naturally or be introduced from other areas.

Invasive Pests

Invasive pests not only pose a threat to crops and livestock, but also threaten native biodiversity by competing with local species for food and space. Many of the pests affecting cultivated and native plants in BC have been inadvertently introduced into the Province. In the absence of natural controls, some have become established and have extended their range as the environment and as availability of host plants permits. Examples of invasive pests include gypsy moth, spotted wing drosophila, brown marmorated stink bug, purple loosestrife, knapweed, yellow nutsedge, Japanese knotweed, canola blackleg, puncturevine, blueberry scorch virus and European chafer.

PEST MANAGEMENT

PEST MANAGEMENT ENVIRONMENTAL CONCERNS

Primary environmental concerns related to pests are:

- lack of control of pests that results in loss of biodiversity and natural beneficial organisms through invasive diseases, insects, and weed infestations
- improper choice of pest management strategies that results in soil erosion, water or air pollution, or increased greenhouse gas emissions, or impacts to non-target organisms

For environmental concerns related to use of pesticides to control pests.

➔ see Pesticides, **page 5-15**

For information on these concerns:

➔ see Impacts on Biodiversity and Habitat, **page 7-7**

➔ see Soil Quality Factors, **page 8-1**, and refer to Contaminants

➔ see Water Quality and Quantity Factors, **page 9-1**, and refer to Contaminants

➔ see Air Contaminants, **page 10-1**

➔ see Climate Change Factors, **page 12-1**

PEST MANAGEMENT LEGISLATION

The following is a brief outline of the main legislation that applies to pest management.

➔ see **page A-1** for a summary of these and other Acts and Regulations

Local Bylaws

Many local governments have specific bylaws or restrictions on noise scaring devices for bird control. Some local governments have by-laws that require the control of specific pests. Local governments may also have by-laws restricting the use of "cosmetic" pesticides; these do not apply to agriculture.

Environment Management Act

This Act describes responsibilities for use of pesticides in agriculture and other sectors and spill reporting, response, and recovery, which are supported by several regulations.

The *Code of Practices for Agricultural Environmental Management* regulates pesticide movement from the applicator's property.

SECTION 77.1: Unless an adjacent property owner agrees otherwise, a person who uses pesticides for the purpose of an agricultural operation must ensure that a no-treatment zone between an outdoor pesticide use area and the adjacent property is sufficient to prevent the unreasonable release of pesticide spray or runoff onto the adjacent property.

- "No-treatment zone" means an area of land that must not be treated with pesticide.

It is important for producers to ensure that their pesticide application practices adhere to SECTION 77.1 as described above, because it may be applied when a drift incident is being investigated in order to determine if the use of the pesticide resulted in an unreasonable release of pesticide to the adjacent property.

Integrated Pest Management Act

Administered by BC Ministry of Environment and Climate Change Strategy, this Act regulates the sale, containment, transportation, storage, preparation, mixing, application and the disposal of pesticides and their containers.

The *Integrated Pest Management Act* and Regulation establish conditions for the sale and use of pesticides in BC through a classification system and regulatory provisions for licences, certification, permits, Pest Management Plans and ministry confirmations of receipt of a pesticide use notice. The Regulation also contains public notification, consultation, reporting, and record keeping provisions – as well as standards for use of Integrated Pest Management and for human health and environmental protection.

Under the *IPM Act*, a person must not "use, handle, release, transport, store, dispose of or sell a pesticide in a manner that causes or is likely to cause an unreasonable adverse effect." This general prohibition, in concert with requirements for Integrated Pest Management (IPM), underpins the ministry's approach to regulation of pesticide use in BC.

SECTION 3(1): Without limiting any other provision of this Act, a person must not (a) use a pesticide that causes or is likely to cause, or use, handle, release, transport, store, dispose of or sell a pesticide in a manner that causes or is likely to cause, an unreasonable adverse effect.

It is important for producers to ensure that their pesticide application practices adhere to Section 3(1), as described above, because it may be applied when a drift incident is being investigated in order to determine if the use of the pesticide resulted in an unreasonable adverse effect, or if the action was likely to cause the unreasonable adverse effect.

SECTION 4(1): Except as provided in the regulations, a person must not use a pesticide for a prescribed use unless the person holds the licence that is, under the regulations, required for that purpose, and complies with the terms and conditions in or attached to that licence. When hiring a custom applicator (or when providing a spray service to another grower/farmer), a pesticide user licence and an applicator certificate are required.

Pesticide storage and safe handling practices may be reviewed by a Ministry inspector or a Conservation Officer (also designated as an inspector under the *IPM Act*) during a farm inspection.

Plant Protection Act

Administered by AFF, this Act is the provincial counterpart to the federal *Plant Protection* Act that focuses on plant protection issues affecting Canada. It provides for the prevention of the spread of pests destructive to plants in BC. Inspectors have powers to enforce the provisions of the Act, including the authority to establish quarantine areas. To assist in the enforcement of the Act, the BC Plant Protection Advisory Council advises and co-ordinates the actions of provincial and federal officials to deal with potential hazards to BC agriculture and forestry from insects, plant diseases, weeds or other biotic agents. The Council's power comes from the mandates of the agencies whose members sit on committees struck to deal with plant protection issues in specific commodity sectors.

The purpose of this Act is to prevent the deleterious spreading of insects, pests, or diseases that are destructive to plants. Under this Act, inspectors may enter premises at any reasonable time for an inspection of the premises, plans, root mediums, or containers. They can order the treatment, confiscation, or destruction of plants. Regulations under this Act include:

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Administered by AFF, this Act places the responsibility for the control of noxious weeds on the occupiers of the land. It provides for the appointment of inspectors to ensure compliance and, failing that, for a method by which they can control weeds and recover the costs from the occupier. Weed Control Committees may be established by municipal councils to administer the Act within a municipality. Committees report to the municipal council and the Minister.

Wildlife Act

The provincial *Wildlife Act* protects wildlife designated under the Act from direct harm, except as allowed by regulation (e.g., hunting or trapping), or under permit. Legal designation as Endangered or Threatened under the Act increases the penalties for harming a species. The Act also enables the protection of habitat in a Critical Wildlife Management Area.

Agriculture Environment Management Code, Administered by BC Ministry of Environment and Climate Change Strategy, this AEM Code regulates pesticide movement from the applicator's property.

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- "no-treatment zone" means an area of land that must not be treated with pesticide.

It is important for producers to ensure that their pesticide application practices adhere to Section 77.1 as described above, because it may be applied when a drift incident is being investigated in order to determine if the use of the pesticide resulted in an unreasonable release of pesticide to the adjacent property.

Fisheries Act

Administered by both Fisheries and Oceans Canada and Environment and Climate Change Canada, this Act is established to manage Canada's fisheries resources, including fish habitat. The Act can also be administered provincially by FLNRORD and ENV. The Act applies to all Canadian waters that contain fish, including ditches, channelized streams, creeks, rivers, marshes, lakes, estuaries, coastal waters and marine offshore areas. It also applies to seasonally wetted areas that provide fish habitat such as shorelines, stream banks, floodplains, intermittent tributaries and privately owned land. The Act includes provisions for stiff fines and imprisonment to ensure compliance.

The purpose of this Act is to provide a framework for (a) the proper management and control of fisheries; and (b) the conservation and protection of fish and fish habitat, including by preventing pollution.

This Act was updated in 2019 and now empowers the Minister to make regulations for the purposes of the conservation and protection of biodiversity.

The definition of fish habitat is: "water frequented by fish and any other areas on which fish depend directly or indirectly to carry out their life processes, including spawning grounds and nursery, rearing, food supply and migration areas". The quantity, timing and quality of the water flow that are necessary to sustain fish habitat are also deemed to be a fish habitat. Furthermore, serious harm to fish includes the death of fish or any permanent alteration to, or destruction of, fish habitat.

Provisions of the Fisheries Act relevant to agricultural operations include:

- Protection for all fish and fish habitats;
- Prohibition against the death of fish or the 'harmful alteration, disruption or destruction of fish habitat';
- A permitting framework and codes of practice to improve management of large and small projects impacting fish and fish habitat;
- Protection of fish and/or fish habitats that are sensitive, highly productive, rare or unique; and
- Consideration for the cumulative effects of development activities on fish and fish habitat.

Specific Sections of the Act include:

SECTION 34.2(1) The Minister may establish standards and codes of practice for:

(a) The avoidance of death to fish and harmful alteration, disruption or destruction of fish habitat;

(b) The conservation and protection of fish or fish habitat; and

(c) The prevention of pollution.

SECTION 34.4(1) No person shall carry on any work, undertaking or activity, other than fishing, that results in the death of fish.

SECTION 35 (1) No person shall carry on any work, undertaking or activity that results in the harmful alteration, disruption or destruction of fish habitat.

Every person who contravenes subsection 34.4(1) or 35(1) is guilty of an offence and liable.

Notifying authorities about serious harm to fish or deposit of a deleterious substance:

SECTION 38 (4.1) Every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations of a harmful alteration, disruption or destruction of fish habitat that is not authorized under this Act, or of a serious and imminent danger of such an occurrence, if the person at any material time

(a) Owns or has the charge, management or control of the work, undertaking or activity that resulted in the occurrence or the danger of the occurrence; or

(b) Causes or contributes to the occurrence or the danger of the occurrence.

SECTION 38 (5) If there occurs a deposit of a deleterious substance in water frequented by fish that is not authorized under this Act, or if there is a serious and imminent danger of such an occurrence, and detriment to fish habitat or fish or to the use by humans of fish results or may reasonably be expected to result from the occurrence, then every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations.

SECTION 38 (7) As soon as feasible after the occurrence or after learning of the danger of the occurrence, the person shall provide an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations with a written report on the occurrence or danger of the occurrence.

Migratory Birds Convention Act

Under this Act, the federal government is responsible for implementing a Convention between Canada and the U.S. for the protection of migratory birds and nests. The Canadian Wildlife Service of Environment Canada administers the regulations.

- SECTION 35(1): prohibits the deposit of oil, oil wastes or any other substance harmful to migratory birds in any area frequented by migratory birds

Migratory waterfowl populations create demands on the use of adjacent agricultural lands. Under the Act, it is an offence to harm the habitat of any migratory bird while the bird is resident at the site or to release any substance (including pesticides) harmful to migratory birds into areas frequented by them.

Plant Protection Act

Administered by Agriculture and Agri-Food Canada, this Act is to protect plant life and the agriculture and forestry industries by preventing the importation, exportation, and spread of injurious pests.

Species at Risk Act

This Act has sections that protect listed species, their residence and critical habitat. It applies to federal lands, internal waters (i.e., all watercourses), territorial sea of Canada, and the air space above them.

The provisions of the *Species at Risk Act* (known as the'safety net') could be invoked on BC crown and private lands using a federal order under the Act if provincial action is not sufficient to protect listed species.

Pest Control Products Act

Under this Act and its regulations, Health Canada has the authority to regulate pest control products used in agriculture, forestry, industry, public health and domestic situations.

The Act is intended to ensure that no person shall store, display, distribute or use a pest control product under conditions that are unsafe to human or animal health or that will adversely affect the environment.

Pest control products include herbicides, fungicides, insecticides, rodenticides, biological controls such as bacteria and viruses and antimicrobial agents such as those used in wood preservation, water purification systems and material preservatives. The intent of the legislation is to ensure the safety, merit and value of pesticides used in Canada.

PEST BENEFICIAL MANAGEMENT PRACTICES

Comply with applicable pest management related legislation, including the above, and where applicable, implement the following beneficial management practices to protect the environment.

Integrated Pest Management (IPM)

Integrated Pest Management is an approach that relies on the appropriate use of various sound practices to protect crops, animals, and the environment from the adverse impact of pests. Integrated Pest Management does not mean that chemical pesticides are never used nor does it require complete elimination of all pests. A properly designed program aims to create conditions that are optimal for crop production and less favourable for pest development.

Integrated Pest Management includes the use of production practices that prevent or reduce pest problems as well as use of monitoring to determine the need and correct timing of control methods, including pesticide applications. When used, IPM practices reduce potential impact to the environment by means of:

- Less reliance on pesticides by effective use of non-chemical methods, including biological, cultural, behavioural, and mechanical control practices either alone or in combination with pesticides.
- Less risk of development of pesticide resistance that can lead to increased pesticide use and poor pest control.
- Encouraging use of least-toxic, target-specific pesticides as appropriate.

INTEGRATED PEST MANAGEMENT

Integrated Pest Management (IPM) is promoted and explained in the commodity-specific

Crop Production Guides, shown below.

They form a part of the Environmental Farm Plan series of Beneficial Management Practices. This detailed information is recommended for use by producers of these crops. **Table 5.1,** outlines the basic steps in an Integrated Pest Management

A complete list of Production Guides is available at

Species At Risk Act; Information for Private Landowners

For more detailed information on Integrated Pest Management for specific crops, refer to the following publications.

- BC Berry and Vegetable Production Guides
- Best Practices Guide for Grapes for British Columbia Growers
- Floriculture Production Guide
- Fresh Market Grape Production – Best Practices Guide in British Columbia
- Greenhouse Production in British Columbia
- Home and Garden Pest Management Guide for British Columbia
- IPM for Turfgrass Managers
- Integrated Fruit Production Guide for Commercial Tree Fruit Growers
- BC Tree Fruit Production Guide
- Mushroom Production Guide to Best Management Practices in British Columbia
- Nursery Production Guide (Pesticides Registered in Nurseries)
- Vegetable Production Guide – Beneficial Management Practices for Commercial Growers in British Columbia

Invasive Pests

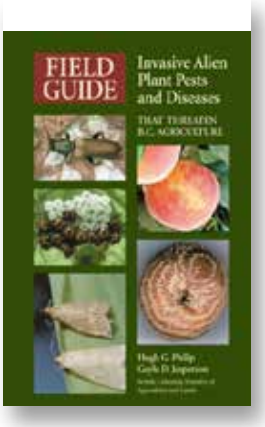
It is important that any unusual or unfamiliar diseases, insects, or weed species be reported to AFF, the Ministry of Forests, Lands, Natural Resource Operations and Rural Development Invasive Alien Plant Program, or the Canadian Food Inspection Agency (CFIA) so that the species can be identified and so any necessary actions can be taken. Check the Weeds BC website, the AFF website on invasive plants and biosecurity, and the Invasive Plant Program website for additional information on new and threatening invasive species.

➔ see Weeds, **page 5-12**, and

➔ see **Chapter 7**, Biodiversity

Weeds BC

Invasive Pests and Biosecurity



Identifying and rapidly responding new pest issues will take on added importance with projected climate change. Climate change can have a strong influence on agricultural pest dynamics and their impacts on agricultural production. A changing climate will also allow some insects, fungi, weeds and bacteria to more easily overwinter and expand their ranges into new regions.

Enhancing Information and Collaboration for Managing Emerging Pests

To reduce the possibility of introducing invasive pests to a farm, check with the Canadian Food Inspection Agency for permit requirements and other restrictions before importing plant material from outside B.C.

Canadian Food Inspection Agency

TABLE 5.1	Steps to Developing an Integrated Pest Management (IPM) Plan

1. Plan & manage crop and animal production to avoid pest problems

- Select a site that is environmentally suited to the crop, or select a crop or crop variety suited to the growing site to minimize predisposition of the crop to pest attack or competition.
- Optimize crop and animal health to avoid predisposition towards pest infestation.
- Encourage the establishment of available biological control agents that can keep pests from becoming problems.
- Use recommended crop and manure management practices to prevent or reduce the risk of attracting and establishing pests.
- Seek out new crops and varieties that can be best adapted to local agronomic and storage conditions.

Example: Practices such as crop rotation and alternating pesticide products can help avoid development of pest resistance

2. Understand & Identify the pest

Develop a management strategy using information on how the pest, crop and environment affect one another. Determine:

- How to correctly identify the pest and the damage it causes to a crop.
- The pest's life cycle and its preferred food and environment requirements—most pests go through at least one developmental stage where control measures and products are most effective:
  - Different products may target a different life cycle stage.
  - Timing the use of control tools and actions to occur at the pests' susceptible stage.
- What conditions promote pest introduction, development and population increase.
- How to identify any beneficial organisms that eat, compete with, or parasitize the pest.

Example: Two fungal diseases of chrysanthemum must be properly identified because one (brown rust) causes minor damage and is not of regulatory significance and the other (white rust) is an invasive pest regulated by the Canadian Food Inspection Agency (CFIA). Improper identification or a delay in action will result in greater infestation and significant crop losses.

3. Monitor populations of pests and beneficial organisms, pest damage & environmental conditions

Monitor the crop, flock or herd regularly to collect information on:

- The abundance and stage of development of pest populations;
- The numbers of beneficial organisms present;
- The crop stage and vigour;
- The amount of crop damage;
- Temperature and moisture conditions - used in models to predict the occurrence of specific pest stages which can assist in decisions regarding the timing of pest management actions.

Example: Using an apple scab forecasting model to determine when fungicides should be applied to protect apple orchards. The model uses leaf wetness and temperature data to predict the most likely period of infection.

4. Use economic thresholds (where possible) and past experience in making pest control decisions

Ideally, pests are controlled in advance of reaching a level that causes unacceptable economic damage. However, such threshold data do not exist for many pests. Take the following considerations into account when deciding if and when control actions are necessary:

- Use pest numbers and life stage information from monitoring:
  - The susceptibility of the crop to damage at various stages of growth.
  - Pesticide use restrictions such as pre-harvest interval, re-entry interval, buffer zone.
- Compare the pest control cost with the value of potential losses (quantity and/or quality) if the pest is not controlled (cost/benefit analysis):
  - Economic thresholds are specific for given crop/pest combinations and can vary depending on local crop values and control costs.
- Consult with local experts or use past experiences to make control decisions.

Example: Leaf rollers are counted in raspberry buds in spring and insecticide is used only if more than 10% of buds are affected (i.e., more than 10 leaf rollers per 100 buds).

5. Choose appropriate control methods

Use a combination of biological, cultural, mechanical, behavioural and chemical controls as described below.

Biological Control: beneficial organisms such as predators and parasites will help control pests. They are naturally occurring or can be released into an area to control pests when needed.

- Predators eat the pest.
- Parasites and some predators live in or on the pest to weaken or kill it:
  - Parasites are often very small but can be extremely important in controlling pests.
- Some microorganisms (i.e., bacteria, fungi, nematodes) reduce populations of plant pathogens or insect pests:
  - Healthy soils often have high populations of "good" microorganisms.
  - Commercially available beneficial microorganisms available (predators, parasites, nematodes, microbials are readily available).
- Monitoring and encouraging beneficial organisms is an important part of an Integrated Pest Management program.

Example 1: The controlled introduction of two moth species, (one feeds on roots and the other on leaves), and one flea beetle species, has provided successful control of the noxious weed Tansy Ragwort in localized areas on Vancouver Island and the Fraser Valley.

Example 2: Livestock grazing can help prevent weed seed production and gradually weaken the roots, reducing weed establishment and proliferation.

Cultural Control: production practices that discourage the introduction, establishment or development of pest populations, such as

- Selection of varieties resistant to pests.
- Planting cover crops that compete with weeds and provide shelter or food for beneficial insects.
- Rotating of crop species to reduce pest population levels.
- Timing of cultivation or soil disturbance.
- Pruning to remove diseased material, thinning fruit or plants to create an environment less attractive or conducive to pests.
- Planting certified clean material.
- Reducing the accumulation of plant residues and animal waste where pests can breed.

Example: Removal of waste material from confined livestock and poultry operations at least once every 10 to 12 days during the fly breeding season helps with fly control.

Mechanical Control: involves the use of barriers or devices to exclude or control pests. These include window screening, netting, rodent traps, seed cleaning to remove weed seeds, air curtains, fly paper, ground fabric, mulches

Example: Netting on grape vineyards to prevent bird damage on ripening fruit; audible scare devices to prevent bird damage of ripening fruit in orchards; timing tillage operation for weed control

Behavioural Control: takes advantage of specific attraction or repellent responses of pests to certain odours, sounds, and colours in order to cause confusion or disorientation and prevent mate or host finding

Examples: Insect mating disruption using sex attractants (pheromones), odour-baited traps, yellow sticky traps, distress recordings, repellents, and black light electrocutors for flies

Chemical Control: Can be considered when other preventive and non-chemical control options fail to prevent or reduce pest numbers or damage to an acceptable level. Pesticides vary greatly in risks posed to the environment, human health, and toxicity to non-target organisms (e.g., birds, fish, pollinators).

refer to Crop Production Guides

- When possible, use lower risk pesticides that are compatible with Integrated Pest Management practices.
- Pesticides labels are legal documents and must be read prior to selecting and using the pesticide. Pesticide labels contain detailed information on how to use the product correctly and safely.
- In order to prevent or delay the development of pesticide resistance, always follow the general and product-specific resistance management directions on the label.

Example: Herbicides in pasture and rangeland, along with primary weed management strategies such as grazing and correct fertilizer applications can lead to good weed control.

6. Evaluate the effects & efficacy of the program

- Keep good records such as: pest and weather monitoring, pesticide application (site or area treated, products and amounts used, crop stage, application dates, application methods, spray volume), crop harvest dates, crop yield and quality, and any other observations related to the condition or appearance of the crop or animals.
- Annually review this information to decide how to improve the Integrated Pest Management program.

Pathogens

Pathogens (disease-causing organisms) are easily spread and diseases impact the host (plant or animal). Prevention is the best management strategy, but early detection and treatment can also be effective. While many pathogens are crop-specific, some may affect a wide range of crops. Implement the following practices:

- Use clean certified seed or plant sources, where available.
- Remove infected plants or affected plant parts to prevent further spread.
- Practice crop rotation to discourage the build up of specific pathogens.
- Select disease-resistant varieties, where available.
- Use qualified laboratories to confirm pathogen identification and then follow their recommendations.

Soil Fumigation. This technique is used to control soil borne pests such as nematodes. Implement the following practices:

- Have a fumigation management plan.
- Follow label restrictions.
- Ensure applicators have been certified and are using proper equipment.
- Do not apply when the weather forecast is for heavy rain.
- Ensure that adequate moisture is in the soil prior to fumigation.
- Use plastic tarps to seal in the fumigant to reduce air pollution and to increase effectiveness of treatment.
- Ensure that adequate buffers are in place to prevent soil loss from fumigated fields left bare through winter.

➔ see Buffers, **page 11-4**

Insects and Mites

Insects and mites are easily spread and can impact the host (plant or animal). The life cycles for many insect pests are well known and most management strategies target a specific developmental stage. Implement the following practices:

- Remove insects to prevent their spread to other hosts.
- Practice crop rotation to discourage the build up of pests.
- Select insect-resistant or tolerant varieties of crops, where available.
- Monitor population levels of both pests and beneficial organisms.
- Learn to identify all species and development stages of pests and beneficial organisms.
- Protect and encourage the establishment of beneficial organisms.
- When possible and appropriate, release (introduce) beneficial organisms.

Flies in Confined Livestock Facilities. An integrated fly management program involves a combination of appropriate animal waste management and fly prevention measures. Implement the following practices:

- Begin a fly control program early in the year.
- Maintain low fly populations by using.
  - Biological fly control programs.
  - Electronic zappers.
  - Chemicals such as fly cake and/or insecticidal bait bands or boards.

Implement the following practices to reduce the need for pesticides to control nuisance fly populations:

- Reduce or periodically remove fly breeding materials such as manure, bedding, and spoiled feed.
- Ensure that potential breeding materials are dried quickly and remain dry.
- Store manure in enclosed structures if it cannot be dried easily or if it cannot be spread every 10-12 days.
- Dispose of dead animals using approved disposal methods.

➔ see Livestock Mortality Disposal, **page 3-52**

In some situations, regular spraying with insecticides may be necessary for effective fly control. Seek advice from a qualified pest control specialist before embarking on any spraying programs. Ensure that only approved chemicals are used. Spraying should never be considered a substitute for proper waste management.

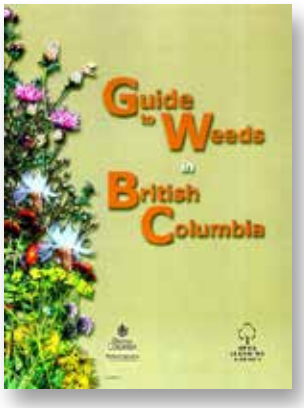
Management of Flies in Layer Barns

Weeds

Weeds reduce crop growth and affect the ability of crops to effectively use nutrients. Although some weeds can use a significant amount of soil moisture and nutrients, as they are not harvested, the nutrients remain in the field and will be released when the weed material breaks down. To reduce the impact of weeds, implement the following practices:

- Always use clean certified seed.
- Control problem weeds before they go to seed.
- Practice crop rotation to discourage build up of specific weeds.
- Learn to identify weeds, particularly at the seedling stage.
- Apply appropriate controls at the recommended stage of crop and weed development.
- Control persistent perennial weeds prior to planting crops.
- Use plastic and organic mulches to control or suppress weeds when appropriate.
- Prevent the movement of weeds to new locations via movement of livestock or equipment.
  - Discourage visits to the farm if the potential for weed movement exists.

➔ see Invasive Pests, next page



Sawdust Mulch. The use of sawdust mulch is a regular practice for some producers, particularly in the cultivation of blueberries, in reducing weeds.

- See the Blueberry Production Guide for more information.

Seven Steps to Managing Your Weeds: A Manual for Integrated Weed Management in British Columbia

Rangeland Management BC

Rangeland Handbook for BC (not available online)

A Guide to Weeds in British Columbia

Enhancing Information and Collaboration for Managing Emerging Pests
(Climate & Agriculture Initiative BC)

Noxious Weeds. Noxious weeds should be prevented from becoming established on a farm and, if present, prevented from spreading to neighbouring properties by following the above beneficial management practices for weeds. Noxious weeds are listed in the *Weed Control Regulation.*

Invasive Species Council of British Columbia

Field Guide to Noxious and Other Selected Weeds of British Columbia

Wildlife

Some wildlife, such as rodents and some birds, are managed as pests. Other wildlife, such as deer, elk, or beaver, are managed as problem wildlife. For problem wildlife information,

➔ see Biodiversity Conflicts, **page 7-25**

Rodents

Rodents are a concern on the farm because they can spread diseases and bacteria (e.g., salmonella) and contaminate feed and other livestock and crop products. Rodents also cause structural damage by tunnelling through soil and buildings and chewing through wiring. To effectively ward off rodent infestations, implement the following practices:

- Control food and water supplies by:
  - Avoiding spillage of feed both inside and outside barns.
  - Keeping all feed in covered containers.
  - Eliminating water sources like leaky taps, sweaty pipes and open drains.
- Rodent-proof buildings and eliminate nesting sites by:
  - Keeping buildings in good repair.
  - Keeping areas next to buildings free of weeds, long grass, and debris.
  - Screening ventilation ports and other openings.
- Maintain good general sanitation and cleanliness throughout the farmstead.

When rats and mice are established, they can be controlled by poisoning with rodenticides, fumigating, trapping or any combination of such practices. Always place rodenticides in covered bait stations. If placed in and around manure piles, collect before the manure is removed for land spreading. Rodenticides spread on land with waste products pose a serious threat to pets, birds, farm animals, and wildlife.

Control of Rats and Mice on Poultry Farms

Birds

Starlings, robins, crows, magpies and other bird species may cause significant crop loss, are a nuisance to livestock and crop producers, and have been implicated in the spread of diseases. Control measures are usually less effective once birds have established feeding patterns. Implement the following practices:

- Bird-proof structures that store or contain grain.
- Clean up spilled grain immediately.
- Drain or fill-in water pools and puddles as starlings are attracted to water.
- Keep water in livestock waterers at levels low enough to prevent birds from drinking when perched on the waterer edge.

To manage damage to crops, use techniques or equipment such as bird distress calls, noisemakers, netting, population control, and starling traps. Check local municipality bylaws before using any methods.

Berry Production Guide

Bird Predation Management Plan - Blueberries

Starlings and Livestock Farms

Manage audible bird scaring devices according to Normal Farm Practices as set out in established standards and decisions issued by the BC Farm Industry Review Board.

Audible Bird Scare Devices in BC

Also refer to AGRI's Wildlife Damage Control guidelines.

Wildlife Damage Control – Interior BC

Wildlife Damage Control – South Coastal BC

PESTICIDES

PESTICIDE ENVIRONMENTAL CONCERNS

Primary environmental concerns related to pesticides are:

- Pesticides inappropriately applied, spray or vapour drift, spills, backflow and improper disposal of chemicals or containers that results in soil, water or air pollution; or in damage to non-target organisms.
- Birds and wildlife coming into contact with pesticides or crops receiving pesticide application that results in damage to birds and wildlife.
- Excessive application of petrochemical-based pesticides contributes to greenhouse gas emissions causing climate change. Increased application of all pest-control products adds to the farm energy consumption through elevated equipment use.

For detailed information on these concerns:

➔ see Impacts on Biodiversity and Habitat, **page 7-7**, and refer to Impacts to Biodiversity and Habitat

➔ see Soil Quality Factors, **page 8-1**, and refer to Contaminants

➔ see Water Quality and Quantity Factors, **page 9-1**, and refer to Contaminants

➔ see Air Contaminants, **page 10-1**

PESTICIDE LEGISLATION

The following is a brief outline of the main legislation that applies to pesticides that are related to environmental protection.

➔ see **page A-1** for a summary of these and other Acts and Regulations

The *National Farm Building Code 1995* outlines standards for pesticide storage and **is enforced only where proclaimed by local governments.**

- SECTION 4.1.4: requires storage facilities for pesticides to:
  - Be vented to the outdoors, accessible from outdoors only, secured against unauthorized entry.
  - Have an impervious floor that is curbed to contain spills.
  - Be identified with a sign at entrance stating "Danger – Chemical Storage – Authorized Person Only" or words to that effect.
  - Be separated from all food, feed and water supplies.
  - Be insulated and have a heated cabinet for chemicals requiring frost protection.
  - Separate oxidizing and flammable chemicals.

Local governments may also have by-laws restricting the use of "cosmetic" pesticides; these bylaws do not apply to land used for agriculture, residential areas of farms or for the management of pests that impact agriculture

Drinking Water Protection Act

This Act and Regulations have requirements regarding the protection of drinking water quality and regulate domestic water systems (those serving **more** than one single-family residence).

- SECTION 23(1): subject to subsection (3), a person must not (a) introduce anything or cause or allow anything to be introduced into a domestic water system, a drinking water source, a well recharge zone or an area adjacent to a drinking water source, or (b) do or cause any other thing to be done or to occur if this will result or is likely to result in a drinking water health hazard in relation to a domestic water system.

Environmental Management Act

This Act describes responsibilities for use of pesticides in agriculture and other sectors and spill reporting, response, and recovery, which are supported by several regulations.

The *Code of Practice for Agricultural Environmental Management* requires persons to use environmentally responsible and sustainable agricultural practices when carrying out agricutural operations, for the purpose of minimizing the introduction of waste into the environment and preventing adverse impacts to the environment and human health. The AEM Code is expected to regulate discharges with respect to pesticides, with specific regulations coming into effect at a later date.

The *Code of Practices for Agricultural Environmental Management* regulates pesticide movement from the applicator's property.

SECTION 77.1: Unless an adjacent property owner agrees otherwise, a person who uses pesticides for the purpose of an agricultural operation must ensure that a no-treatment zone between an outdoor pesticide use area and the adjacent property is sufficient to prevent the unreasonable release of pesticide spray or runoff onto the adjacent property.

- "No-treatment zone" means an area of land that must not be treated with pesticide.

It is important for producers to ensure that their pesticide application practices adhere to SECTION 77.1 as described above, because it may be applied when a drift incident is being investigated in order to determine if the use of the pesticide resulted in an unreasonable release of pesticide to the adjacent property.

The *Spill Reporting Regulation* requires spills of a polluting substance be reported immediately to the Provincial Emergency Program (PEP) at 1-800-663-3456 (24 hour service). Report spills of pesticides (pesticide, pesticide mixture or waste) if the spill enters, or is likely to enter, a body of water, or if the spill is greater than 5 kg or 5 litres.

The *Hazardous Waste Regulation* (section 42(1)) specifies measures for the cleaning and disposal of pest control products and containers.

Integrated Pest Management Act

This Act and the *Integrated Pest Management Regulation* have numerous requirements regarding the use, containment, transport, storage, disposal and sale of pesticides.

The *Integrated Pest Management Act* and Regulation establish conditions for the sale and use of pesticides in BC through a classification system and regulatory provisions for licences, certification, permits, Pest Management Plans and ministry confirmations of receipt of a pesticide use notice. The Regulation also contains public notification, consultation, reporting, and record keeping provisions – as well as standards for use of Integrated Pest Management and for human health and environmental protection.

Under the *IPM Act*, a person must not "use, handle, release, transport, store, dispose of or sell a pesticide in a manner that causes or is likely to cause an unreasonable adverse effect." This general prohibition, in concert with requirements for Integrated Pest Management (IPM), underpins the ministry's approach to regulation of pesticide use in BC.

Pesticide storage and safe handling practices may be reviewed by a Ministry inspector or a Conservation Officer (also designated as an inspector under the *IPM Act*) during a farm inspection.

- SECTION 3(1): Without limiting any other provision of this Act, a person must not (a) use a pesticide that causes or is likely to cause, or use, handle, release, transport, store, dispose of or sell a pesticide in a manner that causes or is likely to cause, an unreasonable adverse effect.

  It is important for producers to ensure that their pesticide application practices adhere to Section 3(1), as described above, because it may be applied when a drift incident is being investigated in order to determine if the use of the pesticide resulted in an unreasonable adverse effect, or if the action was likely to cause the unreasonable adverse effect.

- SECTION 4(1): Except as provided in the regulations, a person must not use a pesticide for a prescribed use unless the person holds the licence that is, under the regulations, required for that purpose, and complies with the terms and conditions in or attached to that licence. When hiring a custom applicator (or when providing a spray service to another grower/farmer), a pesticide user licence and an applicator certificate are required.

Integrated Pest Management Regulation

- SECTION 18(1): Permit-restricted pesticides are considered to be prescribed for the purpose of the Act.
- SECTION 18(2): Except as provided in subsection (4), the following uses of a pesticide are prescribed for the purpose of the Act:
  - Aerial application of a pesticide.
  - Use of a pesticide, other than an excluded pesticide, in or on a body of water, unless a licence is required for the use or a confirmation is required for the use.

  Aerial applications to private land used primarily for agriculture do not require a Pesticide Use Permit.

- SECTION 18(4): A use described in subsection (2) is not prescribed if:
  - The use is aerial application to private land used primarily for agricultural production, the use is aerial application of a Scheduled Pesticide, in accordance with a licence or a confirmation, and to land that is neither in an urban area nor used for residential purposes.

  SECTION 33(1): A person who stores a pesticide must store it in a manner that:
  - Minimizes hazards to human health and the environment, and
  - Is in accordance with the standards prescribed in Sections 65 [pesticide container and labeling standards], 66 [pesticide storage] and 67 [pesticide storage — licencee], as applicable.
- SECTION 33(2): A person who transports or causes or allows the transport of a pesticide must ensure that the pesticide is secured and transported in accordance with the applicable standards prescribed in Division 7 [Standards for Use, Containment, Transport, Storage or Sale of Pesticide] of Part 2 and in a manner that prevents:
  - The escape, discharge or unauthorized removal of the pesticide from the transport vehicle, and
  - The contamination of food or drink intended for animal or human consumption, bedding or similar items that are transported with the pesticide.
- SECTION 33(3): A person who uses a pesticide must use it in a manner that:
  - Minimizes hazards to human health and the environment, and
  - Is in accordance with the applicable standards prescribed in Division 7 [Standards for Use, Containment, Transport, Storage or Sale of Pesticide] of Part 2 in relation to the handling, mixing, applying or disposing of pesticides, and the handling and disposal of containers used for pesticide.
- SECTION 65(1): Pesticide must be kept, handled, stored or transported:
  - In the container in which it was originally packaged and with the label originally affixed by the manufacturer, or
  - In a container designed for containing the pesticide and labeled in accordance with subsection (2).

- SECTION 65(2): For the purposes of subsection (1)(b), a label must display:
  - The trade name of the pesticide,
  - The name and the concentration of the active ingredient in the pesticide, and
  - The pesticide's registration number under the federal Act.
- SECTION 65(3): Subsections (1) and (2) do not apply to tanks being used for mixing pesticides for or holding pesticides during use.
- SECTION 66(1): Pesticide, other than excluded pesticides and domestic pesticides, must be stored:
  - Separately from food intended for human or animal consumption, and
  - In a storage facility that is ventilated so that pesticide vapours are vented to the outside, not used for the storage of food intended for human or animal consumption, locked when unattended, and accessible only to persons authorized by the person storing the pesticide.
- SECTION 66(2): Each door providing access to a facility described in subsection (1) must bear a sign that:
  - Has the words "warning: chemical storage — authorized persons only" written in block letters, and
  - Is clearly visible to a person approaching the door.
- SECTION 66(3): Fumigants and other pesticides that:
  - Release vapours, and
  - Bear a "poison" symbol on the label and must be stored in a storage facility that is not attached to or within a building used for living accommodation.
- SECTION 70(1): A container used to prepare, mix or apply a pesticide must not be washed or submerged in a body of water
- SECTION 70(2): If equipment is used to draw water from a body of water or an irrigation system into a container used to contain, prepare, mix or apply a pesticide, a gap must be maintained between the pesticide and the equipment so that pesticide is prevented from entering the body of water or irrigation system

A summary of the *Integrated Pest Management Act* and *Regulation* can be found at

Integrated Pest Management Act and Regulation

Email: bc.ipm@gov.bc.ca or Phone: (250) 387-9502 or

Pesticide Certification and Training Website BC

Public Health Act

Administered by the Ministry of Health, this Act has a specific prohibition that "a person must not willingly cause a health hazard, or act in a manner that the person knows, or ought to know, will cause a health hazard". This prohibition would apply to farm practices that may result in a health hazard, such as when nutrients, contaminants or pathogens are discharged to land, water or air so as to pose a public health problem. Any situation that entails a health hazard will enable health officers to investigate using their powers under the Act. Under the *Public Health Act*, the local Health Authority must investigate any health hazard and has authority to order that a person prevent or stop a health hazard, or mitigate the harm or prevent further harm from a health hazard amongst other powers. Similar regulatory provisions exist for addressing health hazards to drinking water supplies under the *Drinking Water Protection Act*.

This Act prohibits activities that may cause a health hazard:

- SECTION 11: requires the reporting of any health hazard to a prescribed person (a health hazard may be the escape of toxic substances).
- SECTION 15: a person must not willingly cause a health hazard, or act in a manner that the person knows, or ought to know, will cause a health hazard.

The Act has conditions under the *Health Hazards Regulation*:

- SECTION 8: separation distance of wells to be 30 metres from any probably source of contamination.

Wildlife Act

The provincial *Wildlife Act* protects wildlife designated under the Act from direct harm, except as allowed by regulation (e.g., hunting or trapping), or under permit. Legal designation as Endangered or Threatened under the Act increases the penalties for harming a species. The Act also enables the protection of habitat in a Critical Wildlife Management Area.

Agriculture Environment Management Code: Administered by BC Ministry of Environment and Climate Change Strategy, this AEM Code regulates pesticide movement from the applicator's property.

SECTION 77.1: Unless an adjacent property owner agrees otherwise, a person who uses pesticides for the purpose of an agricultural operation must ensure that a no-treatment zone between an outdoor pesticide use area and the adjacent property is sufficient to prevent the unreasonable release of pesticide spray or runoff onto the adjacent property.

- "no-treatment zone" means an area of land that must not be treated with pesticide.

It is important for producers to ensure that their pesticide application practices adhere to Section 77.1 as described above, because it may be applied when a drift incident is being investigated in order to determine if the use of the pesticide resulted in an unreasonable release of pesticide to the adjacent property.

Fisheries Act

Administered by both Fisheries and Oceans Canada and Environment and Climate Change Canada, this Act is established to manage Canada's fisheries resources, including fish habitat. The Act can also be administered provincially by FLNRORD and ENV. The Act applies to all Canadian waters that contain fish, including ditches, channelized streams, creeks, rivers, marshes, lakes, estuaries, coastal waters and marine offshore areas. It also applies to seasonally wetted areas that provide fish habitat such as shorelines, stream banks, floodplains, intermittent tributaries and privately owned land. The Act includes provisions for stiff fines and imprisonment to ensure compliance.

The purpose of this Act is to provide a framework for (a) the proper management and control of fisheries; and (b) the conservation and protection of fish and fish habitat, including by preventing pollution.

This Act was updated in 2019 and now empowers the Minister to make regulations for the purposes of the conservation and protection of biodiversity.

The definition of fish habitat is: "water frequented by fish and any other areas on which fish depend directly or indirectly to carry out their life processes, including spawning grounds and nursery, rearing, food supply and migration areas". The quantity, timing and quality of the water flow that are necessary to sustain fish habitat are also deemed to be a fish habitat. Furthermore, serious harm to fish includes the death of fish or any permanent alteration to, or destruction of, fish habitat.

Provisions of the Fisheries Act relevant to agricultural operations include:

- Protection for all fish and fish habitats;
- Prohibition against the death of fish or the 'harmful alteration, disruption or destruction of fish habitat';
- A permitting framework and codes of practice to improve management of large and small projects impacting fish and fish habitat;
- Protection of fish and/or fish habitats that are sensitive, highly productive, rare or unique; and
- Consideration for the cumulative effects of development activities on fish and fish habitat.

Specific Sections of the Act include:

SECTION 34.2(1) The Minister may establish standards and codes of practice for:

(a) The avoidance of death to fish and harmful alteration, disruption or destruction of fish habitat;

(b) The conservation and protection of fish or fish habitat; and

(c) The prevention of pollution.

SECTION 34.4(1) No person shall carry on any work, undertaking or activity, other than fishing, that results in the death of fish.

SECTION 35 (1) No person shall carry on any work, undertaking or activity that results in the harmful alteration, disruption or destruction of fish habitat.

Every person who contravenes subsection 34.4(1) or 35(1) is guilty of an offence and liable.

Notifying authorities about serious harm to fish or deposit of a deleterious substance:

SECTION 38 (4.1) Every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations of a harmful alteration, disruption or destruction of fish habitat that is not authorized under this Act, or of a serious and imminent danger of such an occurrence, if the person at any material time:

(a) Owns or has the charge, management or control of the work, undertaking or activity that resulted in the occurrence or the danger of the occurrence; or

(b) Causes or contributes to the occurrence or the danger of the occurrence.

SECTION 38 (5) If there occurs a deposit of a deleterious substance in water frequented by fish that is not authorized under this Act, or if there is a serious and imminent danger of such an occurrence, and detriment to fish habitat or fish or to the use by humans of fish results or may reasonably be expected to result from the occurrence, then every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations.

SECTION 38 (7) As soon as feasible after the occurrence or after learning of the danger of the occurrence, the person shall provide an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations with a written report on the occurrence or danger of the occurrence.

Migratory Birds Act

Under this Act, the federal government is responsible for implementing a Convention between Canada and the U.S. for the protection of migratory birds and nests. The Canadian Wildlife Service of Environment Canada administers the regulations.

Under the Regulations:

SECTION 35(1): prohibits the deposit of oil, oil wastes or any other substance harmful to migratory birds in any area frequented by migratory birds

Pesticides may be considered harmful substances..

Pest Control Products Act

The Act and *Pest Control Products Regulations* require all pesticides used in Canada to be registered and have a Pest Control Products number on the label. Pesticides can only be used according to label directions (directions include environmental protection requirements).

Pest control products include herbicides, fungicides, insecticides, rodenticides, biological controls such as bacteria and viruses and antimicrobial agents such as those used in wood preservation, water purification systems and material preservatives. The intent of the legislation is to ensure the safety, merit and value of pesticides used in Canada.

It is an offence under the Act and its regulations to use an unregistered pesticide or to use a product in a way that is inconsistent with the directions or limitations as shown on the product label.

Species at Risk Act

This Act has sections that protect listed species, their residence and critical habitat. It applies to federal lands, internal waters (i.e., all watercourses), territorial sea of Canada, and the air space above them.

The provisions of the *Species at Risk Act* (known as the 'safety net') could be invoked on BC crown and private lands using a federal order under the Act if provincial action is not sufficient to protect listed species..

Transportation of Dangerous Goods Act

Under this Act, Transport Canada is responsible for regulating the handling and transportation of poisonous substances, flammable and combustible liquids and other products hazardous to the environment. The Act has been adopted as provincial legislation and is administered by the BC Ministry of Transportation and Infrastructure.

Dangerous goods may include pesticides. Transportation of large quantities (more than 500 kg) of pesticides requires shipping documents, special product labels and vehicle placards.

This Act and *Transportation of Dangerous Goods Regulations* provide requirements for the handling and transportation of "poisonous substances" which includes pesticides. Farmers transporting more than 1,500 kg of pesticides in a licensed farm vehicle more than 100 km must comply with special requirements. Farmers moving a sprayer containing more than 6,000 litres of spray mixture for more than 100 km on a public road must comply with special requirements.

PESTICIDE BENEFICIAL MANAGEMENT PRACTICES

Comply with applicable pesticide related legislation, including the above, and where applicable, implement the following beneficial management practices to protect the environment.

Since pesticides are designed to harm target organisms, take proper safety precautions to protect non-target organisms and the environment. If pesticides come in contact with surface water or groundwater there is a high risk of environmental impact.

Pesticide Applicators Certificate

Certification and/or training is required for anyone who:

- Purchases or applies restricted class pesticides.
- Assists a certified applicator in the application, transportation, storage, and security of pesticides.
- Applies pesticides for authorization holders (business or organizations that have pesticide use permits, pest management plans or pesticide user licences).
- Dispenses (sells) pesticides for a licensed vendor.

Pesticides listed on Schedule 2 of the *Integrated Pest Management Regulation* do not require a certificate for application. Some specific training is needed in order to become certified as a pesticide applicator.

Pesticide Risks

Pesticide Movement. A pesticide is any material used to kill, control or manage pests, including products to manage the growth of plants. The primary concern related to pesticides is any unwanted movement to sensitive environmental areas such as watercourses, groundwater, fish or wildlife habitat. Pesticides can move off-target by:

- Drift – the movement of spray droplets or vapour in the air.
- Runoff – the movement across the surface of the land in water or bound to eroding soil.
- Leaching– the movement in water through the soil.
- Direct transport – the movement of soil, vegetation and other materials that contain pesticide residues.

Movement of pesticides depends on pesticide characteristics, site characteristics, and pesticide application practices.

Pesticide Characteristics. Once released into the environment, pesticides dissipate at varying rates. Dissipation characteristics influence a pesticides' potential to harm the environment. Such characteristics include:

- Degradation – the ability to break down in the environment.
  - Pesticides are broken down by microbes, chemical reactions, hydrolysis and sunlight.
  - The faster a pesticide degrades in the soil, the less likely it is to be carried to aquatic systems and groundwater.
- Volatility – ability to turn into fumes.
- Solubility in water – ability to dissolve in water soluble pesticides can leach through soil to groundwater.
- Adsorption – the ability to bind onto soil particles.
  - Pesticides that bind to soil particles are less likely to contaminate water.
- Absorption – ability to move into organisms or materials.
- Bio-accumulation – ability to accumulate in tissues.
- Toxicity – the degree to which a substance is harmful or poisonous.

When selecting pesticides, choose ones with the shortest degradation period, lowest volatility, lowest solubility, highest capacity to bind onto soil, and lowest toxicity.

Site Characteristics. Site conditions affecting pesticide movement include:

- The infiltration and permeability of soil.
- The binding capacity of soil to hold pesticides.

➔ see Contaminant Leaching in Soil, **page 8-15**

- The closer the water table is to the surface, the greater the contamination risk.
- The closer proximity to surface water bodies, the greater the contamination risk.
- The steeper the slope, the greater is the risk of runoff (slope direction determines runoff path).

If a site is likely to pose a high risk of pesticide movement, select crops or production methods that require little or no pesticide application.

The product label will state if there are certain environmental conditions (e.g., minimum temperature, maximum temperature, precipitation amount) that should be observed when applying that specific product.

Pesticide Mixes. The Pest Management Regulatory Agency provides guidance on the use of unlabelled tank mixes of commercial class pest control products used for crop production or vegetation management, as long as:

- Each tank mix partner is registered for use in Canada on the crop of interest, including genetically modified crops.
- The tank mix only includes an adjuvant, when specifically required by one of the tank mix partner labels. If an adjuvant is not required on the label of any tank mix partner, then no adjuvant may be added to the tank mix.
- The application timings of all tank mix partners are compatible with crop and pest staging.
- Each tank mix partner is applied in accordance with its registered product label (Directions for Use, Precautions, Buffer Zones, etc.). In cases where information on the tank mix partner labels differs between them, the most restrictive directions must be followed.
- The tank mix is not specifically excluded or contraindicated on either tank mix partner label.
- The use of the tank mix provides additional value to the user (e.g., increased scope of pests controlled, contributes to resistance management or integrated pest management, cost or time savings).

Application Practices. Application characteristics affecting the movement of pesticides include:

- Application method – direct-applied pesticides (wipe-on) have a lower risk than sprayer-applied.
- Droplet size – coarse droplets are less prone to drift than fine droplets.
- Application rate – lower rates decrease the risk of runoff and leaching.

When selecting pesticide application equipment, check the label information. If feasible, choose methods that wipe-on chemical or produce coarse droplets, and have low application rates.

Pesticide Transport

When transporting pesticides, implement the following practices:

- Follow requirements of *Transportation of Dangerous Goods Regulations.*
- Transport only pesticide containers that are undamaged, properly labelled and securely closed.
- Secure pesticide containers in transport vehicles.
- Transport in a separate compartment from people, animals, food or clothing.
- Place pesticides on non-absorbent materials such as metal or plastic (wood is not considered a preferred material to wash spillage from).
- Carry a pesticide spill clean-up kit.

Pesticide Storage Requirements

When storing pesticides, implement the following regulations and practices:

- Use a locked, dry building that is vented to the outside and with a "Warning– Chemical Storage – Authorised Person Only" warning sign posted on the door.
- Locate the building away from yard drains, ditches, wells, and watercourses:
  - At least 30 m from any well (*Public Health Act - Health Hazards Regulation*);
  - 15 m or more from watercourses (suggested);
  - 30 m or more from a water intake used for domestic purposes (suggested);
  - If in an area is vulnerable to flooding or surface runoff, consider moving to a different site, raising the building floor above flood levels, or wet-proofing the pesticide storage structure.

- Label container with the name, trade name, concentration of active ingredient, and Pest Control Product (PCP) registration number. PCP numbers are required under the *Pest Control Products Act* to identify pest control products that achieve a satisfactory assessment for use.
- Store pesticide-treated seed in areas where animals, including wildlife will not come in contact with the seed.
- Store pesticides in their original containers and close containers tightly.
- If the original container is damaged, place pesticide in a suitable container.
- If the original label is illegible or missing, obtain a replacement label from the supplier or website.
- Do not store food, feed, fertilizer, seed, livestock or livestock medication with pesticides.

Pesticide Storage Recommendations

- Store following label directions – check MSDS sheets for more information:
  www.msdsonline.com/msds-search
- Construct the storage with curbs of concrete or other impervious material that will contain spills and allow for easy clean-up.
- Site to protect the storage from collision by vehicular traffic.
- Store herbicides separate from other pesticides to prevent cross-contamination.
- Locate a pesticide spill clean-up kit nearby.
- Keep an updated list of stored pesticides in case of fire or spill emergencies.
- Keep a list of emergency phone numbers in a convenient location known by all farm workers.
- Refer to **Figure 5.1**, for an example of a pesticide storage shed.
  On Farm Pesticide Storage and Handling Facilities

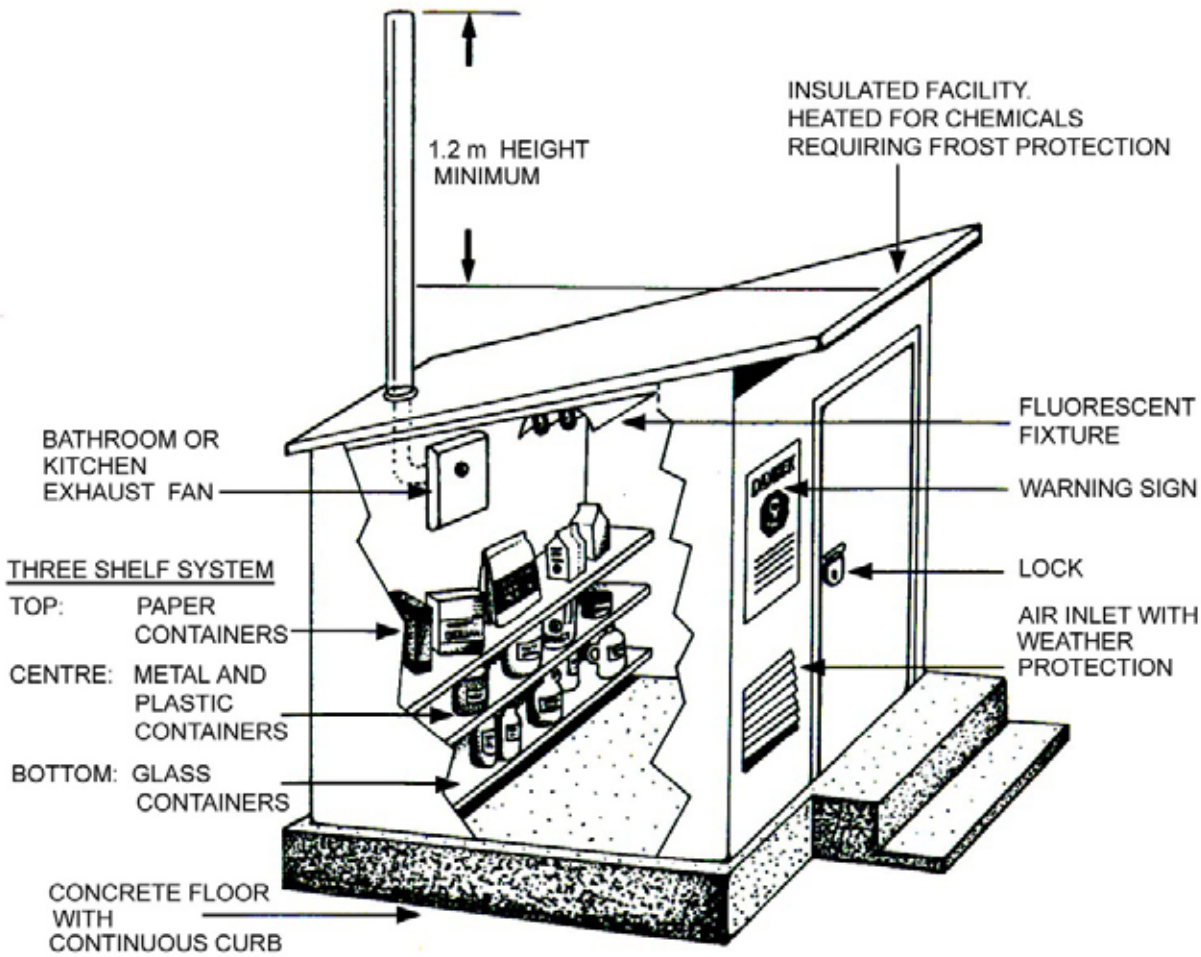


FIGURE 5.1 Pesticide Storage Shed

Pesticide Use

Use Integrated Pest Management (IPM) principles to determine if and when pesticides may be needed. Only use pesticides that are registered for a particular pest and crop. Pesticide labels have environmental protection information (such as buffer zones). Follow the specified uses and instructions on the label to minimize impacts to the environment.

Pesticides and Pest Management BC

Follow best practices to protect health and safety of workers who work with or near pesticides. WorkSafeBC has published a manual:

Standard Practices for Pesticide Applicators

Pre-Application. Before mixing pesticides, implement the following practices:

- Ensure that the correct pesticide is selected for a given pest.
- Read the label carefully, including any attached booklets, and follow safety precautions and instructions.
- Pesticides can only be applied via aerial application or chemigation if it is stated on the pesticide label.
- Know the size of the crop area to be treated and know exactly how much pesticide is required for that area to avoid excess chemical disposal.
- If spraying near an environmentally sensitive area, ensure that the pesticide can be used safely.
  - Determine the size and type of buffer zone needed to protect the sensitive area.

  ➔ see Buffers, **page 11-4**
- Ensure that the application equipment is in good working order.
- Ensure that equipment is calibrated.
- Be prepared to handle a spill.

Equipment Calibration. Before mixing pesticides, ensure the equipment will apply the correct amount uniformly by completing a thorough calibration. Implement the following four-step equipment calibration practice:

- Step 1: set-up of the equipment (usually the most time-consuming step, but one that must be done to ensure uniform and properly targeted application).
  - Ensure there are no leaks, the spray boom is properly arranged for the target, and the swath width and driving pattern are determined.
  - Select nozzles, spray pressure and spray volume.
  - Measure the output of individual nozzles for uniformity and wear.
- Step 2: measure the delivery rate of the application equipment.
- Step 3: adjust the delivery rate, if required, after comparing the measured delivery rate to the rate recommended on the pesticide label or the Production Guide.
- Step 4: calculate the amount of pesticide to add to the sprayer tank to provide the correct pesticide application rate.

Calibration should be done:

- Before new or altered equipment is used.
- When making changes that affect the delivery rate.
- At regular intervals to see if wear is affecting output.
- At least once a year.
- Prior to the first application of the year.

Crop Production Guides

Suggestions for Field Sprayer Operation and Maintenance

Calibration Worksheet – Boom Sprayer

Sprayer Filling and Mixing. To protect the environment at filling and mixing locations, implement the following practices:

- Install an approved back-flow prevention device on the waterline or ensure that an air gap of at least 30 cm (suggested) between the end of the water supply line and the spray tank exists.
- Locate sprayer filling sites:
  - At least 30 m from any well (*Public Health Act – Health Hazards Regulation*).
  - 15 m or more from watercourses (suggested).
  - At a lower elevation than any wells – if not at a lower elevation, have a berm around the well to divert runoff.
  - With buffer areas between it and all watercourses.

➔ see Buffers, **page 11-4**

- Mix only the required pesticide needed for a single day.
- Have spill cleanup equipment such as absorptive materials, personal protective equipment and shovels readily available.
- After emptying any pesticide container and prior to spraying its contents, rinse the container and pour the rinse water into the sprayer (rinse according to **Table 5.3**).

Application. While applying pesticides, implement the following practices:

- Have valid certification and training.

Pesticide Certification and Training BC

Conditions have been placed on fumigation certifications and pesticide licences to ensure fumigations are performed safely, and according to pesticide labels and current standards.

Fumigator Applicator Certificate BC

- Use the application rate specified on the label.
- Maintain an untreated buffer between treated areas and sensitive areas.
- Follow pesticide label setbacks from non-target aquatic and terrestrial areas, and from wells.

➔ see Buffers, **page 11-4**

- Only apply pesticides by aircraft or chemigation if specified on the label.
- Use GPS guidance systems where appropriate to avoid application overlap.
- Apply pesticides in suitable weather conditions:
  - Do not spray in strong winds over 8 km/hr.
  - Do not apply if heavy rain is expected.
- Protect bees and other beneficial insects by applying pesticides:
  - When flowers are not present.
  - During early morning or late evening hours when insects are not active.
  - Away from insect drinking water sources.
  - That are least toxic to insects.
- Shut off spray nozzles when they are over non-targeted areas (e.g., while turning on headlands).
- Incorporate granular insecticides into soil to protect birds and wildlife.

Drift Control. Drift refers to the movement of pesticide droplets, dust or vapours, by wind or air currents, away from target areas.

The degree of drift is strongly related to droplet size. The smaller the droplet, the farther wind carries them from the target area. Fine droplets can be carried several kilometres. In addition, larger distances between the sprayer nozzle and the target will result in more drift.

Vapour drift from volatile chemicals can continue long after the spraying operation is completed. Small amounts of highly volatile pesticides can impact susceptible plants and watercourses near treated areas. This can occur even under stable air conditions because vapours tend to flow along the ground without dispersal.

To minimize spray drift, implement the following practices when practical:

- Replace or clean faulty nozzles to reduce fogging.
- Use nozzles such as low-pressure, air induction, flooding, or raindrop nozzles to produce drops more resistant to drift.
- Use shrouded, air-assist or tunnel sprayers.
- Only use special, low-volume sprayers where suitable.
  - Such sprayers typically produce small droplets more subject to drift.
- Apply pesticides at low spraying pressures to reduce the number of fine spray droplets.
- Keep boom height as low as possible while maintaining uniform coverage.
- Do not spray during strong or gusty wind conditions or during dead calm.
  - Avoid spraying during conditions when temperature inversions may occur.

Use plastic tarps when fumigating soils to contain fumigant. Tarps not only reduce air pollution but increase the effectiveness of treatment. Tarp removal or cultivation of fields too soon after fumigation can result in the release of unwanted pesticide into the air. Plastic used in fumigation should go to a landfill. Soil Fumigation requires a fumigation applicators certificate.

Buffer Zones. Many pesticide labels have buffer zone information on the label. The pesticide labels may specify:

- Whether the buffer zone is to protect aquatic and/or terrestrial habitat.
- What is considered to be aquatic or terrestrial habitat (See **Figure 5.2**).
- The type of pesticide application equipment that requires a buffer zone.
- If and how buffer zones can be reduced; the use of drift reducing spray shields, special nozzles, or other application modifications may allow the applicator to reduce the buffer zone.
  - And any types of application equipment that do not need a buffer zone.
- That the buffer zones on a label are required between the point of direct application and the closest downwind edge of sensitive terrestrial or aquatic habitats.
  - Buffer zones may depend on wind direction.
- The size of the buffer zone (see the example in **Table 5.2**).

TABLE 5.2 Example of a Buffer Zone on a Pesticide Label

Method of Application	Crop		Buffer Zones (metres) Required for the Protection of:		
			Freshwater Habitat of Depths:		Terrestrial Habitat
			Less than 1m	Greater than 1m	
Field Sprayer	Field crops		10	5	1
Airblast Sprayer	Stone fruits and grapes	Early Growth stage	40	30	2
		Late growth stage	30	25	1

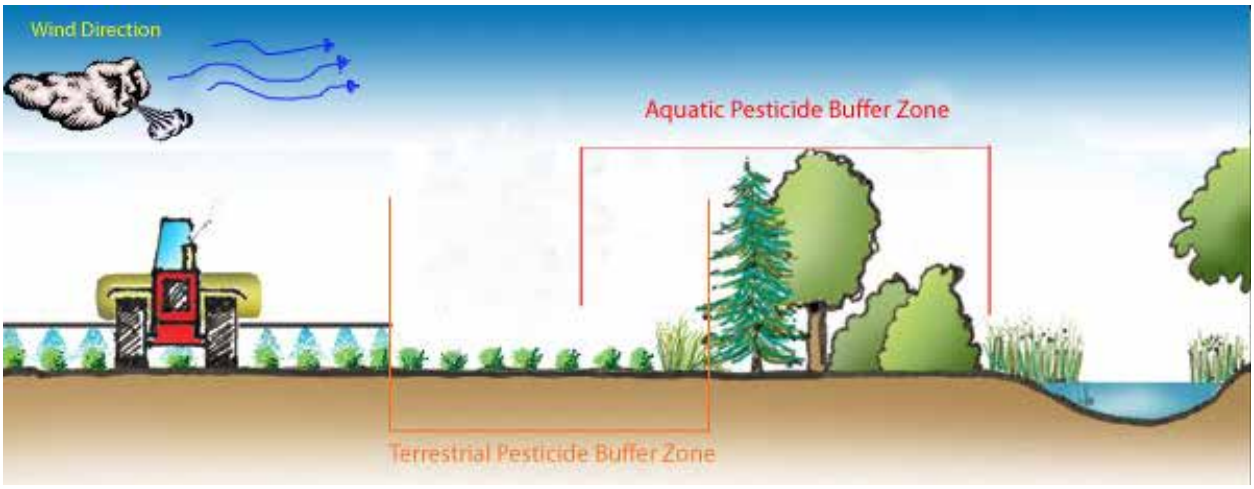


FIGURE 5.2 Identifying Aquatic and Terrestrial Buffer Zones

Leaching Control. Pesticides that have a tendency to leach into groundwater may have special restrictions on the label. Read and follow these instructions. Be aware of the depth of the groundwater and characteristics of the site and pesticides applied.

Runoff Control. Runoff from areas treated with pesticides can pollute streams, ponds, lakes and wells. To reduce pesticide runoff, implement the following practices:

- To prevent the application of pesticides immediately prior to a heavy rain, check the weather forecast (rain can wash pesticides off treated surfaces and can cause runoff or erosion to occur from treated areas).
- Use minimum tillage techniques to reduce soil erosion and runoff of pesticides bound to the soil.
- Leave a buffer of vegetation and plant material around ditches and natural water bodies to filter pesticide-contaminated runoff.
- Collect contaminated runoff, where feasible.

➔ see Runoff, **page 9-51**

Equipment Washing. When washing equipment used to apply or mix pesticides, implement the following practices:

- Clean sprayers as far as conveniently possible from watercourses, ditches, or wells to prevent pesticide movement from runoff into watercourses, or via leaching to groundwater.
  - Cleaning sites must be at least 30 m from any well (*Public Health Act – Health Hazards Regulation*).
  - 15 m or more from watercourses (suggested).
- Dispose of wash water by using as a pesticide or by following **Table 5.3.**

Record Keeping. Knowing when, where and how pesticides were applied is a critical part of an IPM program, implement the following practices:

- Maintain a record of all pesticide applications including the site (field size and location), date, target pest, pesticide and amount used, crop stage, harvest date, application method, spray volume, weather observations, and precautions followed (e.g., buffer zones).
- Food safety programs and WorkSafe BC also have record keeping requirements; incorporate their requirements into your records.

  WorkSafeBC Standard Practices for Pesticide Applicators

- Often there are examples of records in Crop Production Guides.

➔ see, **page 5-8** for list of Guides

Pesticide Application to Livestock. Several species of insects and mites attack cattle. Pesticides are available in various formulations to protect livestock from injury and disease associated with pest attack. New livestock pests may emerge with climate change for which pesticides are not readily available.

Farm Practice Pest Management

Pesticides applied to animals for the purposes of reducing disease or applied internally to control arthropods are not considered pesticides and are exempt from the *Integrated Pest Management Act and Regulation*.

To avoid contamination of soil and water, implement the following practices:

- Use pour-on or spot treatments in place of whole-body sprays.
- Place self-activated and forced-use pesticide backrubbers at least 30 m from wells (*Public Health Act – Health Hazards Regulation*) and 15 m from watercourses (suggested).
- Ensure that backrubbers are not leaking and are adjusted correctly for dispensing appropriate concentrations of insecticide.
- Ensure that used insecticidal ear tags are collected and properly disposed.

Pesticide and Pesticide Container Disposal

Disposal of pesticides is complicated and expensive. The best precaution to avoid disposal is through good planning. Plan pesticide purchases to minimize the amount of pesticides stored and the accumulation of unwanted pesticides.

Excess Mixed Pesticide. Implement the following practices:

- Reduce the volume of waste by mixing only the amount of pesticide required for a specific application.
- Do not store excess mixture in spraying equipment for extended periods of time.
  - Some pesticides may undergo chemical degradation resulting in a decrease in efficacy.
- Use excess spray mixtures on another crop or at another site if label specifications allow.
- Do not exceed label application rates by re-spraying treated areas.
- Do not dump unused mixed pesticide on land or allow to drain into sewers or other piping systems.

Excess Concentrated Pesticide. Implement the following practices:

- Purchase no more than one year's supply of pesticide at a time.
- Return unopened pesticide containers to the manufacturer or dealer.
- Do not dump unused or unwanted pesticide concentrate on land or allow to drain into sewers or other piping systems.
- Contact a hazardous waste disposal company or ENV for information on disposal of leftover pesticides.
- Occasionally there are agricultural unwanted pesticide collection programs that will accept unwanted pesticides from farmers. These collections are advertised through grower associations, the BC Agriculture Council or pesticide distributors.

Disposal of Empty Pesticide Containers. After emptying pesticide containers it is a legislative requirement that all pesticide containers are properly rinsed and disposed of as outlined in **Table 5.3**. After rinsing the container implement the following practices:

- Crush or puncture the container so that it cannot be reused.
- Dispose of containers at pesticide container collection sites, or safely store for a short time until disposal is more convenient.
- Do not burn paper or plastic pesticide bags to prevent the release of toxic fumes.

Some pesticide dealers in BC now accept properly rinsed metal and plastic containers for recycling. This is the preferred disposal method for containers. Visit Clean Farms to find disposal locations and procedures for your region.

TABLE 5.3 *Hazardous Waste Regulation* for Empty Pesticide Containers	
Rinsing Method for Empty Pesticide Containers★	
Type of Container	**Rinsing Method**
Rigid plastic or metal (non-pressurized)	Pressure rinse[1] for 30 seconds or single rinse 3 times
Rigid plastic or metal (pressurized)	No rinsing required
Glass bottle	Rinse[2] three times
Paper or plastic bag	Rinse
Containers labeled "Domestic"	No rinsing required
Any container type not listed above	As approved by ENV

Disposal Method for Empty Pesticide Containers★

The owner of a waste pesticide product container that has been emptied and rinsed must recycle or dispose of it:

(a) in an approved landfill, or;

(b) by burying it, but only if;

(i) the burial location is on land owned or leased by the person owning the container or is on land owned, leased or maintained in a tree farm licence as defined in the Forest Act by the person owning that container:

(ii) the burial location is on flat ground, not in a swale and at least 200 m from surface water or a well;

(iii) the ground does not consist of gravel, sand or other similarly porous material, and;

(iv) the owner covers it with at least 0.5 m of soil immediately after burial.

Disposal Method for Container and Equipment Wash Water★

Waste produced by cleaning pesticide application equipment or by rinsing waste product containers must, if practicable, be used in mixing a product solution but, if not practicable, it may be applied to land if the area to which it is applied.

(a) is on land to which the product contained in the waste has been applied for purposes of pest control,

(b) is flat ground, not in a swale, and at least 200 m from surface water or any well, and

(c) does not consist of gravel, sand or other similarly porous material.

★ See *Hazardous Waste Regulation* section 42 - these methods must be used for the containers not to be considered a hazardous waste.
1 pressurized spraying of an appropriate solvent into an empty container for at least 30 seconds
2 introduce an appropriate solvent into an empty container in an amount not less than 20% of its volume, to close and shake the container so that the solvent makes contact with all interior surfaces, and to open and empty the container

Pesticide Storage Fires

Pesticide fires are extremely dangerous because they may release highly toxic fumes. Implement the following practices:

- Keep an up-to-date list of stored pesticides in an easily accessible location separate from the storage.
- Inform local fire department about the type of pesticides stored and location of storage.
- Post a warning sign on all entrance doors to any pesticide storage facility.
- Keep emergency phone numbers posted in an accessible location.
- Keep pesticide storage areas locked.
- Do not store pesticide in glass containers in sunlight.
- Keep fire extinguishers approved for chemical fires near storage areas.
- Store combustible materials away from heating systems.

If a fire occurs, call the fire department and keep people upwind and away from the fire. Warn firefighters of the presence of pesticides in the building.

Pesticide Spills

Be prepared to handle spills by having a pesticide spill cleanup kit when transporting, storing or using pesticides. Such a kit includes gloves, protective clothing, containers for contaminated waste, tools to collect the waste and absorbent materials such as clay, kitty litter or sawdust.

Report pesticide spills in accordance with all of the following:

- *Public Health Act* (a prescribed person as defined by regulation).
- The *Spill Reporting Regulation* of the *Environmental Management Act* (contact the 24-hour Provincial Emergency Program 1-800-663-3456 to report).
- The *Integrated Pest Management Act and Regulation.*

If a pesticide spill occurs, proper cleaning and decontamination of the area may avoid environmental contamination. Implement the following practices:

- Prevent exposure of people and animals to the pesticide and its fumes.
- Put on appropriate personal protective equipment.
- Prevent the spread of the pesticide.
- Cover a liquid pesticide with soil, sawdust or any absorptive material to prevent spread or entry into a watercourse or subsurface drain.
- Dry formulations can be swept up and reused if they have not become wet or contaminated with soil or debris.
- Place collected contaminated dry formulations and absorbent material into an empty clearly-labelled garbage container and contact ENV for information on appropriate disposal.
- If possible, safely decontaminate the surfaces that the spill has come into contact with.
- Check the label for specific directions – many pesticides can be detoxified by washing the area with chlorine bleach and detergent – do not use excessive amounts of water.
- Prevent the wash solution from spreading and contaminating a larger area.
- If the spill occurs on the soil, remove the top 5 to 7 cm of soil (suggested), cover the area with lime and uncontaminated soil and contact ENV for instructions on disposal of contaminated material.
- If the spill occurs beside a watercourse, remove the top layer of contaminated soil immediately and relocate it to a safe site.

REPORTING REQUIREMENT

Under the *Spill Reporting Regulation*, pesticide spills greater than 5 litres or 5kg of product, mixture or waste must be reported immediately to the Provincial Emergency Program (PEP) at 1-800-663-3456 (24hr service).

It is very easy to generate more than 5 kg or 5 L of contaminated materials. By law, ENV must be contacted for advice on the proper method for disposal. If the spill takes place in a public area like a highway, call the local police. If the spill has released pesticide into the environment, contact the 24-hour Emergency Management Program (EMP) at 1-800-663-3456.

Pesticide Contingency Plan

Have a list of emergency numbers so it is easy to notify emergency responders (such as the local fire department) of the amount and type of pesticide stored and the storage locations. Develop a contingency plan when storing any quantities of pesticides. The plan should provide a timely and effective response to any emergencies involving the release of pesticides into the environment, from:

- Accidental spills, such as when transporting, storing, applying or dispensing.
- Release due to building fires or natural events, such as forest fires, floods, or earthquakes.
- Release due to vandalism.
- Application errors, such as applying the wrong pesticide or too much pesticide.

Contingency Plan – Template for On-Farm Planning

CHAPER 6 METRIC CONVERSIONS

Metric	Imperial Equivalent
3 m	10 feet
5 m	16.5 feet
8 m	26 feet
10 m	32 feet
30 m	100 feet
30.5 m	100 feet
122 m	400 feet
50 m^3/ha	4,500 gal/acre
50 tonnes/ha	22 tons/acre
300 µg/ml	300 ppm
15 µg/g	15 ppm
20 µg/g	20 ppm
30 µg/g	30 ppm
45 µg/g	45 ppm
50 kg/ha	45 lbs/acre
150 kg/ha	135 lbs/acre
200 kg/ha	180 lbs/acre
300 kg/ha	270 lbs/acre

Conversions in this table are rounded to a convenient number.
See Appendix E for exact conversion factor.

Values from tables and examples are not included in Metric Conversions

CHAPTER 6 TABLE OF CONTENTS

CHAPTER 6

NUTRIENT APPLICATION

INTRODUCTION

This chapter discusses nutrient management practices for protection of the environment. It contains introductory information on the relationship between nutrient sources used in agriculture and the environment. It also contains information on environmental concerns, legislation, and beneficial management practices related to:

- Application of nutrient sources, including fertilizers and soil amendments.
- Nutrient management planning.

NUTRIENT SOURCES AND THE ENVIRONMENT

- The primary role of fertilizers and soil amendments is to provide nutrients for crop growth or to provide materials for soil improvement. Misuse of fertilizers and soil amendments can result not only in damage to crops but can also cause negative impacts on the receiving soil, water, air, or habitat environment. Pertinent environmental subjects related to soil amendments are listed in alphabetical order below.

Amendments

For the purposes of this publication, soil amendments are distinguished from commercial fertilizers and broadly defined as materials applied to soil for the purpose of supplying nutrients or improving soil characteristics. How an amendment is managed will depend on the characteristics of the material itself.

Note: The term "soil amendment" as defined in the *Code of Practice for Soil Amendments* refers to specific materials (Table 6.5) which must be managed in accordance to the AEM Code. The term "soil amendment" is used in this Chapter in a much broader sense.

➔ see Legislation, **page 6-4**

Legumes and Nitrogen Fixation

Legume crops form associations with soil bacteria which provide a source of nitrogen for the plants. The rhizobium bacteria colonize the plant roots in nodules, and carry out nitrogen fixation, where atmospheric nitrogen is transformed into plant available nitrogen.

When innoculated and colonized by the correct rhizobium bacteria, legumes are less dependent on nitrogen from the soil or in amendments. However, legumes will take up nitrogen from the soil if it is available, therefore the use of on farm nutrient sources like manure can still provide benefit to the crop when applied at the correct rate.

Micronutrients and Metals

Common sources of micronutrients and metals are manure and chemical fertilizer. Some metals are plant micronutrients while some can become contaminants (toxic to soil microorganisms or plants). The availability of these elements varies, depending on soil type and soil pH.

Value of Micronutrients and Metals in Manure. The major micronutrients and metals found in manure are iron, manganese, boron, chlorine, zinc, copper and molybdenum. Under both neutral soil pH and average organic matter conditions, most micronutrients in manure are available to the crop. Soil pH webpage

Micronutrients and Metals as Contaminants. Some micronutrients and metals can pollute the soil if found at excessive levels. At high levels, necessary trace elements such as boron, zinc, and chromium may be of concern for plant growth. Some metals, which are not plant nutrients, can be toxic to plants when applied in excess. These include arsenic, lead, and cadmium..

Nitrogen (N)

Common sources of nitrogen are manure, chemical fertilizer and nitrogen-fixing plants like legumes and legume residues. Nitrogen is contained in a variety of agricultural by-products and other materials.

Value of Nitrogen in Manure. Manure contains nitrogen in both the inorganic and organic forms. Until the organic matter is biologically decomposed in the soil, nitrogen in the organic form remains unavailable for plant use. Nitrogen in this form exists as a reserve in the soil and is slowly released for plant use. Soil microbes must decompose the organic nitrogen compounds in manure before they are available to plants. A proportion of the nitrogen that enters the soil following application is available during the year of application. Most of the remaining nitrogen becomes available within the five years following application.

Livestock manure loses some inorganic nitrogen in the barn and during storage as ammonia by volatilization to the atmosphere. When manure is spread onto land for crop production, some of the remaining inorganic nitrogen may also be subject to volatilization losses, particularly if not incorporated into the soil.

Nutrient Source

The term "nutrient source" as defined in the *Code of Practice for Agricultural Environmental Management* refers to sources of nitrogen or phosphorus which must be managed in accordance to the AEM Code.

Materials which may be considered nutrient sources include: fertilizers and soil conditioners, agricultural by-products, compost produced through agricultural composting or materials produced in accordance with the *Organic Matter Recycling Regulation*, soil amendments as defined in the *Code of Practice for Soil Amendments*, digestates from anaerobic digesters, wastewater, irrigation water, and reclaimed water.

➔ see Legislation, **page 6-4**

Particle Size

The particle size of materials used as soil amendments affects the efficiency of their utilization in soil and their impact on the environment. Fine particle sized materials such as sawdust can easily be incorporated into the soil and decompose rapidly in comparison to coarser materials such as wood chips. The more rapidly an amendment decomposes, the sooner nutrients from that material are made available for plant uptake.

Particle size can also play a role in the loss of soil amendments from fields. Smaller particles are easily suspended in water or wind and are therefore carried away by runoff or erosion

Phosphorus (P)

Common sources of available phosphorus are manure and chemical fertilizer. The expression of phosphorus concentrations and rates is often confusing and can lead to serious calculation errors. Refer to **Table 6.1**, below.

TABLE 6.1 Phosphorus: Converting P to/from P_2O_5

- phosphorus content in soil or plant material, either total or plant-available form, is often expressed in terms of elemental phosphorus (P)
- phosphorus application rates for commercial fertilizers are given in terms of P_2O_5 (phosphate)
- the conversion factors are:

$P_2O_5 = P \times 2.291$

$P = P_2O_5 \times 0.436$

Phosphorus is contained in a variety of agricultural by products and other materials.

Value of Phosphorus in Manure. While most phosphorus contained in manure is in the inorganic form, it is the remaining organic form that is the most available. Availability is dependent on the rate at which soil organisms break down organic matter and release plant available phosphorus.

Phosphorus is normally bound strongly by soil particles and therefore not readily available to plants, in mineral soils. The ability of soils to bind phosphorus varies based on certain soil properties. For example, phosphorus is generally bound more than two times as tightly in Fraser Valley soils in comparison to Okanagan soils, due to differences in soil pH, geology, and soil characteristics. In situations where soil phosphorus levels are high, more than 70% of the phosphorus in manure may be available to plants in the year of application. In contrast, on soils with low soil phosphorus levels, less than 70% of the phosphorus in manure may be available to plants in the year of application.

Although manure phosphorus adds to the soil's reserve of organic phosphorus, the availability of phosphorus is low in the early spring when phosphorus uptake may be important for plant growth. This is because phosphorus availability depends on the rate at which soil microbes break down organic matter and release plant-available phosphorus, which depends on favourable soil temperature and moisture.

Potassium (K)

Common sources of potassium are manure and chemical fertilizer. The expression of potassium concentrations and rates is often confusing and can lead to serious calculation errors. Refer to **Table 6.2**, below.

TABLE 6.2 Potassium: Converting K to/from K_2O

- potassium content is often expressed in terms of elemental potassium (K)
- potassium application rates for commercial fertilizers are given in terms of K_2O (potash)
- the conversion factors are:

$K_2O = K \times 1.205$

$K = K_2O \times 0.83$

Value of Potassium in Manure. All potassium in manure is available immediately after application.

pH

Soil amendments have varying influences on soil pH. Many inorganic fertilizers, particularly nitrogen and sulfur based fertilizers, have an acidifying effect. Potassium and phosphorus-based fertilizers have a neutral effect on soil pH. However, phosphoric acid, a phosphorus-based fertilizer, has an acidifying effect. Organic-based soil amendments such as manure have a high buffering capacity and therefore have a neutral or alkaline effect on soil pH.

Salts

Most soil amendments contain salts. The salt content will vary depending on the nature of the amendment. Manure, for example, contains between 10% and 13% salts on a dry weight basis. Composted manure is characterized by higher concentrations. The presence of salt in manure is often directly related to nutrient concentrations within livestock feed.

Excess application of amendments onto land can lead to negative impacts on soil quality and crop production caused by salt effects alone. Salt levels are gauged by a manure's or soil's electrical conductivity. Salt content in soil can also be expressed as exchangeable sodium percent.

In areas of low precipitation, high annual doses of manure can adversely affect many crops by increasing soil salinity. In areas of high precipitation, salts may cause short-term problems until they are leached from the root zone.

Secondary Nutrients

Calcium (Ca). Common sources of calcium are lime, poultry manure and some chemical fertilizers.

Magnesium (Mg). Common sources of magnesium are dolomite lime, magnesium sulfate (i.e., Epsom salts) and some chemical fertilizers.

Sulphur (S). Manure and many chemical fertilizers are a source of sulphur.

SOIL AMENDMENTS: IS IT A NITROGEN SOURCE OR A SOIL CONDITIONER?

The characteristics of a soil amendment will determine how the material should be managed. A major distinction among soil amendments is the release rate of nitrogen from the material after it is applied to the soil.

All other factors being equal, a soil amendment that releases nitrogen quickly in soil (nitrogen source) poses a higher degree of nitrate leaching risk than a soil amendment in which the nitrogen releases slowly in soil (soil conditioner). The purpose of this section is to provide information that will assist in making decisions about whether a soil amendment should be used primarily as a nitrogen source or as a soil conditioner.

Soil Amendment Sources

Numerous soil amendment sources are available to producers. These materials may or may not come from the farm.

On-Farm Sources. These amendments are typically agricultural by-products and include bedding, compost, crop residue, manure, silage juice, spoiled feed, washwater, spent soilless media, spent mushroom media, and spent nutrient solution. Table 6.4 describes various sources of on-farm soil amendments

Off-Farm Sources. These are usually purchased and include chemical conditioners such as lime, soilless media constituents such as perlite, manure from other farms, compost, wood residue, and non-agricultural by-products such as municipal biosolids. Table 6.5 describes various sources of off-farm soil amendments.

Manage as a Nitrogen Source or as a Soil Conditioner?

Specific soil amendments have inherent characteristics that determine whether they are to be used primarily as a nitrogen source or as a soil conditioner.

Nitrogen Source. Some organic materials, such as manure or composts, that are added to soil will result in a release of mineral nitrogen which may be taken up by plants, stored in the soil, or lost to the environment. The primary goal of applying these materials is to provide available nitrogen which contributes to or meets a crop's nitrogen requirement.

Organic materials that are classified as nitrogen sources have a carbon-to-nitrogen ratio of less than 30:1. Table 6.3, next page, outlines criteria based on the carbon-to-nitrogen ratio for determining whether soil amendment materials should be managed as a nitrogen source or soil conditioner.

Soil Conditioners. These are materials that provide limited amounts of nitrogen, but are managed primarily for their beneficial impact on the biological, physical, or chemical nature of the soil. Soil conditioners can be organic such as compost or wood residue or inorganic such as lime or perlite..

Certain materials have properties that allow them to be used as both a nitrogen source and a soil conditioner. If this is the case, they should be managed primarily as a nitrogen source.

Organic soil conditioners typically have high levels of organic matter but are not an immediate or significant source of plant-available nitrogen and have a carbon-to-nitrogen (C:N) ratio greater than 30:1. Addition of soil amendments with a high C:N ratio may result in crop-available nitrogen being tied up (immobilized). Nutrients will be temporarily tied up in the soil, unavailable for plant use unless nitrogen is added to the soil to decrease the C:N ratio.

Case Study: Use of Poultry Manure on Berry Fields. Poultry manure has been used in the replanting of berry fields. The raw manure provides benefits of a soil conditioner, including the addition of organic matter. However, poultry manure is a nitrogen source, and the first-year berry plants have a low nitrogen requirement. Consequently, much of the nitrogen in the poultry manure is not used and at high risk of being leached, even at application rates as low as 10 yards^3/acre (20 m^3/ha). To minimize this risk, use alternate sources of organic matter with lower nitrogen levels, compost the poultry manure before application, or limit the amount of poultry manure being used. Calculate the nitrogen availabile from applications of manure or compost:

Nutrient Management Calculator web page

TABLE 6.3 Management of Soil Amendments Based on Carbon-to-Nitrogen Ratio

C:N ratio	Management Recommendations
Less than 20:1	Manage as a nitrogen source
Between 20:1 and 30:1	Material has properties of a nitrogen source and a soil conditioner but should be managed primarily as a nitrogen source
Greater than 30:1	Manage as a soil conditioner

Neither a Nitrogen Source or a Soil Conditioner Some products, such as vegetable washwater, have very little or no value as a nitrogen source or soil conditioner, causing any application of such material to be for disposal purposes. Such products require ENV authorization.

➔ see Farm Waste, **page 2-19**

Accumulation of Soil Phosphorous

Soil conditioners present a lower risk of nitrogen loss compared to nitrogen sources. However, soil conditioners, particularly if produced from animal manures (e.g., composted manure), may still contain significant amounts of other nutrients, including phosphorus (P). The accumulation of P in soil eventually leads to small but potentially significant amounts of P that may leave the fields via runoff, erosion or drainage water that flows through subsurface tile drains. Applying the right rate principles in the Beneficial Management Practices section of this chapter can mitigate long-term risks of P losses from soil and prevent water quality challenges downstream of the farm.

➔ see Right Rate, **page 6-17**

Contaminants in Soil Amendments

Soil amendments can have salt, pH or metal levels that will cause soil pollution. Before bringing any non-agricultural waste onto a farm operation, be aware of any regulations or restrictions related to the use of these materials. For all soil amendments, determine the biological, chemical or physical properties of the materials and determine before hand if they can be used beneficially on the farm.

➔ see Soil Contamination, **page 8-15**

Producers should be aware of the provisions of the federal *Fertilizers Act* and *Fertilizers Regulations* as they relate to the quality of fertilizers and supplements (note the definition of supplement in the Act is less inclusive than this publication's definition of soil conditioner). Any products bought or sold in Canada where a claim is being made as to the contents of the product to supply plant nutrients, aid in plant growth, or improve the physical condition of soil are required to be registered under the Act. The *Fertilizers Act* and *Fertilizers Regulations* require that all regulated fertilizer and supplement products must be effective and safe for humans, plants, animals, and the environment. They must also be properly labeled. For farms operating anaerobic digesters and importing off-farm products to supplement their energy production, please refer to the following resources:

- An Overview of On-Farm Biogas Production
- BC On-Farm Anaerobic Digestion Benchmark Study
- Biogas Association of BC

TABLE 6.4 Managing On-Farm Soil Amendment Sources as a Nitrogen Sources or Soil Conditioners

Soil Amendment Source	Managed Primarily as		Comments (check nutrient content before land application)
	Nitrogen Source	Soil Conditioner	
Bedding ▪ With little or no manure.	x	✓	▪ Low nutrients.
Building Drains ▪ Floor or roof.	x	x	▪ Check chemistry of water.
Compost	✓	✓	▪ Characterized by slow nutrient release, ▪ Often applied as both a nitrogen source and soil conditioner.
Contaminated Surface Runoff ▪ Water from yards, corrals.	✓	x	▪ Low in nutrients, ▪ Usually incorporated with liquid manure.
Crop Residue ▪ Green leaves or stems, ▪ Dry (i.e. straw or prunings).	✓ x	x ✓	▪ Characterized by variable nutrient levels and C:N ratios.
Inert Growing Media ▪ Rockwool.	x	x	➔ Farm Waste, **page 2-19**
Leachate ▪ From manure, compost, ▪ Or wood residue.	?	x	▪ Usually incorporated with liquid manure, ▪ Variable nutrient levels, ▪ Normally acidic and high Biochemical Oxygen Demand (BOD).
Manure – Liquid	✓	x	▪ Variable nutrient levels.
Manure – Solid ▪ Includes bedding containing significant amount of manure.	✓	✓	▪ Normally a nitrogen source but may be used as a soil conditioner if low in nutrients and if C:N ratio greater than 30:1.
Milking Centre Wash Water	✓	x	▪ Low in nutrients, ▪ Usually incorporated with liquid manure.
Mortalities ▪ Composted, ▪ Not composted.	✓ x	✓ x	▪ Handle as a compost (see above). ➔ Livestock Mortality Disposal, **page 3-49**
Silage Effluent	✓	x	▪ High nutrients and very high BOD.
Used Mushroom Growing Media	✓	✓	▪ Variable nutrient levels, ▪ Normally a nitrogen source but may be used as a soil conditioner if low in nutrients and if C:N ratio greater than 30:1.
Spent Nutrient Solution	✓	x	▪ Variable to low nutrient levels.
Spent Soilless Media ▪ Peat/wood residue based.	x	✓	▪ Variable nutrient levels.
Spoiled Feed	x	✓	▪ Variable nutrients levels, high BOD.
Wash water ▪ From washing and grading fruit and vegetables.	x	?	▪ Low in nutrients but may contain silt, chemical contaminants or high BOD. ▪ Apply at rates not exceeding water absorption capacity of soil to avoid runoff.
Wood Residue ▪ (not regulated by the AEM *Code of Practice for Soil Amendments*) fresh or composted.	x	✓	▪ Normally high C:N ratio.

? means material must be tested to determine if it is a nitrogen source or a soil conditioner

TABLE 6.5 Managing Off-Farm Soil Amendment Sources as Nitrogen Sources or Soil Conditioners

Soil Amendment Source	Managed Primarily as		Comments (check nutrient content before land application)
	Nitrogen Source	Soil Conditioner	
Biosolids ▪ Class A compost or biosolids. ▪ Other forms.	✓ ?	✓ ?	▪ May exhibit slow nutrient release. ▪ Often applied as both nitrogen source and soil conditioner. *Organic Matter Recycling Regulation* Schedule 12
Compost ▪ Class A compost. ▪ Other forms.	✓ ?	✓ ?	▪ May exhibit slow nutrient release. ▪ Often applied as both nitrogen source and soil conditioner. *Organic Matter Recycling Regulation* Schedule 12
Fish Wastes ▪ Class A compost. ▪ Other forms.	✓ ?	✓ ?	▪ May exhibit slow nutrient release. ▪ Often applied as both nitrogen source and soil conditioner. *Organic Matter Recycling Regulation* Schedule 12
Food Processing Wastes ▪ Class A compost. ▪ Other forms.	✓ ?	✓ ?	▪ May have slow nutrient release. ▪ Often applied as both nitrogen source and soil conditioner. *Organic Matter Recycling Regulation* Schedule 12
Liming Materials	x	✓	▪ May contain metals. ▪ PH impact varies with source.
Off-Farm Manure – Liquid	✓	x	▪ Variable nutrient levels.
Off-Farm Manure – Solid ▪ Includes bedding containing significant amounts of manure.	✓	✓	▪ Normally a nitrogen source but may be used as a soil conditioner if low in nutrients and if C:N ratio greater than 30:1.
Off-Farm Spoiled Feed	x	✓	▪ Variable nutrients levels, high Biochemical Oxygen Demand.
Sand or Other 'Clean' Soil Material	x	✓	▪ Check nutrient and metal levels. ▪ Consult Agricultural Land Commission and local government regarding bylaw requirements.
Used Mushroom Growing Substrate	✓	✓	▪ Variable nutrient levels. ▪ Normally a nitrogen source but may be used as a soil conditioner if low in nutrients and if C:N ratio greater than 30:1.
Whey	✓	x	▪ Normally blended with liquid manure. *Organic Matter Recycling Regulation* Schedule 12
Wood Residue fresh or composted	x	✓	▪ Normally high C:N ratio.
			continues...

TABLE 6.5 cont.	Managing Off-Farm Soil Amendment Sources as Nitrogen Sources or Soil Conditioners		
Soil Amendment Source	Managed Primarily as		Comments (check nutrient content before land application)
	Nitrogen Source	Soil Conditioner	
Materials Regulated by the Code of Practice for Soil Amendments ▪ Fly ash, lime mud, residuals from primary or secondary treatment of liquid waste from a pulp or paper mill, including domestic sewage if it is mixed with those residual solids, water treatment, industrial residues of wood. ▪ Pulp and paper residuals.	x ✓	✓ x	▪ Consult ENV for authorization for materials not covered by the: Organic Matter Recycling Regulation Schedule 12
All Other Organic Materials	?	?	▪ Consult ENV for authorization for materials not covered by the: Organic Matter Recycling Regulation Schedule 12
All Other Inorganic Materials	?	?	▪ Consult ENV or Agricultural Land Commission for authorization.

? means material must be tested to determine if it is a notrogen source or a soil conditioner
Class A compost or biosolids are defined in *Organic Matter Recycling Regulation*

NUTRIENT APPLICATION

NUTRIENT APPLICATION ENVIRONMENTAL CONCERNS

Primary environmental concerns related to nutrient application are:

- Application rate exceeding the soil's ability to assimilate nutrients or certain soil conditioner components (i.e., salts, pH, C:N ratio, contaminants) resulting in water and/or soil pollution.
- Over-application of nutrients when managing as a soil conditioner that results in water pollution.

Inappropriate application method or timing that results in:

- Water or air pollution,
- Erosion or soil compaction on wet fields,
- Release of nitrous oxide from saturated and warm field conditions, contributing to climate change,
- Damage to the crop, leading to poor nutrient uptake or soil erosion,

Ineffective buffers or impacts caused by inappropriate placement or location (e.g., close proximity to watercourse, wrong soil type, unsuitable topography, sensitive habitat) that results in:

- Water pollution,
- Nuisance odours to neighbours,
- Habitat impact.

For information on these concerns:

➔ see Crops and the Environment, **page 4-1**, and refer to Crop Quality

➔ see Impacts on Biodiversity and Habitat, **page 7-7,** and refer to Impacts to Biodiversity and Habitat

➔ see Soil Quality Factors, **page 8-1,** refer to Contaminants

➔ see Water Quality and Quantity Factors, **page 9-1**, and refer to Contaminants

➔ see Air Quality Factors, **page 10-1**

NUTRIENT APPLICATION LEGISLATION

The following is a brief outline of the main legislation that applies to nutrient application.

➔ see **page A-1** for a summary of these and other Acts and Regulations

Agricultural Land Commission Act

The *Agricultural Land Commission (ALC) Act* S.B.C. 2002, c. 36, and *Agricultural Land Reserve (ALR) Regulations* are the legislative framework for the establishment, administration, and procedures of BC's agricultural land preservation program. The ALC Act does not replace other legislation and bylaws that may apply to the land. Local and regional governments, as well as other provincial agencies, are expected to plan in accordance with the provincial policy of preserving agricultural land.

The *ALR General Regulation, B.C. Reg. 171/2002*, identifies the procedures for submitting applications and notices of intent.

The *ALR Use Regulation, B.C. Reg. 30/2019* specifies land uses permitted in the ALR.

The policies of the Commission provide interpretation and clarification of the regulations; outline guidelines, strategies, rules or positions on various issues and provides clarification and courses of action consistently taken or adopted, formally or informally.

ALC Policies and Bylaws

Drinking Water Protection Act

The *Drinking Water Protection Act* and its Regulations have requirements to protect drinking water quality and regulate domestic water systems (those serving more than one single-family residence).

- SECTION 23(1): subject to subsection (3), a person must not (a) introduce anything or cause or allow anything to be introduced into a domestic water system, a drinking water source, a well recharge zone or an area adjacent to a drinking water source, or (b) do or cause any other thing to be done or to occur if this will result or is likely to result in a drinking water health hazard in relation to a domestic water system.

Environmental Management Act

Under the *Environmental Management Act*, the *Code of Practice for Agricultural Environmental Management* requires persons to use environmentally responsible and sustainable agricultural practices when carrying out agricultural operations, for the purpose of minimizing the introduction of waste into the environment and preventing adverse impacts to the environment and human health. The AEM Code includes provisions on nutrient application, setbacks, and soil sampling,

This Act empowers ENV to control pollution within BC. Waste is defined to include "air contaminants, litter, effluent, refuse, biomedical waste, hazardous wastes" and any other substance designated by Lieutenant Governor in Council, or the minister. Pollution is defined in the Act as "the presence in the environment of substances or contaminants that substantially alter or impair the usefulness of the environment."

The *Code of Practice for Agricultural Environmental Management* requires persons to use environmentally responsible and sustainable agricultural practices when carrying out agricultural operations, for the purpose of minimizing the introduction of waste into the environment and preventing adverse impacts to the environment and human health. The AEM code contains specific requirements regarding the application of nutrient sources. The AEM code defines nutrient sources as materials that are a source of nitrogen or phosphorus including fertilizers and soil conditioners, agricultural by-products, compost produced through agricultural composting or materials produced in accordance with the *Organic Matter Recycling Regulation*, soil amendments as defined in the *Code of Practice for Soil Amendments*, digestates from anaerobic digesters, wastewater, irrigation water, and reclaimed water.

- SECTION 17: outlines the setbacks required (see table 6.6) between the application of nutrient sources and drinking water sources or watercourses.

TABLE 6.6 Setback distances required for Application of Nutrient Sources	
Drinking Water Source*	Watercourse
30 m from a well or diversion point	1.5 m for commercial fertilizer and manure injection
3 m in any other case, or if commercial fertilizer is used	3 m in any other case
*as defined in the *Drinking Water Protection Act*	

- SECTION 49: prohibits the application of nutrient sources to land on areas having standing water, on saturated soils, on frozen or partially snow-covered ground, or in a manner that may cause nutrient sources or contaminated runoff, or leacheate to enter a watercourse, cross a property boundary, or go below the water table.
- SECTION 51: requires operations which apply nutrient sources to land to ensure that (a) nutrient sources and leachate do not escape during transport, (b) nutrient sources are not discharged or applied directly into a watercourse, across a property boundary, or below a water table, and (c) drift from broadcasted nutrient sources does not enter a watercourse, cross a property boundary, or go below a water table. Nutrient sources applied to land must also be applied at a rate where the total amount of available nitrogen from soil and all nutrient sources is equal or less than the nitrogen needed by the crop.
- Operations with a land base greater than 2 hectares applying nutrient sources are required to maintain records of when, where, and how much of each nutrient source is applied. Records of crop yields, crop nutrient requirements, and soil tests are also required for the fields receiving nutrients.
- SECTION 53: of the AEM Code requires operations with a landbase greater than 2 hectares to perform specific soil tests of fields if nutrient sources are applied to the land. Fields which are flooded after harvest (e.g., cranberries) or comprised of organic (peat or muck) soils are not subject to the soil testing requirements. At minimum, soils should be tested for:
  - Post-harvest nitrate test or equivalent (see **page 6-15** for more information) every three years, unless a field's post-harvest nitrate test result is greater than 100 kg N/ha, in which case the test must be conducted again the following year.
  - Soil test phosphorus every three years.

The AEM Code includes requirements for operations when applying nutrient sources in specific areas of the Province related to environmental risk. In high precipitation areas (see Appendix B) application of nutrient sources is restricted in the fall and winter months by section 27 of the AEM Code.

In high precipitation areas in October and February-March (shoulder seasons) nutrients may only be applied if they are needed and will be available to the intended crop, and an assessment has been completed to ensure the risk of contamination of surface or groundwater sources is low. In October 2022, the AEM code will be amended to prescribe exact requirements for the assessment.

No application of nutrient sources is permitted from November to January in high precipitation areas, with the exception of wood residues.

Nutrient Management Plans. Results from soil tests required by the code and an operation's location relative to Vulnerable Aquifer Recharge Areas and Phosphorus Affected Areas are used to determine if a nutrient management plan is required for an operation in SECTION 56. The application of these criteria is gradually phased in. Early phase in of the of nutrient management plan requirements apply to livestock operations triggered by high Post-Harvest Nitrate Test values in certain vulnerable aquifer recharge areas, and gradually expand to include all sectors, soil test phosphorus triggers, and phosphorus affected areas.

A nutrient management plan is required for farms operating in vulnerable aquifer recharge areas or phosphorus-affected areas where:

- The operation is a total of five hectares or more.
- Nutrients (such as commercial fertilizer and manure) are applied to the land.
- Soils test results are at or over the following thresholds:
  - In vulnerable aquifer recharge areas, ≥100 kg nitrate/ha, or
  - In phosphorus-affected areas, ≥200 ppm phosphorus.
- The area and type of operation are being "phased-in" according to the schedule contained in the code, with:
  - Vulnerable aquifer recharge areas starting in 2020.

phosphorus-affected areas starting in 2024

Phase in of Agricultural Environmental Management Code of Practice nutrient management planning requirements

Vulnerable Aquifer Recharge Areas and Phosphorus Affected Areas

Nutrient Management Plans prepared for the requirements of the *Code of Practice for Agricultural Environmental Management* must be prepared at minimum by an experienced person (defined as someone with at least 4 years experience carrying out agricultural operations, or a combination of 4 years of operational experience and post secondary training in agricultural sciences). If the soil test values for a field which trigger a nutrient management plan are very high, the Nutrient Management Plan must be prepared by a Qualified Professional.

Very high soil test values which would trigger an Nutrient Management Plan prepared by a Qualified Professional are outlined as

- Post-Harvest Nitrate Test of 150 kg N / ha or more in a Vulnerable Aquifer Recharge Area.
- Soil Test Phosphorus of 300 ppm or more in a Phosphorus Affected Area (2025 onwards).

If a nutrient management plan is required for an operation under the AEM code, SECTION 59 outlines the implementation of the plan. Implementation includes maintenance of farm records relevant to the plan, notification of a Director under the Act if a Qualified Professional was needed to prepare the plan, and annual review of the plan by the operation. Plans are required to be formally updated every 5 years according to the criteria established by SECTION 56, or if significant changes have been made in the agricultural operation.

The *Code of Practice for Soil Amendments* regulates the storage, sampling, application, and record keeping pertaining to specific types of soil amendments. These include:

- Fly ash derived from the burning of wood, other than wood that has been immersed in marine waters.
- Residuals from primary or secondary treatment of liquid waste produced after 1995 from a pulp or paper mill, including domestic sewage if it is mixed with residual solids.
- Lime mud derived from pulp or paper mill processes or waste lime.
- Residuals from the treatment of water for domestic use or use in industrial processes.
- Industrial residue of wood that has not been treated with glue, paint, a preservative, or another substance harmful to humans, animals, or plants.

The *Organic Matter Recycling Regulation* has further requirements related to the land application of additional defined nutrient sources such as Class A Biosolids, Class B Biosolids, Class A Compost, and Class B Compost:

SECTION 5: a Land Application Plan must be developed prior to application of Class A Biosolids, Class B Biosolids, and Class B Compost

SCHEDULE 12: lists organic materials covered by the Regulation

Public Health Act

Administered by the Ministry of Health, this Act has a specific prohibition that "a person must not willingly cause a health hazard, or act in a manner that the person knows, or ought to know, will cause a health hazard". This prohibition would apply to farm practices that may result in a health hazard, such as when nutrients, contaminants or pathogens are discharged to land, water or air so as to pose a public health problem. Any situation that entails a health hazard will enable health officers to investigate using their powers under the Act. Under the *Public Health Act,* the local Health Authority must investigate any health hazard and has authority to order that a person prevent or stop a health hazard, or mitigate the harm or prevent further harm from a health hazard amongst other powers. Similar regulatory provisions exist for addressing health hazards to drinking water supplies under the *Drinking Water Protection Act*.

The Act has conditions under the *Health Hazards Regulatio*n:

- SECTION 8(1): provides separation distance from wells to be at least
- 30 m from any probable source of contamination (probable source of contamination could include nutrients from agricultural by-products)
- 120 m from any dumping ground

Wildlife Act

The provincial *Wildlife Act* protects wildlife designated under the Act from direct harm, except as allowed by regulation (e.g., hunting or trapping), or under permit. Legal designation as Endangered or Threatened under the Act increases the penalties for harming a species. The Act also enables the protection of habitat in a Critical Wildlife Management Area:

- SECTION 7: it is an offense, in a wildlife management area, to alter, destroy, or damage wildlife habitat, or to deposit a substance harmful to wildlife or wildlife habitat

Fisheries Act

Administered by both Fisheries and Oceans Canada and Environment and Climate Change Canada, this Act is established to manage Canada's fisheries resources, including fish habitat. The Act can also be administered provincially by FLNRORD and ENV. The Act applies to all Canadian waters that contain fish, including ditches, channelized streams, creeks, rivers, marshes, lakes, estuaries, coastal waters and marine offshore areas. It also applies to seasonally wetted areas that provide fish habitat such as shorelines, stream banks, floodplains, intermittent tributaries and privately owned land. The Act includes provisions for stiff fines and imprisonment to ensure compliance.

The purpose of this Act is to provide a framework for (a) the proper management and control of fisheries; and (b) the conservation and protection of fish and fish habitat, including by preventing pollution.

This Act was updated in 2019 and now empowers the Minister to make regulations for the purposes of the conservation and protection of biodiversity.

The definition of fish habitat is: "water frequented by fish and any other areas on which fish depend directly or indirectly to carry out their life processes, including spawning grounds and nursery, rearing, food supply and migration areas". The quantity, timing and quality of the water flow that are necessary to sustain fish habitat are also deemed to be a fish habitat. Furthermore, serious harm to fish includes the death of fish or any permanent alteration to, or destruction of, fish habitat.

Provisions of the *Fisheries Act* relevant to agricultural operations include:

- Protection for all fish and fish habitats;
- Prohibition against the death of fish or the 'harmful alteration, disruption or destruction of fish habitat';
- A permitting framework and codes of practice to improve management of large and small projects impacting fish and fish habitat;
- Protection of fish and/or fish habitats that are sensitive, highly productive, rare or unique; and
- Consideration for the cumulative effects of development activities on fish and fish habitat.

Specific sections of the Act include:

SECTION 34.2(1) The Minister may establish standards and codes of practice for:

(a) The avoidance of death to fish and harmful alteration, disruption or destruction of fish habitat;

(b) The conservation and protection of fish or fish habitat; and

(c) The prevention of pollution.

SECTION 34.4(1) No person shall carry on any work, undertaking or activity, other than fishing, that results in the death of fish.

SECTION 35 (1) No person shall carry on any work, undertaking or activity that results in the harmful alteration, disruption or destruction of fish habitat.

Every person who contravenes subsection 34.4(1) or 35(1) is guilty of an offence and liable

Notifying authorities about serious harm to fish or deposit of a deleterious substance:

SECTION 38 (4.1) Every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations of a harmful alteration, disruption or destruction of fish habitat that is not authorized under this Act, or of a serious and imminent danger of such an occurrence, if the person at any material time:

(a) Owns or has the charge, management or control of the work, undertaking or activity that resulted in the occurrence or the danger of the occurrence; or

(b) Causes or contributes to the occurrence or the danger of the occurrence.

SECTION 38 (5) If there occurs a deposit of a deleterious substance in water frequented by fish that is not authorized under this Act, or if there is a serious and imminent danger of such an occurrence, and detriment to fish habitat or fish or to the use by humans of fish results or may reasonably be expected to result from the occurrence, then every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations.

SECTION 38 (7) As soon as feasible after the occurrence or after learning of the danger of the occurrence, the person shall provide an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations with a written report on the occurrence or danger of the occurrence.

Species at Risk Act

The *Species at Risk Act* has sections that protect listed species, their residence, and critical habitat. It applies to federal lands, internal waters (i.e., all watercourses), territorial sea of Canada, and the air space above them.

The provisions of the Act (known as the "safety net") could be invoked on BC Crown and private lands using a federal order under the Act if provincial action is not sufficient to protect listed species.

On private land, unless an order is made by the government, the Act's prohibitions apply only to:

- Aquatic species at risk;
- Migratory birds listed in the *Migratory Birds Convention Act, 1994* and also listed as Endangered, Threatened or Extirpated in Schedule 1 of the Act.

NUTRIENT APPLICATION BENEFICIAL MANAGEMENT PRACTICES

The "4R concept" provides a framework for beneficial management practices for application of nutrient sources such as manures, fertilizers, and composts. The goals of the concept are to improve the efficiency of crop nutrient use and to protect the environment. The four R's include the following:

Right Source - Right Rate - Right Time - Right Place

Read about 4R Nutrient Stewardship

Right Source

The Right Source is the combination of nutrient sources that provide a supply of nutrients in the balance that crops require. In determining which materials should be used to supply a crop's nutrient requirements, highest priority should be given to on-farm sources such as animal manures. Consider supplementation with off-farm manure sources only to top up deficiencies from the on-farm source.

If intending to apply an amendment primarily as a soil conditioner, ensure the product meets all of the following conditions:

- Does not fit the criteria of a "fertilizer".

➔ see Is it a Nitrogen Source or a Soil Conditioner? **page 6-4**

- Can be managed to improve physical, biological, and chemical soil properties.
- Has been checked for salt and contaminant levels.

Particularly in fields where soil phosphorus levels are high and manure is to be applied annually, consider replacing some of the manure nitrogen with chemical nitrogen fertilizer. Chemical fertilizers can provide a faster, more predictable release of nitrogen than manures, especially if the weather is cold and wet, and it is often easier to ensure a more uniform spread of chemical fertilizer than manure. Reducing manure application rates to soils with high phosphorus levels will reduce the risk of phosphorus contaminating adjacent surface waters.

Soil Sampling for Nutrient Management

Highly Soluble vs. Slow-Release Nutrient Sources. Soil type is a primary consideration in determining application rates and nutrient sources.

Alternatively, consider using slow-release nutrient sources such as polymer-coated urea or compost. These nutrient sources are most suitable in areas of high rainfall or where leaching risk is greater, as is the case for coarse soils.

Particle Size. Incorporate small-sized nutrient material into the soil or apply only to sites with vegetative cover that prevents erosion losses by wind or runoff flow. The advantage of using finely-sized soil amendments is that nutrients are available more readily.

Contaminants. Investigate contaminant levels whenever applying chemical fertilizers or other off-farm nutrient sources.

➔ see Soil Contamination, **page 8-17**

Soil Conditioners Give the highest priority to using on-farm materials for soil conditioning. If such materials are not available, select the soil conditioner that will best achieve the desired outcome.

➔ see Tables **6.4** and **6.5**, pages **6-6** and **6-7**, for a list of frequently used soil conditioners

Right Rate

Fine-textured soils such as clays have higher nutrient holding capacities and thus are better suited to receive higher application rates of highly soluble nutrient sources than medium- and coarse-textured soils such as silts and sands. On coarse-textured soils, apply highly soluble nutrients at lower rates but at more frequent intervals.

Apply nutrient sources at rates to meet but not exceed a crop's nutrient needs. A crop's nutrient needs may be described in crop production guides and they may be based on soil testing research. Generally, the crop's nutrient needs are based on soil fertility levels, expected yields, and the crop type. The Nutrient Management Calculator is an online tool that incorporates advice from crop production guides and soil testing research, to compare crop nutrient needs with the rates of nutrients supplied by fertilizers and soil amendments.

The Right Rate concept applies to amendments used as soil conditioners, even if the main intent of the soil conditioner is not to supply nutrients. When applying soil conditioners to correct a soil's deficiency (in organic matter content, for example), phosphorus may be applied in excess of crop needs. The Nutrient Management Calculator can be used to help determine whether the crop phosphorus needs are exceeded, in which case extra precautions may need to be taken to minimize the risk of phosphorus losses from the field.

- Nutrient Management Calculator
- Soil Sampling for Nutrient Management
- Crop Production Guides

Implement the following general practices to apply at the Right Rate:

- Apply at rates that do not lead to crop toxicity or crop smothering.
- For liquid nutrient sources (such as liquid manure or liquid fertilizer) or high-moisture soil conditioners (such as crop wash water), do not apply at rates that exceed the soil's infiltration capacity.
- For grass legume mixes, the application of nitrogen can be reduced in proportion to legume content. Alternatively, the application of nitrogen will replace the nitrogen supply by legumes (via biological nitrogen fixation), but avoid exceeding the nitrogen uptake rate of the grass-legume.
- If plants are grown in soilless media with water-soluble fertilizers such as in greenhouses, choose nutrient application rates based on nutrient levels in plant drainage water, foliar analysis, or electrical conductivity.
  - On-Site Testing of Growing Media and Irrigation Water
- For application of solid organic, inorganic, slow-release, or rapid-release fertilizers, do not apply at rates that exceed the soil's or soilless media's ability to assimilate salts.
  - Crops will be damaged by high rates of nutrient availability or release.
  - To avoid salt toxicity or physical damage to plants, limit nutrient application rates of specialized fertilizer products to the manufacturer's or industry's recommended rate or less.
  - In areas where the risk of leaching or runoff is high due to excessive rainfall or irrigation, adjust application rates to reduce that risk.

    ➔ see Irrigation, **page 9-22**

    ➔ see Runoff, **page 9-50**

Implement the following manure-specific practices to apply at the Right Rate:

- If manure is the primary nutrient source, determine the rate of application by using the Nutrient Management Calculator.
- Note that application of manure to meet crop nitrogen requirements will generally lead to over-application of phosphorus.
- Manure alone should not be used to meet the agronomic nitrogen requirement of crops, if the field receiving the manure has high soil phosphorus levels and water drains from the field into a watercourse.
- If surface sealing of the soil reduces infiltration of water into soils significantly, particularly finer-textured soils, consider reducing one-time application rates below 50 m3/ha (5300 U.S. gallons/acre) of slurry or 50 tonnes/ha of solid manure.
- To reduce the risk of nutrient losses in contaminated runoff, one-time application rates of liquid manure should not exceed the soil's available water holding capacity in the upper 20 cm (8 inches) of soil.

Using the Post-Harvest Nitrate Test to Determine Right Rate

Crop production guides and the Nutrient Management Calculator provide a reasonable starting point for determining a crop's nitrogen requirements. However, the Right Rate for nitrogen is found by adjusting nitrogen applications year-after-year to minimize the amount of nitrate not used by a specific crop for a specific field, while optimizing crop yield and quality. This amount of nitrate is measured for most field crops by soil sampling for the residual soil nitrate through a post-harvest nitrate test (PHNT).

The amount of post-harvest nitrate varies among crops based on the plant and cropping system's inherent nitrogen use efficiency, the year-to-year variation in climate, and management. The amount of expected post-harvest nitrate typically should only be compared within a crop type and growing region.

In the Lower Mainland, for example, expected PHNT values within the top 0-30 cm of soil are 15 ppm nitrate-nitrogen (NO_3-N) for perennial forages and 20 ppm NO_3-N for silage corn. PHNT values that indicate that nitrogen may have been applied in excess of their agronomic N rate are those greater than 30 ppm NO_3-N for perennial forages and 45 ppm NO_3-N for silage corn.

Typically, soil sampling for post-harvest nitrate will be taken from a 0-30 cm soil depth, but sometimes will have to be taken from deeper depths. Additionally, samples should only be taken from crops grown on mineral soils (as opposed to peat or muck soils, to which the PHNT does not apply).

Post-Harvest Soil Nitrate Testing

Right Time

Apply nutrients to make them available when crops need them. Depending on how quickly nutrients are released from a specific nutrient source, the Right Time for nutrient application may be immediately before or months before crop nutrient uptake occurs. The Right Time also needs to consider the risk of nutrient losses immediately following any particular nutrient application. For example, application to a wet soil or before a thunderstorm would likely result in a loss of the fertilizer value of manure and contamination of water quality.

Implement the following practices when selecting the Right Time for nutrient application:

- For annual and perennial crops that grow from early spring through late fall, apply nutrients in multiple applications (e.g., **Tables 6.7** and **6.8**, **pages 6-18** and **6-19**).
- In areas of high rainfall or high leaching risk (e.g., coarse-textured soils), apply nutrients in multiple applications.
- Match nutrient application to the developmental stage and rate of growth of the crop:
  - Plants at the beginning and end of their growth cycle require fewer nutrients than during active growth stages.
  - Apply nutrients prior to the period of rapid uptake.
  - In the south coast region the T-sum Calculator can inform the timing of the first nitrogen fertilizer applications to grassland (see information box below).

To inform the timing of first applications of nitrogen fertilizer on grassland in the Coastal region, it is appropriate to wait until "T-Sum 200." Beginning in late January each year, use the T-Sum Calculator to monitor the T-Sum in a specific area:

www.farmwest.com (Climate/Adaptation tab).

For a given field, a risk assessment should be completed prior to early season manure applications in the Coastal Region.

See legislation: *Code of Practice for Agricultural Environmental Management*

Manure-specific considerations:

- Leave at least three weeks between applications of manure to reduce the risk of soil surface sealing (allows the soil microbes to break up the manure).
- To avoid the transfer of pathogens to crops, berry and vegetable growers should maximize the time between manure application and the crop harvest.
- Manure should be well incorporated into the soil and kept from contacting non-root vegetables.
- Apply manure prior to planting vegetables.
- Apply manure prior to bloom on berries.
- Do not apply manure or fertilizer on excessively wet soils and soils which are frozen, since the nutrients are likely to remain on the surface and be vulnerable to loss in contaminated runoff.
- If applying manure in the fall, wait until after soil temperatures decrease below 10°C and before the soil freezes, to minimize the conversion of manure nitrogen to nitrate that can leach.

TABLE 6.7 Timing Manure Applications to Match Crop Nitrogen Requirements in Coastal Regions

Crop	Suggested Manure Application as a Percentage of Annual Crop Nitrogen Requirement [a]				
	Feb - March [d]	April - May	June - Aug	Sept - Oct [f]	Nov - Jan [f]
Perennial Grass	up to 25%	up to 100%	up to 50%	up to 25%	0%
Silage Corn	0%	up to 100%	up to 20%	0%	0%
Berries	up to 30%	up to 100%	0%[b]	0%	0%
Vegetables	up to 10%	up to 100%	up to 100%	up to 10%	0%
Cover Crop [c]					
Emerged before Aug 15	0%	0%	up to 60%	up to 100%	0%
Emerged before Sept 15	0%	0%	0%	up to 100%	0%
Emerged after Sept 15	0%	0%	0%	0%	0%

[a] Total available nitrogen applied to the soil (from manure and chemical fertilizer) is not to exceed the crop's annual requirement (i.e., the sum of percent applied for each time period through the year is not to exceed 100%)
[b] For new plantings, up to 100% of that year's nutrient need may be applied from June to August
[c] Includes relay crops; post-harvest nitrate test should be below 20 ppm (0–30 cm) if fertilizing a fall-planted cover crop
[d] Manure application is not advised in early spring on sites of fine-textured soil, especially if the site is not yet trafficable or if it drains to a watercourse (Chapter 8)
[e] Manure application is generally not advised from mid-October on sites of coarse-textured soil (Chapter 8)
[f] *Code of Practice for Agricultural Environment Management* prohibits application of nutrient sources (including manure) in the coastal region during this time period

TABLE 6.8	Timing Manure Applications to Match Crop Nitrogen Requirements in Interior Regions				
Crop	Suggested Manure Application as a Percentage of Annual Crop Requirement [a]				
	Feb	March - May [e]	June - Aug	Sept - Oct [e]	Nov - Jan
Perennial Grass	up to 5%	up to 100%	up to 75%	up to 50%	0%
Silage Corn	0%	up to 100%	20%	0%	0%
Cereals (Spring Planted)	0%	up to 100%	0%	0%	0%
Cereals (Fall Planted)	up to 5% [b]	up to 100%	up to 100%	0%	0%
Berries, Tree Fruits and Grapes	0%	up to 100%	0% [c]	0%	0%
Vegetables	0%	up to 100%	up to 100%	0%	0%
Cover Crop [d] Emerged before Aug 15 Emerged before Sept 1	 0% 0%	 0% 0%	 up to 60% 0%	 up to 100% up to 100%	 0% 0%

[a] Total available nitrogen applied to the soil (from manure and chemical fertilizer) is not to exceed the crop's annual requirement (i.e., the sum of percent applied for each time period through the year is not to exceed 100%)
[b] February and March application in the year following planting
[c] For new plantings, up to 100% of that year's nutrient need
[d] Includes relay crops; post-harvest nitrate test should be below 20 µg/g (0–30 cm) if fertilizing a fall-planted cover crop
[e] Manure application in the late fall and March is only advisable on some fields (see table 6.10)

BC Application Risk Management (ARM) Tool

A risk assessment prior to the application of nutrient sources is recommended as a beneficial management practice. **The BC Application Risk Management tool** can guide producers located in high precipitation areas through this process which involves three steps: 1) Check the short-term weather forecast for precipitation; 2) Assess field conditions (crop cover, soil moisture, proximity to watercourses, setbacks); 3) Document for records and take appropriate steps.

BC Application Risk Management tool

Manure or other fertilizer application is not acceptable during times when the environmental risk of nutrient losses is elevated for the field receiving the manure or fertilizer. Cold soil temperatures result in low crop nutrient uptake and low rates of conversion of manure nitrogen into the leachable nitrate form of nitrogen, so it may be acceptable to apply manure during cold periods as long as the manure infiltrates into the soil and stays there for crop uptake during the next growing season. The *Code of Practice for Agricultural Environmental Management* contains regulatory requirements which outline restrictions for nutrient application from October 1 to March 31.

➔ see Legislation, **page 6-9**

Refer to Monthly Manure Spreading Practice Tables **6.9** and **6.10**, **pages 6-20** and **6-21**. These tables summarize the considerations to be taken into account for nutrient application for various months for Coastal and Interior regions of BC.

Apply soil conditioners at the appropriate time of year that will avoid the following situations:

- High risk of runoff caused by excessive rainfall or irrigation.
- Soil compaction on fields where moisture conditions are above field capacity.

TABLE 6.9	Monthly Manure Spreading in Coastal Regions and High Precipitation Areas Relative to Environmental Risks of Contaminating Surface and Drinking Water
September moderate rainfall hence moderate risk	Spreading on grassland to meet crop nutrient needs for this time of year is acceptable. When cropping after corn, cover crops or grassland planted after September 1 should not receive manure unless the need for nitrogen has been proven by a soil test. There is usually enough nitrogen remaining in the soil for a cover crop or newly seeded grass. Not acceptable to spread on bare land (harvested corn, vegetables, berries, etc.) or cover crops that emerged after September 15th. Solid manure with high carbon-nitrogen ratios may be spread and incorporated into the soil as a soil conditioner. Manure should not be managed as a soil conditioner unless a manure test confirms a carbon-nitrogen greater than 30 to 1.
October moderate to high risk	Spreading is not acceptable past mid-October unless: ▪ Grass is actively growing (mean daily temperature above 5°C), AND ▪ Soil is trafficable with no significant rain forecast for next 5 days. If spreading, apply only on grass fields which are not subject to flooding and/or runoff and only at rates matched to crop nutrient needs. A risk assessment must be completed and documented before each application. BC Application Risk Management tool
November to January high rainfall hence high risk	**NO SPREAD PERIOD** Spreading on any crop is not acceptable due to the risk to surface and/or groundwater.
February and March moderate rainfall hence moderate risk	Spreading may only take place if the nutrients are needed by, and will be available to, the intended crop. For grassland and well-established cover crops, it is generally recommended that the first application of manure as a fertilizer should occur near or after the $Tsum_{200*}$ has been reached and at a rate which meets crop nutrient needs. Not acceptable to apply manure: to fields that are subject to flooding or runoff; or to soils that are frozen or saturated. Not acceptable to spread manure on bare land. Spreading can only occur if planning to plant a crop in the near future. A risk assessment must be completed and documented before each application. BC Application Risk Management tool
April to August moderate to low risk	According to crop and soil conditions, apply manure throughout the growing season to meet crop nutrient uptake. Avoid spreading on wet fields or saturated soils. Manure applications should be planned to ensure that storage facilities will be as close to empty as possible by October. To avoid food safety concerns, do not spread manure on berry fields between flowering and harvest or on vegetable fields after planting.

*Find information on the Tsum at www.farmwest.com

TABLE 6.10	Monthly Manure Spreading in the Interior region Relative to Environmental Risks of Contaminating Surface and Drinking Water
September and October low rainfall hence low risk	Spreading on crops is acceptable if soil is not frozen, as most of the manure nutrients will be available for the crop next spring. Not acceptable to spread on bare land (harvested corn, vegetables, berries, etc.) or cover crops that emerged after September 1st Avoid wet areas.
November to February extreme risk of runoff at snow-melt hence high risk.	NO SPREAD PERIOD AEM Code prohibits spreading on soils that are frozen, saturated or snow covered. Spreading is not recommended due to the extreme risk of snowmelt runoff and surface water contamination
March to May moderate to high risk of runoff hence moderate to high risk.	Not acceptable to apply manure: to fields that are subject to flooding or runoff; or to soils that are frozen, saturated or snow covered; or to bare land in March. If field access is possible, avoid wet soils which could compact and lead to poor nutrient utilization or poor crop growth. Meet crop nutrient needs for this time of year is if conditions are acceptable to spread. (See **Table 6.8, page 6-19**) A assessment prior to application is recommended during this season to mitigate runoff risk. Risk Assessment
June to August moderate to high peak rainfall events hence moderate risk	According to crop and soil conditions, apply manure throughout the growing season to meet crop nutrient uptake. (See **Table 6.8**, page **6-19**) Avoid spreading on wet fields, saturated soils or fields prone to flooding. Manure applications should be planned to ensure that storage facilities will be as close to empty as possible by October. To avoid food safety concerns, do not spread manure on berry fields between flowering and harvest or on vegetable fields after planting.
April to August moderate to low risk	According to crop and soil conditions, apply manure throughout the growing season to meet crop nutrient uptake. Avoid spreading on wet fields or saturated soils. Manure applications should be planned to ensure that storage facilities will be as close to empty as possible by October. To avoid food safety concerns, do not spread manure on berry fields between flowering and harvest or on vegetable fields after planting.

Right Place

Accurate and uniform placement as well as the capability to calibrate for desired application rate is essential.

When selecting chemical fertilizer or manure application equipment, ensure the equipment will not apply nutrients beyond the target crop by taking into account the spreading width of broadcast applicators.

Manure Application. The advantages and disadvantages of various manure spreading methods are shown in **Table 6.13**, **page 6-30**. Choose methods that provide uniform placement and which achieve the desired rate of application. Methods that ensure accurate placement on the soil surface or within the crop canopy require smaller buffer distances to sensitive areas.

Injecting liquid manure or manure slurries into the soil can reduce the level of ammonia and nitrous oxide (greenhouse gas) emissions. However, injection combined with the over-application of nitrogen will increase the nitrous oxide emissions from medium to fine-textured soil or increase the nitrate leaching from medium to coarse-textured soil.

To reduce damage to crops from manure smothering or soil compaction, place manure under the canopy in as dilute a consistency as possible. As well, use high flotation tires and low soil disturbance equipment.

Banded Nutrients. For intensively managed row crops such as vegetables, nursery plants, and orchard trees, apply nutrients in bands along the crop rows and in circles around the bases of trees.

Broadcast Nutrients. Broadcast methods of application are suitable for crops such as grass or annually planted vegetables.

Grazing Animals. If grazing livestock are managed at appropriate stocking densities and for appropriate durations, manure deposited by the animals should be evenly distributed and at rates that do not exceed crop requirements. Implement the following practices:

- Manage for uniform manure distribution by regularly moving water supplies and supplemental mineral and feed sources.
- Ensure livestock are moved frequently to avoid overgrazing and to evenly distribute manure for both rotational and conventional grazing systems.
- For seasonal feeding areas, where livestock may have grazing supplemented by outside feed.

➔ see Outdoor Livestock Areas, **page 3-8**

Advanced Forage Management

Rangeland Handbook for BC

BC Rangeland Seeding Material

Methods. Optimal methods of application and placement of soil conditioners are dependent on the crop being grown and the reason for applying the material. Implement the following practices:

- For most field crops such as annual vegetables and forages, broadcast soil conditioners uniformly and incorporate into the soil as soon as possible.
- For soil conditioners applied as "mulches" to improve water conservation or to alter soil conditions within the target crop's rooting zone, use equipment that will uniformly and adequately cover the primary rooting area (e.g., sawdust placed around blueberry plants).
- For perennial crops for which certain soil conditioners such as lime cannot be incorporated regularly, implement the following practices:
  - Reduce the annual application rate to avoid toxicity.
  - Increase the frequency of application to compensate for reduced rate.

➔ see Nutrient Application Methods, **page 6-26**

➔ see Soil Management, **page 8-7**

Nutrient Application Setbacks from watercourses. Application of nutrient sources should consider the location of watercourses and provide enough setback to protect the watercourse. Under the *Code of Practice for Agricultural Environmental Management* minimum setbacks are required:

- 1.5 m: Minimum setback for broadcast of commercial fertilizer or sub-surface injection of manure.
- 3 m: Minimum setback for all other nutrient applications, including manure.

Increase setback width to provide a buffer and avoid any contaminated runoff based on climate conditions, soil, soil cover conditions, and slopes greater than 3%. See Chapter 11: Buffer Beneficial Management Practices.

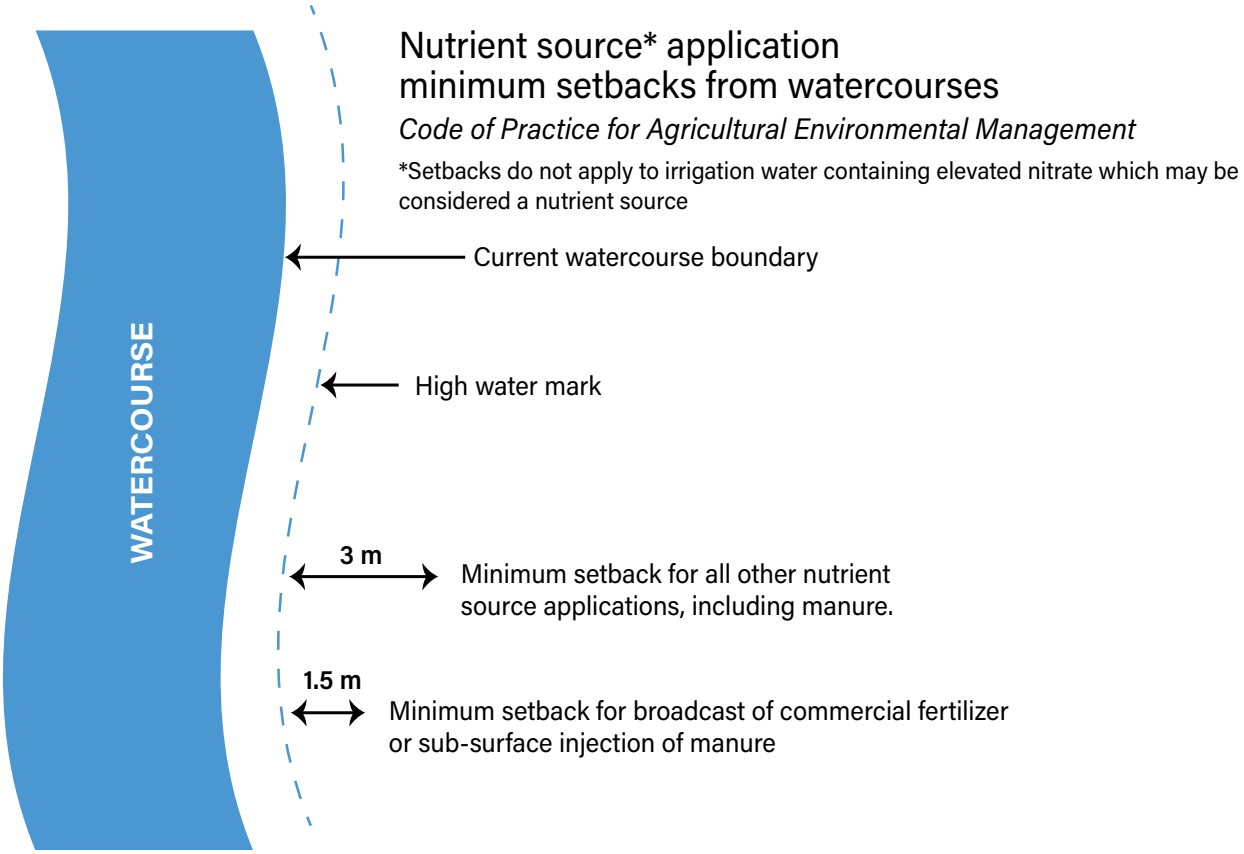


FIGURE 6.1 Nutrient Application Setbacks to a Watercourse

TABLE 6.11	Liquid Manure Application Methods by Order of Preference	
Method	Advantages	Disadvantages
1. Band Applicator with or without Soil Aerator (e.g., Sleighfoot or Aerway SSD)	▪ Easy calibration, ▪ Uniform application, ▪ Accurate placement, ▪ Low ammonia loss, ▪ Fertilizer value maximization, ▪ Wider spreading window, ▪ Nitrous oxide release minimization.	▪ Higher cost, ▪ Slow application, ▪ Crop damage from wheels if applied when crop is tall, ▪ Soil compaction from tanker.
2. Injector	▪ Easy calibration, ▪ Uniform application, ▪ Accurate placement, ▪ Highest potential to maximize nitrogen fertilizer value, ▪ Fast application (with hose reel or umbilical systems), ▪ Ammonia and odour reduction.	▪ Increased potential for nitrous oxide release under saturated soil conditions, if nitrogen is over-applied; ▪ Only suitable for some soil and crop conditions; ▪ Higher cost; ▪ Slow application (with tanker system); ▪ Low application rate difficult to achieve; ▪ Short application window; ▪ Soil compaction from tanker.
3. Splash Plate	▪ Easy calibration, ▪ Lower cost, ▪ Low nitrous oxide release.	▪ Soil and crop compaction, ▪ Short application window, ▪ High ammonia loss, ▪ Non-uniform application.
4. Irrigation Gun Greatest challenges with odour, calibration, uniformity, and drift, among the four methods described	▪ Lower cost, ▪ Fast application, ▪ Provides opportunity for nutrient application in spring, to fields that are poorly trafficable, as long as environmental runoff risk is low (See Runoff Factors, page 9-54).	▪ Difficult to calibrate; ▪ Non-uniform application; ▪ Inaccurate placement means that manure application should be at least 10 m from watercourses; ▪ Short application window; ▪ High ammonia loss loss in warm (summer) temperatures or during windy conditions; ▪ High risk of pathogen, aerosol, and odour drift.

Table 6.12	Solid Manure Application Methods by Order of Preference	
Method	Advantages	Disadvantages
1. Spinning Disks	▪ Easy calibration, ▪ Accurate placement, ▪ Fast application.	▪ Need dry manure, ▪ High dust production.
2. Flail Broadcast	▪ Can spread variable moisture content.	▪ Inaccurate placement, ▪ Non-uniform application.
3. Dump and Grade Not recommend for use due to poor uniformity	▪ Low cost.	▪ Cannot be calibrated, ▪ Non-uniform application, ▪ Difficult to control rate.

Fertigation. The application of nutrients through an irrigation or nutrient circulation system is known as fertigation. Fertigation uses the same principles for determining rate and timing of application as any other nutrient application method. Ensure that nutrients are applied only to the target crop and that watercourses are totally avoided. In addition, check the system for leaks on a regular basis.

- Chemigation Guidelines for British Columbia (1993)
- Plug Fertilization Strategies

Nutrient Application Equipment Calibration

In order to manage nutrients effectively, both manure and fertilizer spreaders need to be maintained and calibrated to ensure uniform distribution. Calibration is a determination of the amount of solid or liquid applied to a given area for a specific piece of application equipment. To properly calibrate a manure spreader, it is important to know the capacity of the unit, the distance traveled, the spreading band width, and the time it takes to unload the spreader at a chosen tractor speed. When calibrating for solid manure, the manure density must also be known.

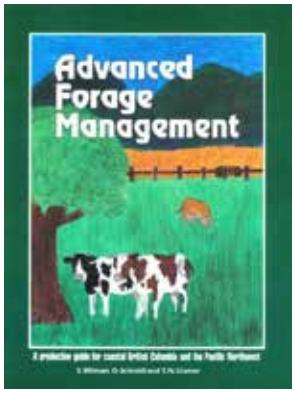
Uniformity is the evenness of application across the band spreading width from the beginning to end of each pass. To test uniformity, place buckets, tarps or some other form of collection system at a variety of locations in areas over which the manure is to be spread. The volume or weight of manure can then be measured, and an average can be calculated. A generally acceptable level of uniformity is when all samples are within 15% of the average within the direct spreading area (an area not influenced by previous or subsequent overlapping passes). Minor uniformity problems can be overcome by varying the entry point or direction of travel when spreading manure in a particular field.

- Choosing and Calibrating Manure Application Equipment

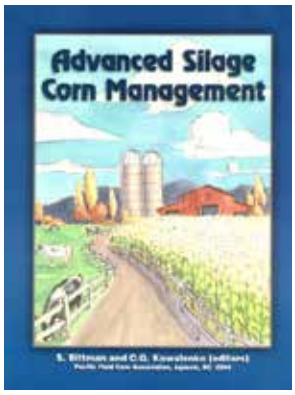
Application Equipment Calibration. To achieve the desired result with any soil conditioner, calibrate application equipment to ensure that the actual rate of application and placement of material match the intended rate and placement.

Forage Nutrients

Annual and Perennial Forage Crop Nutrient Uptake. Basic plant growth characteristics and structure play a role in nutrient uptake and soil management. Annual crops by their nature generally have shorter nutrient uptake periods than perennial crops. For example, a perennial forage grass may take up nutrients for as long as 240 days while an annual corn crop will take up nutrients for less than 80 days.



Nutrient uptake in annual forage crops is not constant, but typically follows an S-shaped curve with very low uptake for a period of about 30 days, then increases sharply until flowering, then decreases rapidly with maturity. In a perennial forage crop the curve may be elongated, or in the case of a forage grass or grass/legume mix there will be several periods of varying uptake in response to multiple cuttings. Figure 6.1 illustrates such patterns. Forage grasses are generally subject to a range of harvesting options, which include variations in numbers of cuts, times of cutting, and cutting height. Each of these influences the effectiveness of a grass crop to take up nutrients.



Harvest Date. The time of harvest plays a critical role in nutrient uptake for perennial forages such as grass. Perennial forages produce dry matter and protein in response to cutting frequency, cutting height and grazing practices. These factors can be varied to achieve either maximum dry matter yields or maximum protein yield.

- Advanced Forage Management
- Advanced Silage Corn Management
- Cool Forages

For annual crops harvested at maturity, such as corn, harvest date does not affect nutrient uptake. However, if annual crops are planted late and harvested at an immature stage the full potential nutrient uptake will not be achieved. If the crop was fertilized for mature yields and harvested at an immature stage, there may be excess nutrients remaining in the soil after harvest.

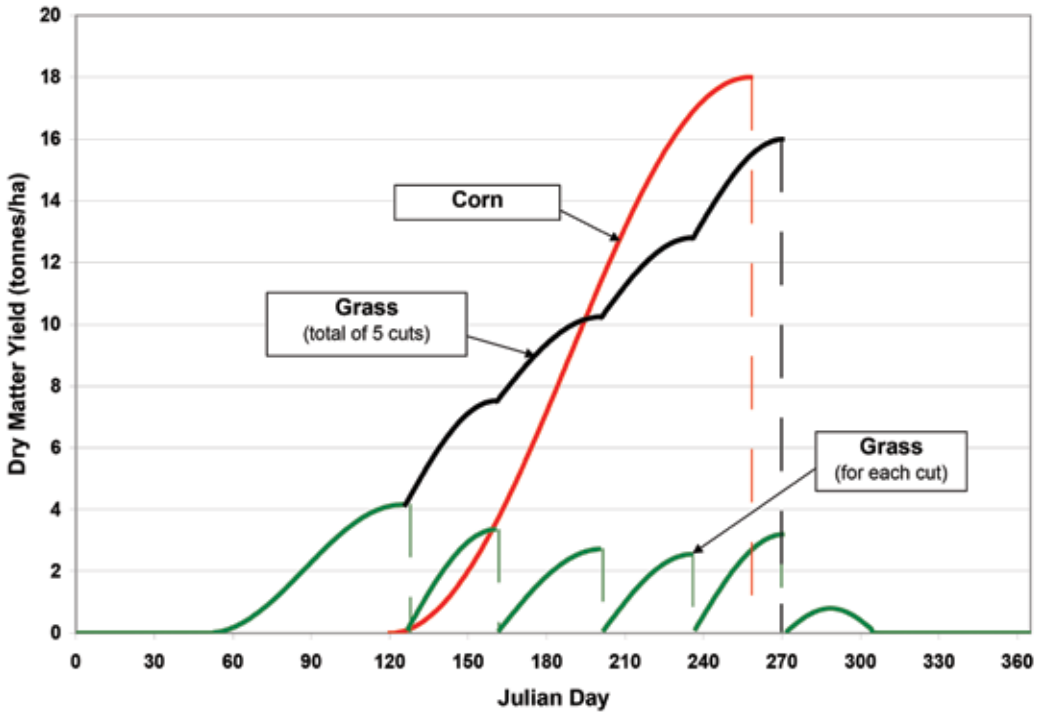


FIGURE 6.2 Generalized Dry Matter Accumulation versus Time of Year

Horticultural Crop Nutrients

Nutrient uptake by horticultural crops varies with the type of crop grown. Some tree fruit and berry crops require most of their nutrients in the spring and early summer. Some vegetable crops take up large amounts of nutrients later in the summer and early fall. Manage nutrient applications so that they are available when required to both maximize crop growth and minimize any potential for leaching.

Risk of Pollution During Nutrient Application

Surface Water. Any nutrients that enter a watercourse can degrade water quality and impact fish and fish habitat. Select application rates and management practices that keep nutrients out of watercourses.

The rate at which liquid infiltrates into the soil is important in evaluating the risk of runoff. Poorly drained soils become saturated quickly with the result that precipitation can no longer enter the soil, leading to increased stormwater flows. Water ponding on any soil surface is an indication that the liquid is being applied faster than it can infiltrate into the soil. In addition, runoff risks are greater on sloping land. In certain conditions, even a small amount of rain can create runoff problems. If runoff due to site and weather conditions occurs, stop application, or reduce the application rate. Enlarge buffers to address persistent runoff events.

➔ see Buffers, **page 11-4**

If liquid manure is pumped through pipes over or within 10 m of a watercourse, secondary containment on the pipes is suggested to prevent any leakage from entering the watercourse. Where possible pipes should be located 10 m or more (suggested) away from a watercourse.

Manure application should not occur within:

- 3 m or more of a bank or a slope leading to a dry ditch or dry watercourse *(Code of Practice for Agricultural Environmental Management).*
- 5 m or more of a bank or a slope leading to wet ditch or wet watercourse (suggested).
- Applications must be setback at least 30 m from any well or water intake used for domestic purposes because it is deemed a potential source of contamination *(Health Hazards Regulation)*.

Commercial fertilizer application should not occur within:

- 1.5 m or more of a bank or a slope leading to a dry ditch *(Code of Practice for Agricultural Environmental Managment).*
- 3 m or more of a bank or a slope leading to wet ditch or any watercourse (suggested).
- At least 30 m from any well or water intake used for domestic purposes because it is deemed a potential source of contamination (*Health Hazards Regulation*).

In certain circumstances, setback distances to watercourses for manure and commercial fertilizer may need to be increased to avoid contaminated runoff. The determination of an appropriate setback should be based on:

- Soil texture, porosity and moisture;
- Soil cover conditions;
- Slope toward a watercourse, particularly if slope exceeds 5%;
- Sensitivity of the watercourse.

Spring Runoff. In areas of the Province where soils are frozen and where snow accumulates during the winter months, snowmelt has the potential to enter adjacent watercourses. Do not apply manure to frozen or snow covered land if manure can be carried with the melt water and contribute to water contamination.

Subsurface Drains and Macropores. Fields with effective subsurface drainage systems pose a particular pollution risk. Liquid wastes applied to the soil can find its way through macropores in the soil (e.g., cracks, worm holes and mouse or mole holes) into drains and eventually to watercourses. This risk applies to any drained field regardless of slope or its proximity to a watercourse.

➔ see Drainage Water Quality, **page 9-48**

Where lowland fields with clays or silt loams have had drainage systems installed at some time in the past, the pipes may still work even if a modern system has not been installed. Where the risk of macropore flow to watercourses is elevated, implement the following practices:

- Do not spread manure on grass or bare fields when fields are wet and tile drains are running.
- Cultivate bare fields to break up macropores shortly before spreading manure (within 7 days).
- Reduce one-time manure application rates, depending on soil conditions.
- If contamination still occurs, it may be necessary to block the outflow or contain the contaminated drain water and apply to fields as irrigation water when the tile drains are not running.

Preferential Flow of Manure in Tile Drainage

Greenhouse/Nursery Container Beds. Check drainage discharge water from greenhouse floor drains or from under nursery container beds and capture and recirculate any contaminated water.

Ground Water. In the presence of coarse-textured sandy or gravelly soils or fractured bedrock aquifers, the movement of nutrients and pathogens to groundwater is accelerated, creating the potential for pollution. Timing and rate of manure or fertilizer application are important. Follow a nutrient management plan for manure and fertilizer applications in areas over moderately or highly vulnerable aquifers that are used for drinking water.

➔ see **Table 6.6, page 6-11**

To avoid the risk of contaminating wells from macropore or runoff flow, implement the following practices:

- Maintain a 30 m manure or chemical fertilizer "no-spread-zone" around well sites (*Public Health Act*).
- Protect the well by constructing a secure berm to divert runoff flows away from the well head, and ensure that the well and well casing are properly constructed and maintained.

Weather. Applications in adverse weather conditions will increase the risk of manure leaving target areas, which may cause pollution. Implement the following practices:

- Avoid spreading in diverting winds.
- Avoid spreading during heavy rains or if significant rain (i.e., greater than 10 mm of rain or its equivalent in snow) is forecast any of the next 3 to 5 days.

Soil, Crop or Crop Residue. Implement the following practices to reduce the risk of nutrient loss (by surface sealing, ponding, runoff flow and leaching) during and after application:

- Apply to an actively growing crop, cover crop or significant crop residue.
- Apply to soil that is free of surface and subsurface compaction.

Air. A large portion of the total ammonia and odour emissions from manure occur during land application. The control strategies that can be used include timing and method of spreading.

Choosing an appropriate time to spread manure can go a long way in minimizing complaints due to odour. Using the following as general guidelines, spread manure:

- As soon as is appropriate to reduce methane emissions.
- When prevailing winds blow away from close urban areas or neighbouring residences.
- On cool days to reduce the rate of odour release.
- Prior to an expected light rainfall or before irrigation.
- Early in the day to take advantage of increased wind turbulences later in the day that can dilute odours.
- Midweek, rather than on weekends or holidays, as this time is less likely to be a nuisance to neighbours pursuing outdoor activities.

➔ see Nutrient Application, **page 6-9,** and refer to Timing

Most soil conditioners present a reduced risk of pollution when compared with fertilizers. Since many soil conditioners have a high percentage of plant fibre and are very light when dry, they are easily wind blown when applied to land. Work them into the soil as soon after application as possible. As a precaution establish and maintain an adequate buffer between soil conditioner application areas and sensitive areas to prevent nuisance or pollution risks.

➔ see Buffers, page **11-4**

Rapid-cover manure application techniques may ultimately be the best solution in long-term reduction of odour complaints and concerns. Such methods of application are more costly than conventional practices but will maximize returns from the manure as a fertilizer in nutrient savings and won't release as many odours or gaseous emissions.

- On plowed land, follow the spreading of manure closely with a disc or tiller.
- On perennial forages, consider using a sleighfoot attachment or an attachment that combines a dribble bar with a soil aerator.
- Make more frequent manure applications at lower application rates using sleighfoot or shallow injection equipment for more efficient use of nitrogen.

➔ see Nutrient Application, **page 6-9**, and refer to Nutrient Application Methods

Nutrient Application Impact on Climate Change

The nitrogen from manure and fertilizer can be converted into the greenhouse gas nitrous oxide (N_2O) during periods where the soil is saturated or will become saturated within a short time period with the onset of fall and winter rains or rise in water tables due to subirrigation.

- Avoid spreading manure or fertilizers in conditions where soil is saturated.
- Avoid spring or winter grazing on areas subject to high water tables or flooding, and complete a risk assessment of seasonal feeding areas to ensure the risk of off-site transport of manure and greenhouse gas emissions from wet soils are minimized.

➔ see Climate Change Factors, **page 12-1**

Crop Monitoring and Nutrient Application

Monitor plant health and nutritional status throughout the growing period on an ongoing basis. Implement the following practices:

- Record all application amounts, conditions, practices, and crop results to assess effectiveness of nutrient application strategies.
- Under highly intensive crop production systems (i.e., greenhouses), monitor pH and electrical conductivity of the rooting medium weekly to determine plant nutritional status throughout the growing period.
- Record all applications, conditions, practices, and crop results. Due to soil conditioners' lower nutrient value, over application or organic matter at high rates frequently occurs.

NUTRIENT MANAGEMENT PLANNING

Nutrient management planning is a process to optimize the relationship between farm management techniques, crop requirements, and land application for the purpose of maximizing nutrient use while minimizing environmental impact. The process attempts to balance nutrients on an individual crop or field basis across the farm.

The Code of Practice for Agricultural Environmental Management may require an operation to prepare and implement a Nutrient Management Plan (NMP) (see legislation **page 6-9**), however the process is more broadly recommended as a beneficial management practice.

The components of a NMP are outlined in **Table 6.6.** NMPs include both on-farm risk assessments and recommended nutrient application strategies using planning tools which aid in the estimation and accounting of nutrient use on the farm. For a self-guided introduction to nutrient management planning, use the following web-based tool to help choose the right rate and nutrient source for your crops:

Nutrient Management Calculator web page

Online Resources related to Nutrient Management Planning

Soil Nutrient Testing web page

Soil Sampling for Nutrient Management

Understanding Different Soil Test Methods

Nutrient Testing Laboratories in BC

A NMP is a component of an iterative process. Once a plan is created, monitoring the implementation of the plan with record keeping is an important component of nutrient management. The plan should be revised and improved based on farm records and experience with any changes implemented from the plan.

TABLE 6.13 Components of a Nutrient Management Plan (NMP)

Farm Description:

The description should include a total number of acres cropped under the NMP, number and type of animals on the farm. If manure is collected on-farm, the NMP should describe the handling system and storages. If the farm is located in a vulnerable aquifer recharge area, and/or a phosphorus affected area, and/or a high precipitation area as defined in the *Code of Practice for Agriultural Environmental Management* it should be noted in the farm description.

A farm map should identify the location of manure storages and animal housing in relation to any watercourses, wells, or other areas of concern. Field maps identifying each field and their relation to environmental risk (watercourses, topography, recommended locations for nutrient application setbacks) should be included. Additional field information which may be included in maps or a text/tabular form includes the spreadable area of each field, soil characteristics, and cropping history.

Nutrient Source Inventory and Use:

The inventory of nutrient sources includes estimated annual amounts of manure generated by animals (or other agricultural by-products associated with them) kept on-farm. Nutrient sources that are imported to the farm are also accounted for in the inventory.

Nutrient sources should be categorized in the inventory according to how they are land applied. In most cases, this aligns with their handling and storage. Several sources of materials may contribute to manure in a storage system, however, it is the characteristics and volume of the material as it is applied to land which are used for the allocation of nutrients in the planning process.

Where nutrient sources are generated on farm, the quantity generated is compared with the recommended quantity being applied to land. The balance of manure generated and applied will indicate if there is too much or too little manure for the farm's landbase.

Field Specific Nutrient Source Application Rates:

The core recommendations of a NMP provide guidance for nutrient source applications on every field. The plan will contain recommended rates, timing, and sources of nutrients which are informed by management history, soil testing, and nutrient source testing.

Application rates which meet the crops production requirements, and reduce the risk of over application of nutrients of environmental concern are set by estimating Agronomic Nutrient Balances, and if applicable, Crop Removal Nutrient Balances for each field.

- The Agronomic Nutrient Balance process considers the estimated availability of Nitrogen, Phosphorus, and Potassium for the crop(s) from the soil and determines a crop requirement for each nutrient. This requirement is balanced by the estimated availability in the nutrient sources which are applied throughout the year.
- The Crop Removal Balance is used to assess the potential for accumulation (or depletion) of nutrients in soil, and considers the total amounts of Nitrogen, Phosphorus, and Potassium removed by the harvested crop, contrasted with the total nutrients applied to soil as the nutrient sources.

Plan Recommendations:

In addition to field specific guidance, the NMP will include recommendations to address any issues with manure storage, handling, or application. This may entail changes to practices (when and where nutrients are applied) or equipment and infrastructure improvements. For farms that have an imbalance between the use and generation of nutrient sources, the NMP should provide guidance on where excesses will go, or what sources may be used to address any deficits.

Results of soil tests and materials analysis:

Test results from the analytical lab for soils, manure, or other materials should be kept with the NMP.

Environmental Farm Plan Nutrient Management Plan Triggers

Within the Environmental Farm Plan program, producers in any of the following four situations are recommended to complete a Nutrient Management Plan:

1. **Farms Out of Compliance with Nutrient Application Legislation.** This applies to farms that answer "no" to any of the legislative questions on the Nutrient Application Worksheet in the Environmental Farm Plan Workbook. The proposed action is the development of a Nutrient Management Plan.
2. **Livestock Producers and Producers of Intensively Managed Outdoor Crops** Livestock producers and intensively managed outdoor horticulture crop producers applying nutrients over a moderately to highly vulnerable aquifer used for drinking water.
3. **Users or Generators of Significant Manure Nitrogen.** Producers that generate or use manure should complete one of the following two assessments:

   Manure Assessment 1 (Worksheet #4): A manure nitrogen assessment for farms that generate manure (if some of the manure is land-applied on the farm), or

   Manure Assessment 2 (Worksheet #5): A manure nitrogen assessment for farms that use manure as a fertilizer but do not generate manure.

   The objective of the assessments is to determine if manure nitrogen generation or utilization are above the values in **Table 6.14,** below. Farms that apply manure at rates below these values are considered to be at a low risk of causing pollution as long as the manure is being stored, handled, and applied in compliance with the *Code of Practice for Agricultural Environmental Management*.

TABLE 6.14 Baseline Values Used for Assessing the Requirement for a Nutrient Management Plan (used in Worksheets #4, #5)

Crop Type	Baseline Manure Nitrogen Application Rate (kg N/ha/yr)★
Non-forage (e.g., berries, tree fruits, vegetables)	50
Forage grass (South Coastal BC)	300
Forage grass (rest of BC)	200
Forage corn	150

★ Value based on Total Manure N

   Farms that apply manure at rates above these values may also be managing their nutrients in full compliance with the Code, but the risk of over-applying nutrients and potentially causing pollution is higher. The actual risk would be specific to the farm being assessed, depending on a variety of factors including crops being grown, yield potential, topography, proximity to watercourses, and climate. For farms that apply manure at rates above these values, a NMP is recommended.

4. **Farms with High Soil Phosphorus.**

Manure Nitrogen Assessment 1: Farms that Generate Manure

Using **Worksheet #4, page 6-33**, with the appropriate information from **Table 6.8**, this assessment compares:

- The amount of manure nitrogen generated by a farm with livestock with the calculated baseline value required by the crops on that farm.

Follow these four steps on **Worksheet #4**:

Step 1: estimate the annual manure nitrogen excretion to be applied to the farm.

Step 2: calculate the manure nitrogen application for each crop area.

Step 3: add the manure nitrogen application values for each crop area to get the application for the whole farm.

Step 4: a Nutrient Management Plan is recommended if the farm's manure nitrogen generation is greater than the calculated value for the farm.

WORKSHEET #4
Manure Nitrogen Application Assessment for farms that Generate Manure

Workbook Question 274

Question: **Proceed through the following worksheet calculations to assess whether or not a Nutrient Management Plan (NMP) would be recommended for this farm.**

Information:

Indicate the type of animal (Refer to Table 6.7*)			
Number of animals	50000	2	
Percentage of manure remaining on the farm after manure export (a percentage expressed as a value between 0 and 1)	0.10	3	
Assumed annual N excretion per animal place (Refer to Table 6.7*)	0.25	4	kg N/animal

Calculation: Step 1 **Estimate the manure N excreted and remaining on farm, using Equations below:**

EQUATION: Annual N Excreted & remaining on Farm (kg)

Number of Animals		x	portion of manure left		x	Annual N Excretion/ animal place (kg)			=	Annual N Excreted & remaining on Farm (kg)		
50000	2	x	0.10	3	x	0.25	4	kg/animal	=	1250	5	kg N

Step 2 **Calculate annual baseline manure N application for crops grown on farm, using Equation below:**

EQUATION: Manure N Application for Farm (kg)

	Area Manure Spread on (ha)			x	Manure N Application Rate (kg N/ha)		=	Manure N Application for Farm (kg)		
non-forage area		6	ha	x	50	kg N/ha	=	0	10	kg N
forage grass (Fraser Valley) area		7	ha	x	300	kg N/ha	=	0	11	kg N
forage grass (rest of BC) area		8	ha	x	200	kg N/ha	=	0	12	kg N
forage corn area	5	9	ha	x	150	kg N/ha	=	750	13	kg N

Step 3 **Calculate Annual Baseline Manure N application for whole farm**

(Sum of boxes 10 to 13) = 750 **14** kg N

Answer:

Step 4 Is the annual N excretion remaining on the farm 1250 **5** less than 750 **14** the baseline application value?

No **a NMP is recommended** **or** YES **a NMP is Optional**

A Nutrient Management Plan (NMP) is suggested to optimize nutrient utilization and protect the environment.

Note: Refer to Tables in BC Environmental Farm Plan Reference Guide

Manure Nitrogen Assessment 2: Farms that Do Not Generate Manure

Using **Worksheet #5** with the appropriate information from **Table 6.7**, this assessment compares:

- The amount of manure nitrogen used by a farm without livestock with the calculated baseline value required by the crops on that farm.

Follow these four steps on **Worksheet #5**:

Step 1: estimate the annual manure nitrogen use for the farm.

Step 2: calculate the manure nitrogen application for each crop area.

Step 3: add the manure nitrogen application values for each crop area to get the application for the whole farm.

Step 4: a Nutrient Management Plan is recommended if the farm's manure nitrogen use is greater than the calculated value for the farm.

WORKSHEET #5
Manure Nitrogen Application Assessment for Farms that Use Manure but do not Generate Manure

Workbook Question 274

Question: **Proceed through the following worksheet calculations to assess whether or not a Nutrient Management Plan (NMP) would be recommended for this farm.**

Information:

Indicate the type of animal (refer to Table 6.7)*	Poultry Broiler	1	
Manure Volume	100	2	m^3
Average manure N concentration (Refer to Table 6.7*)	15.8	3	kg N/m^3

Calculation: Step 1 **Estimate total N content of manure supply, using Equations below:**

EQUATION: Annual N Excreted & remaining on Farm (kg)

Manure Volume (m^3)	x	Assumed manure N concentration (N/m^3)	=	Total N content (kg)
100 (2) m^3	x	15.8 (3) kg N/m^3	=	1580 (4) kg N

Step 2 **Calculate manure N application value for crops grown on farm, using Equation below:**

EQUATION: Manure N Application for Farm (kg)

	Area Manure Spread on (ha)		x	Manure N Application Rate (kg N/ha)		=	**Manure N Application for Crop (kg)**	
non-forage area	10	5 ha	x	50	kg N/ha	=	500	9 kg N
forage grass (Fraser Valley) area		6 ha	x	300	kg N/ha	=	0	10 kg N
forage grass (rest of BC) area		7 ha	x	200	kg N/ha	=	0	11 kg N
forage corn area		8 ha	x	150	kg N/ha	=	0	12 kg N

Step 3 **Annual Baseline Manure N application for whole farm** = 500 (13) kg N

Answer:

Step 4 Is the annual N content remaining on the farm 1580 (4) less than 500 (13) the baseline application value?

No **a NMP is recommended** **or** YES **a NMP is Optional**

A Nutrient Management Plan (NMP) is suggested to optimize nutrient utilization and protect the environment.

Note: Refer to Tables in BC Environmental Farm Plan Reference Guide

TABLE 6.15	Assumed Annual Manure Nitrogen Excretion Values and Manure Nitrogen Concentrations in Storage for Various Animal Types ★		
Type of Animal		Use with Worksheet #4, Box 3	Use with Worksheet #5, Box 3
		Assumed Annual Manure N Excretion (kg N/animal)	Average Manure N Concentration (kg N/m^3)
Beef Cattle	Cows and Bred Heifers	73	3.4
	Feeder 340 to 500 kg	52	3.4
	Yearling 230 to 340 kg	35	3.4
	Calves 50 to 230 kg	17	3.4
Dairy Cattle	Milking cow including associated replacements	200	1.6 (watery)
			2.8 (medium slurry)
			4.0 (thick slurry)
Ducks		0.40	11.8
Goats		10.5	2.9
Horses		55	3.3
Poultry	Broiler	0.25	15.8
	Layer plus associated pullets	0.67	10.9
	Hatching Egg Layer plus associated pullets	1.25	9.2
	Turkey	1.12	11.5
Sheep		6.1	2.9
Hogs	Sow – Farrow to Finish	92	3.5 Liquid
	Sow – Farrow to Wean	19	2.9 Liquid
	Grower / Finisher	10	3.5 Liquid
Veal		9.9	2.1

★ Where available, values are based on BC data. Otherwise, based on *Manure Production and Characteristic Standards (2005)* by American Society of Agricultural Engineers. If the actual farm situation differs significantly from the foregoing, the value in this table should be adjusted up or down in consultation with your Planning Advisor.

Liquid For swine, it is assumed that the manure is in the liquid form. Manure nitrogen concentrations can be extremely variable in liquid systems. The values for liquid manure in this table are based on uncovered manure storage facilities. For farms in high rainfall areas with covered manure storage, multiply the manure nitrogen concentration values by 1.5 or get a manure analysis done and use the on-farm value.

7 BIODIVERSITY

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BIODIVERSITY

INTRODUCTION

This chapter defines biodiversity and describes how biodiversity can benefit farm productivity and contribute to long term resiliency and sustainability. The chapter also discusses farm management practices for protection of the biodiversity of aquatic life, wildlife and plants. It contains information on biodiversity, habitat and stewardship, the complex relationship between biodiversity and agriculture and impacts on biodiversity and habitat. It also contains information on environmental concerns, legislation and beneficial management practices related to:

- Aquatic biodiversity,
- Terrestrial biodiversity,
- Biodiversity conflicts.

This chapter is not intended to provide extensive solutions but to raise awareness and to encourage consideration of fish, other aquatic life, wildlife and plants and their habitat where appropriate in farm management. For information on specific local biodiversity concerns and solutions to conflicts refer to AFF, ENV, FLNRORD and DFO staff or other resource people. The following discussion may not apply to all areas of BC.

BIODIVERSITY AND HABITAT

What is Biodiversity?

Biodiversity is the variety of life on Earth, it includes all organisms, species, and populations; the genetic variation among these; and their complex assemblages of communities and ecosystems. Natural processes include pollination, predator-prey relationships, and natural disturbances such as floods and wildfires.

There are three basic levels of biodiversity: ecosystem, species, and genetic diversity.

Ecosystem Diversity. Ecosystem diversity refers to the variety of ecosystems in a given area and the different ways they function. Ecosystems are all the living (e.g., plants, animals) and non-living things (e.g., soil, water, air) in a given area, plus the interactions that occur among them. Ecosystems can be managed or unmanaged. Most agricultural landscapes are managed ecosystems.

It is important to note that ecosystems exist at different scales. You can find an ecosystem within a single tree, or it can extend across a field, an entire farm, or a large region like a major river basin. Interactions between living and non-living things occur at all these scales at the same time.

Ecosystems develop in response to local conditions, which are influenced by such things as climate patterns, soil types, and topography.

Species Diversity. Species diversity refers to the variety of species that occurs within an area or ecosystem. Different types of birds and different types of trees are examples of species diversity. Generally, the greater the number of species in an ecosystem, the more stable it is.

Genetic diversity. Genetic diversity refers to the variety of genes within a species. Genes determine individual characteristics such as size, shape, and colour. The different characteristics that exist among breeds of chickens are an example of genetic diversity. Genetic diversity allows species to adapt to changes in their ecosystem or environment.

All of these levels of diversity are intricately connected. Change in one part of the ecosystem can affect the functioning of other parts.

Benefits of Biodiversity to Agriculture

Biologically diverse ecosystems provide a number of critically important goods and services that benefit humans. While conserving and enhancing biodiversity may come at a cost to producers, there are immeasurable benefits to farmers and ranchers, including:

- Soil formation and retention processes.
- Maintaining soil productivity and preventing soil loss due to wind and water erosion.
- Nutrient breakdown, storage and cycling.
- Playing a role in sequestering carbon – soil organisms such as mychorrizal fungi can help retain and build soil organic carbon.
- Making nutrients available to domestic and native plants, preventing organic debris from accumulating, and maintaining water quality.
- Helping to control pest populations.
- Reducing crop losses due to fluctuating climate and extreme weather.
- Pollination services.
- Enhancing yields for pollinator-dependent crops such as fruit trees.
- Supporting wild species that are a source of the genetic material needed to breed crops and livestock that perform better than existing varieties.

The above ecosystem goods and services can reduce the need for inputs such as pesticides and fertilizers, increase the productive capacity of the land, and reduce production risks. They have the potential to maintain or even increase farm profitability. In addition, maintaining biodiversity on agricultural lands can increase land value and provide opportunities to develop agri-tourism and other niche marketing activities.

Managing for biodiversity ensures that agricultural lands can continue to receive the benefits provided by natural systems. Some of those benefits are discussed below.

Enhancing Production. Biologically diverse ecosystems tend to be healthy and productive. Diverse plant communities are generally more productive than communities with little diversity. In modern cropping systems, increased soil biodiversity has been associated with increased soil fertility. Soils with greater biodiversity tend to process and store nutrients and use water more efficiently, and are often less likely to leach nutrients beyond the root zone. Maintaining biologically diverse vegetation and soils can improve productivity by:

- Improving soil fertility through enhanced nutrient cycling;
- Improving water infiltration and water holding capacity of soils;
- Reducing plant and soil pathogen populations;
- Reducing levels of pollutants;
- Reducing weed populations;
- Increasing grazing capacity.

Agricultural productivity also benefits from the presence of diverse populations of wild pollinators, such as hummingbirds, moths, native bees, and other insects. Maintaining a diversity of pollinators increases the quantity, reliability, and duration of pollination services to crops. For example, there are several advantages to maintaining healthy populations of native bees in addition to honeybees:

- Native bees generally spend more hours during the day pollinating than honeybees.
- Native bees are usually more active in cold and wet weather than are honeybees.
- Many native bees use "buzz" pollination, which allows them to pollinate crops that honeybees cannot.
- When native bees compete with honeybees for the same plant, honeybees can become more efficient pollinators.
- Native bees have greater species diversity than honeybees; therefore, they are less susceptible, as a group, to pests and disease.
- Native bees tend to be more efficient at distributing pollen than honeybees.

Agricultural landscapes that have a good mix of cropped and non-cropped, natural and semi-natural areas tend to have higher rates of pollination than less complex landscapes.

Stability in Production. Managing for biodiversity creates the foundation for sustainable agriculture. This stability will take on added importance in adapting to a changing climate. Generally, the more diverse a production system is, the more stable it tends to be. For example:

- Diverse systems are more resistant to variations in climate, invasive alien species, outbreaks of diseases, and natural disturbances such as floods, wildfires, and windstorms.
- Increasing the genetic diversity of crop and/or livestock varieties can reduce the risk of production failures.
- Maintaining diverse bird and insect communities can help in controlling agricultural pests.
- Studies indicate that birds can suppress insect and rodent populations, at least at medium to low infestation levels.

Flexibility in Production. Maintaining both native areas and a mix of crop varieties on the farm can maintain biodiversity while providing flexibility in production. For example, creating a shelterbelt that has a diversity of plants can provide:

- Wood fibre;
- Windbreaks;
- Reduced risk of erosion;
- Habitat for pollinators and desirable wildlife species;
- Habitat connections across landscapes;
- Favourable growing conditions for crops that require shelter or certain microclimates;
- Buffers against nuisances such as dust, noise, and odours.

Additionally, maintaining a diversity of crop and/or livestock varieties may provide flexibility in marketing opportunities for agricultural products. Similarly, using environmentally-friendly management practices may provide an opportunity to market specialty products to consumers who are concerned about the environment and how their food is produced.

Agricultural Landscapes are Important to Biodiversity

Agricultural landscapes play a significant role in providing features that are essential for conserving biodiversity. These include:

- An adequate supply of habitat;
- Structurally diverse habitats;
- Connectivity between habitat patches;
- Healthy, functional habitats;
- Storehouses of genetic diversity.

Because valley bottoms and coastal lowlands have longer growing seasons and better soils, these landscapes are more biologically productive than other parts of British Columbia. Greater biological productivity makes these landscapes the best agricultural areas of the Province, but it also makes these lands disproportionately important to wildlife. Land conversion from natural ecosystems to agriculture has the potential to impact the Province's biodiversity, but beneficial management practices can help to mitigate those impacts and maintain biodiversity.

While living in areas abundant with fish and wildlife is considered a positive lifestyle amenity, it comes with added environmental responsibilities. The extent of development and the intensity with which we manage the landscape mean that impacts to, and conflicts with, wildlife are inevitable. Good stewardship and effective land management mean considering the effects of our activities and employing means to minimize conflicts and maximize benefits. Some of these impacts have been mitigated by farms that:

- Provide fish habitat:
  - Constructed ditches that fish colonize, irrigation reservoirs that are stocked with fish, planted riparian vegetation, assured fish passage at weirs and dams, maintenance of functional riparian areas.
- Provide planted or protected wildlife feed and habitat:
  - Critical winter and early spring forage in feed stacks, pastures and fields, and migratory bird stopover points.
- Practice plant stewardship:
  - Grassland management and protection.
- Avoid attracting problem wildlife.
- Store feed and clean up spills.
- Dispose of livestock carcasses properly.

While all farming systems have an influence on the surrounding biodiversity, the degree and type of influence will vary greatly by virtue of the many differences between farms. The relationship between fish and wildlife and agriculture is complex and is most usefully viewed as providing both benefits to agriculture as well as having costs to agriculture.

What is Habitat in an Agricultural Landscape?

Environmental concerns are often mentioned in the context of their effect on habitat. Habitats in agricultural landscapes provide the life requisites that all species need to survive: water, food, shelter from predators and adverse weather conditions, and places to safely breed, and rear young. Habitat can include land associated with farms, as well as resources such as constructed ditches, forage areas and woodlots.

➔ see Aquatic Habitat, **page 7-16**

➔ see Wildlife Habitat, **page 7-26**

Aquatic and Riparian Areas. All habitats within the agricultural landscape are important, but aquatic and riparian areas are especially significant to both biodiversity and agricultural production. Aquatic areas are considered to be some of the most productive ecosystems on Earth. Aquatic ecosystems interact closely with riparian zones—the areas of lush, green, moisture-loving vegetation that surround wetlands, lakes, streams, and rivers. Riparian areas form a transition zone between aquatic and dry, upland habitats. In their natural state, these areas typically have higher biodiversity than other habitats in agricultural landscapes because they provide

shelter, food, breeding and rearing habitat, and safe access to water. The riparian areas along streams and rivers also provide travel corridors for a whole range of organisms that use aquatic and upland areas. In some intensively farmed areas of the Province, retained aquatic and riparian areas provide the only opportunity for connecting habitats. Moreover, wetlands, peat lands and riparian zones house very large and important carbon reserves, which help to slow the release of CO_2 into the atmosphere.

Terrestrial Areas. In agricultural landscapes, terrestrial habitat consists of both native areas, such as forests and grasslands, and semi-natural areas, such as farm woodlots, pastures, hedgerows, and cultivated fields. While native areas within and around farms provide the best opportunity for conserving biodiversity, land that is used for agricultural production is also important. Forests and grasslands also have value as soil carbon sinks.

Structurally Diverse Habitats. Structurally diverse habitats have a mix of vegetation types with different heights and forms. This variation in structure provides different types of important habitats for a variety of native species. Farms and ranches that have a mix of cultivated and uncultivated fields, woodlands, hedgerows, fencerows, shelterbelts, and aquatic and riparian areas provide greater structural diversity than operations that have only cultivated fields or native pastures.

Connections between Habitat Patches. Corridors that connect patches of native and semi-natural areas provide safe, sheltered travel routes for animals when they are migrating or searching for food and mates, and they provide routes for pollen and seeds to disperse. These corridors also help maintain ecosystem services by controlling erosion, filtering contaminated runoff, acting as windbreaks, and providing opportunities for economic diversification. Grasslands, shelterbelts, hedgerows, woodlands, fencerows, uncultivated areas, gullies, intact riparian areas, and rock outcroppings can be used effectively to provide connections between habitat patches both within an individual farm and between neighbouring properties.

Healthy, Functional Habitats. Habitats that are healthy and functioning properly support higher levels of biodiversity than habitats that have been compromised. Agricultural management practices such as conservation tillage, off-stream watering, and nutrient management can help maintain the health of both native and semi-natural habitats on the farm.

Storehouses of Genetic Diversity. Agricultural operations can act as sources of genetic diversity both by conserving native species and by managing a variety of crops and livestock species. Agricultural practices such as crop rotation, use of winter cover crops and perennial cover, intercropping, and agroforestry contribute to increased levels of biodiversity. Additionally, areas left in native pasture can support a greater diversity of soil microorganisms, native plants, and pollinators than tame pastures.

Crop and Livestock Diversity. Planting a diversity of flowering crops that bloom at different times can provide food and rest areas for native insects such as wild bees, which are important crop pollinators. Planting genetically diverse crops can help stabilize crop production and provide a buffer during adverse and extreme weather events (e.g., drought, early frost), an important consideration for adapting to climate change.

Adding livestock to a crop-based agricultural production system can also provide many benefits. Manure can be used as a soil amendment. Livestock can be used to control weeds and promote desired plant species and structural diversity in pastures when their levels of grazing, trampling, and rooting are properly controlled. Adding different kinds of livestock to a production system can also increase the effective use of pastures.

Crop rotation provides crop diversity over time. Rotational cropping helps retain normal ecosystem functioning by curbing erosion, improving soil structure, conserving soil moisture, and disrupting insect, disease, and weed cycles. Rotations that include three or more crops usually have fewer problems with pests and require fewer crop inputs. Rotational cropping can also contribute soil nutrients.

Cover Cropping. Using cover crops during crop rotation supports beneficial organisms above and below ground. These organisms help build soils by decomposing organic matter and contributing to nutrient cycling. Additionally, organic matter is often lost from fallow fields that lack vegetation cover because the soil is exposed to wind and water erosion. Using cover crops, such as a fall rye, instead of letting fields remain fallow, can improve water infiltration, storage, and flow, and add to soil nitrogen content. Delayed seeding and the use of winter cover crops can also be beneficial to a number of species, particularly some species of waterfowl, shorebirds and grassland birds.

Perennial Cover. Perennial cover can make a larger contribution to biodiversity than annual crops can because there is generally less disturbance from farm activities such as tillage, seeding, and spraying. This allows plants and animals to follow their life cycles without disruption. Perennial cover can also provide a greater diversity of vegetation structure, which in turn supports more species. Perennial cover can include crops such as hay (tame or native vegetation) or berry bushes. It can also include native and semi-natural areas that have been left for beneficial insects and other wildlife.

Intercropping. Intercropping provides crop diversity and can increase vegetation structural diversity. It can also provide habitat for beneficial insects. For example, sunflowers planted within one metre of vegetable crops can increase the number of beneficial insects found in crops.

Agroforestry. Agroforestry intentionally combines the production of trees or shrubs with other crops and/or livestock. By integrating a diversity of crop and other plant species, agroforestry can contribute significantly to the structural diversity of habitats. Agroforestry systems can also serve important roles in adapting to climate change as buffers and shelters in production zones. Carbon storage in trees and shrubs in agroforestry plantings is also generally higher than conventional farming settings.

Species at Risk

A species at risk is defined by the federal *Species at Risk Act* (SARA) as an extirpated, endangered or threatened species or a species of special concern. The Act protects species at risk by providing legal protection to species at risk and their residences.

Under SARA there are several species listed as either endangered or threatened in BC. A significant number of these occur in areas that could be impacted by agriculture.

- Species at Risk Public Registry
- Aquatic Species at Risk

Provincial and local government legislation provides for protection of wildlife on BC Crown and private land. The provincial *Wildlife Act* protects wildlife listed under the Act. There is no stand-alone legislation for protection of species and ecosystems at risk; however, threatened and endangered species are listed in Schedule D and E of the *Wildlife Act Designation and Exemption Regulation*. In addition, the Conservation Data Centre (CDC) provides information on BC's wildlife, plants, and ecosystems, including their conservation status.

- *Wildlife Act*
- *Wildlife Act: Designation and Exemption Regulation*
- CDC Data: BC Species & Ecosystems Explorer

To ensure the protection of species at risk, SARA contains prohibitions that make it an offence to:

- Kill, harm, harass, capture, or take an individual of a species listed in Schedule 1 of SARA as endangered, threatened or extirpated.
- Possess, collect, buy, sell or trade an individual of a species listed in Schedule 1 of SARA as endangered, threatened or extirpated.
- Damage or destroy the residence (e.g., nest or den) of one or more individuals of a species listed in Schedule 1 of SARA as endangered, threatened or extirpated, if a recovery strategy has recommended the reintroduction of that extirpated species.

On private land, these prohibitions apply only to:

- Aquatic species listed as endangered, threatened or extirpated in Schedule 1 of SARA; and
- Migratory birds listed in the *Migratory Birds Convention Act*, 1994 and also listed as endangered, threatened or extirpated in Schedule 1 of SARA.

In some circumstances the prohibitions could also be applied, through an order, to other species when found on private land if provincial/territorial legislation or voluntary measures do not adequately protect the species and its residence. Public consultation would first be sought in accordance with normal federal government regulatory procedure.

- Species at Risk Act: information note for landowners

IMPACTS OF AGRICULTURE ON BIODIVERSITY AND HABITAT

Every time humans interact with their habitat they interact with biodiversity. This is especially evident in any type of resource use, including agriculture. Therefore, it is important to understand the types of interactions that can occur between agriculture and biodiversity and the impacts they may have.

Agriculture changes the landscape and while farm development typically removes specific habitat types, it also creates other habitat types. For instance, land clearing removes forested habitat and replaces it with fields that may have forage value for some wildlife and waterfowl.

Impacts on habitat may occur as a result of various ongoing general farm activities. Works done near watercourses such as bridge and culvert crossings, or the construction of farm buildings, may pose risks to fish and wildlife habitat. Similar risks may occur as a result of transporting, handling, and storing farm products and chemicals. Some of those impacts are listed in the sections below.

Habitat Loss and Fragmentation. Regions that support agricultural production are among the most altered ecosystems on the planet. Loss of habitat to agricultural development is associated with a disproportionately high number of species at risk in agricultural areas. Agricultural land makes up approximately 7% of Canada's land base, yet more than half of the terrestrial species at risk are found in agricultural areas. Accordingly, agricultural producers, who play an important role in land management, are increasingly being asked to consider practices that help conserve biodiversity.

Agricultural activities can also affect biodiversity by altering the size and shape of habitats and the distances between them. Large areas of connected native vegetation tend to support the highest levels of native biodiversity. However, smaller patches of native and semi-natural vegetation can also support many species and populations. This is particularly true where patches are close to one another or are connected by corridors of perennial cover that allow wildlife to move safely between them.

Tillage Impacts. Tillage tends to degrade the diversity of soil micro-organisms found throughout the soil profile. This reduces the efficiency of nutrient cycling, the breakdown of toxins, and the maintenance of soil structure, which are all needed to sustain the productivity of agricultural soils. Mycorrhizal fungi play an important role in maintaining above and below ground biodiversity and soil productivity. These fungi form associations with approximately 80% of the terrestrial plant species in the world, including legumes, flax, sunflowers, corn, and fruit trees. Generally, the fungi make nutrients (i.e., phosphorus, nitrogen, potassium, magnesium, and some micronutrients) available for plant growth. Undisturbed, mycorrhizal fungi grow into long, intricate networks in the soil. They transport nutrients through these networks to the plants' roots in exchange for carbon.

Irrigation Impacts. Many aquatic species, such as fish and amphibians, rely on the maintenance of certain water regimes throughout the year. Changes in water levels, due to control structures and/or irrigation withdrawals, may negatively impact habitat and water quality. In addition, over-irrigating not only depletes surface water and groundwater, it can drown plant roots. It can also reduce nutrient uptake, cool soils, reduce crop quality, and increase erosion as well as nutrient and chemical runoff into watercourses. These impacts affect both aquatic and terrestrial ecosystems and can be detrimental to biodiversity.

Input Impacts. Production inputs include fertilizers and pesticides. Depending on the timing and intensity of their use, production inputs can have significant effects on biodiversity. Repeated additions of nutrients in excess of what crops use can destabilize soil conditions, reduce soil organism diversity, and impair soil processes. Improper use of production inputs can also cause water and air pollution. Nutrients, such as nitrogen and phosphorus, can reduce surface water quality by causing overgrowth of aquatic plants and algae. When these plants decompose, the resulting loss of oxygen can be lethal to fish and other aquatic organisms. Overgrowth of some types of blue-green algae can result in the release of toxins that are harmful to a variety of species.

The use of pesticides (particularly insecticides) can have toxic effects on soil organisms, which can impair soil biological processes. Some pesticides can also have adverse effects on beneficial insects, including pollinators such as bees. Most pollinating insects are especially vulnerable to insecticide applications in the cool of the early morning and when their forage plants are flowering. They can also be affected by chemical drift into non-cropped areas where they nest.

Grazing Impacts. When the intensity and timing of grazing and browsing are not properly managed, biodiversity can be negatively affected. When grazing is too intense or too frequent, individual plants become less vigorous. Over time, plant diversity decreases, and grazing-resistant or less preferred species increase in abundance. These impacts can lead to a loss of food and habitat for beneficial insects, amphibians, reptiles, birds, and mammals.

Different species require different types of vegetation structure. Historically, vegetation structural diversity across the landscape was created by fire and a variety of wild herbivores. In agricultural systems, structural diversity can be achieved by managing grazing intensity to maintain mosaics of lightly grazed, moderately grazed, and more heavily grazed areas. This can support greater biodiversity than areas that are grazed uniformly or left ungrazed.

Grazing that is too intense or that occurs at the wrong time of year can affect soils and site productivity by impacting soil organisms, compacting soils, reducing infiltration of water and associated minerals and nutrients, and affecting the exchange of oxygen, carbon dioxide, and other gases in the root zone. Unmanaged grazing can also create areas of bare soil, which can result in increased erosion and be prime sites for invasive plants to establish. Additionally, unmanaged grazing in aquatic and riparian areas can impact biodiversity and water quality.

The timing of grazing activities must also take into consideration the fact that plants and animals can be especially sensitive to disturbance at certain periods during their life cycle. Some animal species may also be vulnerable during certain times of the day.

Introduction of Invasive Species. The introduction and spread of invasive species poses a threat to ecosystems around the world. These species are sometimes also called "exotic," "introduced," "non-native," "non-indigenous", or "noxious" species. Invasiveness refers to the ability of a plant or animal species to spread beyond its introduction site and become established in new locations. Invasive alien species compete with native species for available resources, and in some cases, contribute to the decline or loss of native species. Some invasive plant species are referred to as “noxious” because of the harm they can do to the environment, animals, or people. Invasive plant species, such as spotted knapweed, are well known for their ability to spread rapidly in disturbed and inappropriately grazed areas. They have the potential to reduce agricultural production by competing with native plants for moisture and soil nutrients but often do not provide suitable forage for wildlife or livestock. Invasive plant species reduce native biodiversity and can be extremely difficult and costly to control once established.

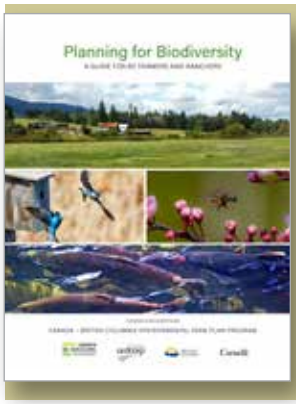
Impacts of Genetically Modified Organisms. Genetically modified organisms (GMOs) are plants, animals, bacteria, or viruses whose genetic makeup has been deliberately altered in a way that does not occur naturally through mating or natural gene recombination. Modification is often designed to improve yield and production by making the organism resistant to disease, insects, and/or pesticides, but it can also be used to enhance or reduce certain traits such as fibre quality or fat content. The growing of GMOs reduces biodiversity because all of the plants within a single species come from a genetically modified source plant, so they are all genetically identical. The overall effects that GMOs have on biodiversity are not fully understood, and they can differ among crops, environments, and the types of modifications made to the organism.

Impacts on Wildlife. Agricultural activities can have impacts on native wildlife species in addition to causing habitat loss. For example:

- Wild sheep and goats that come into contact with domestic sheep, llamas, or alpacas can be exposed to diseases that do not naturally occur in wild populations and for which they have no natural resistance.
- Agricultural activities can disturb wildlife and cause them to move or be displaced, or can upset their normal life cycle.
- Livestock can trample bird nests.
- Equipment used for haying, cultivating, tree harvesting, etc., can injure or kill wildlife.
- Fencing can cut off wildlife access to travel corridors, winter/spring ranges, feeding areas, and water. Animals can also be injured or killed when trying to jump over or go under fences; birds can be harmed by accidently flying into fences.
- Runoff polluted with manure or fertilizer can harm fish and amphibians.
- Pesticide sprays can injure or kill native pollinators.

Biodiversity Plans

Biodiversity in and around the farm operation can provide varying degrees of environmental benefit. In order for producers to gain a better understanding of biodiversity and plan for biodiversity a more detailed assessment is outlined in the Planning for Biodiversity publication.



Planning for Biodiversity: A Guide for BC Farmers and Ranchers is a publication that forms part of the Environmental Farm Plan series on Beneficial Management Practices. The guide is designed for farmers and ranchers who wish to increase their understanding of biodiversity and what it means to their operations. It offers ideas on how agricultural producers can manage for biodiversity, and it provides some tools for doing so. The guide is the next step beyond the EFP process and is not intended to address regulatory issues specifically. The guide provides an opportunity to assess how the farm operation fits within the eight principles of agricultural biodiversity (see Figure 7.1, next page).

EFP Biodiversity Guide Webpage

Eight Agricultural Biodiversity Principles

Managing for agricultural biodiversity is about conserving the variety and number of all living things, including both native and domestic species, and the relationships and interactions among them. The principles on the following pages reflect the key relationships and interactions that need to be considered when managing for biodiversity on farms and ranches.

FIGURE 7.1 Eight Principles of Agricultural Biodiversity

AQUATIC BIODIVERSITY

AQUATIC BIODIVERSITY CONCERNS

Primary environmental concerns related to protection of fish and other aquatic life are:

- Contaminants, such as manure, pesticides and sediments, in water that results in fish health concerns.
- Reduced water quantity or low watercourse flows or velocities causing fish habitat loss resulting in reduction of fish food production, fish, and number of fish species.
- Dredging, dyking and channelizing streams that results in fish habitat loss.
- Loss of riparian vegetation that provides shade, leaf litter and insects for fish food.
- Lack of screens or incorrectly-sized screens on water intakes that result in fish population losses.
- Lack of assured fish passage through or around control structures such as dams or weirs.

For information on these concerns:

➔ see Impacts on Biodiversity and Habitat, **page 7-7**, and refer to Farm Activities and Impacts

➔ see Water Quality and Quantity Factors, **page 9-1**, and refer to Contaminants

➔ see Buffers, Riparian Areas, and the Environment, **page 11-15**, and refer to Riparian Areas

AQUATIC BIODIVERSITY LEGISLATION

The following is a brief outline of the main legislation that applies to aquatic biodiversity.

➔ see **page A-1** for a summary of these and other Acts and Regulations

Environmental Management Act

The Code of Practice for Agricultural Environmental Management, which is concerned with agricultural wastes, makes no direct references to fish habitat. **Compliance with the AEM Code does not necessarily ensure habitat protection.**

Riparian Areas Protection Act

The *Riparian Areas Protection Act* creates the authority for government to enact Provincial directives to protect areas that border streams, lakes, and wetlands. The *Riparian Areas Regulation* (RAR) calls on local governments to protect riparian areas during residential, commercial, and industrial development by ensuring that a Qualified Environmental Professional (QEP) conducts a science-based assessment of proposed residential, commercial, and industrial activities in riparian areas.

With this Act, and through the *Riparian Areas Regulation*, local governments in certain regions of the Province are able to protect riparian areas during residential, commercial, and industrial development by ensuring that a Qualified Environmental Professional (QEP) conducts a science-based assessment of proposed activities. This includes residential buildings on land zoned for agricultural purposes. SECTION 12 provides Provincial directives on streamside protection.

The RAR only applies to the residential portion of the farm and only in the southern half of BC. The RAR does not apply to farm practices as defined in the *Farm Practices Protection Act*. In some cases, this can lead to the misunderstanding that the RAR does not apply to lands zoned for agriculture, or in the Agricultural Land Reserve (ALR). The RAR does apply to these lands for activities that are not *farm practices*, for example residential construction. It is important to note that local governments have the ability to establish bylaws that apply to agricultural lands, and some have implemented setbacks for agricultural buildings that complement the setbacks designated under RAR. Guidelines for *Agricultural Building Setbacks from Watercourses in Farming Areas* have been developed and incorporated into the Guide for Bylaw Development in Farming

Water Sustainability Act

The *Water Sustainability Act* (WSA) is the principal law for managing the diversion and use of water resources. Non-domestic groundwater users are required to apply for a water licence to maintain their right to use groundwater.

SECTION 6: Prohibits diverting water without a licence except in limited circumstances for fire suppression, domestic use and mineral prospecting.

SECTION 11: Requires approvals for making changes in and about streams.

The *Water Sustainability Regulation* contains the rules for applications for licensing of surface and groundwater diversions and use, and for "changes in and about a stream."

There are a number of purposes for this regulation, which include:

- Establishing application requirements for WSA authorizations, including licences and use approvals for stream water and groundwater;
- Defining processes for making changes in and about streams, and in particular delineating changes that can be made by notification to government and those that must be made after making application for and being granted a Change Approval;
- Defines "sensitive streams" in British Columbia;
- Establishes procedures for licence holders to expropriate land reasonably required for the construction, maintenance, improvement or operation of works authorized or necessarily required under the licence; and
- Defines certain water uses that may occur under the regulation rather than under a licence or use approval, such as short term use of water for well drilling purposes and use of deep saline groundwater in north east BC.

Wildlife Act

The provincial *Wildlife Act* protects wildlife designated underthe Act from direct harm, except as allowed by regulation (e.g., hunting or trapping), or under permit. Legal designation as Endangered or Threatened under the Act increases the penalties for harming a species. The Act also enables the protection of habitat in a Critical Wildlife Management Area.

Fisheries Act

Administered by both Fisheries and Oceans Canada and Environment and Climate Change Canada, this Act is established to manage Canada's fisheries resources, including fish habitat. The Act can also be administered provincially by FLNRORD and ENV. The Act applies to all Canadian waters that contain fish, including ditches, channelized streams, creeks, rivers, marshes, lakes, estuaries, coastal waters and marine offshore areas. It also applies to seasonally wetted areas that provide fish habitat such as shorelines, stream banks, floodplains, intermittent tributaries and privately owned land. The Act includes provisions for stiff fines and imprisonment to ensure compliance.

The purpose of this Act is to provide a framework for (a) the proper management and control of fisheries; and (b) the conservation and protection of fish and fish habitat, including by preventing pollution.

This Act was updated in 2019 and now empowers the Minister to make regulations for the purposes of the conservation and protection of biodiversity.

The definition of fish habitat is: "water frequented by fish and any other areas on which fish depend directly or indirectly to carry out their life processes, including spawning grounds and nursery, rearing, food supply and migration areas". The quantity, timing and quality of the water flow that are necessary to sustain fish habitat are also deemed to be a fish habitat. Furthermore, serious harm to fish includes the death of fish or any permanent alteration to, or destruction of, fish habitat.

Provisions of the *2019 Fisheries Act* relevant to agricultural operations include:

- Protection for all fish and fish habitats;
- Prohibition against the death of fish or the 'harmful alteration, disruption or destruction of fish habitat';
- A permitting framework and codes of practice to improve management of large and small projects impacting fish and fish habitat;
- Protection of fish and/or fish habitats that are sensitive, highly productive, rare or unique; and
- Consideration for the cumulative effects of development activities on fish and fish habitat.

Specific sections of the Act include:

SECTION 34.2(1) The Minister may establish standards and codes of practice for:

(a) The avoidance of death to fish and harmful alteration, disruption or destruction of fish habitat;

(b) The conservation and protection of fish or fish habitat; and

(c) The prevention of pollution.

SECTION 34.4(1) No person shall carry on any work, undertaking or activity, other than fishing, that results in the death of fish.

SECTION 35 (1) No person shall carry on any work, undertaking or activity that results in the harmful alteration, disruption or destruction of fish habitat.

Every person who contravenes subsection 34.4(1) or 35(1) is guilty of an offence and liable.

Notifying authorities about serious harm to fish or deposit of a deleterious substance:

SECTION 38 (4.1) Every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations of a harmful alteration, disruption or destruction of fish habitat that is not authorized under this Act, or of a serious and imminent danger of such an occurrence, if the person at any material time:

(a) Owns or has the charge, management or control of the work, undertaking or activity that resulted in the occurrence or the danger of the occurrence; or

(b) causes or contributes to the occurrence or the danger of the occurrence.

SECTION 38 (5) If there occurs a deposit of a deleterious substance in water frequented by fish that is not authorized under this Act, or if there is a serious and imminent danger of such an occurrence, and detriment to fish habitat or fish or to the use by humans of fish results or may reasonably be expected to result from the occurrence, then every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations....

SECTION 38 (7) As soon as feasible after the occurrence or after learning of the danger of the occurrence, the person shall provide an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations with a written report on the occurrence or danger of the occurrence

Species at Risk Act

The purposes of this Act are to prevent wildlife species from becoming extirpated or extinct, to provide for the recovery of wildlife species that are extirpated, endangered or threatened as a result of human activity and to manage species of special concern to prevent them from becoming endangered or threatened. Once a species is legally listed, the Act requires that recovery strategies be developed for extirpated, endangered and threatened species, and that action plans be developed where recovery is feasible.

- Schedule 1 of the Act sets out the legal list of species at risk (extirpated, endangered, threatened and special concern) in Canada.

Where the Act applies, it makes it illegal to kill, harm, harass, capture or take a species at risk, or to possess, collect, buy, sell or trade any individual or parts of an individual that is at risk. The Act also prohibits the damage or destruction of either the residence (for example, the nest or den) or the critical habitat of any species at risk. Critical habitat is legally identified in a posted recovery strategy or action plan.

While the Act applies to all land and waters in Canada, these prohibitions only apply to areas of federal jurisdiction including migratory birds, all waters (sea and fresh) in Canada, as well as to all federal lands, including Indian reserves and national parks, and the airspace above them.

On **private land**, unless an order is made by the federal government, the SARA prohibitions apply only to:

- Aquatic species at risk; and
- Migratory birds listed in the *Migratory Birds Convention Act*, 1994 and also listed as endangered, threatened or extirpated in Schedule 1 of the Act.

The provisions of the *Species at Risk Act* (known as the 'safety net') could be invoked on BC crown and private lands using a federal order under the Act if provincial action is not sufficient to protect listed species.

While SARA prohibitions do not apply to species of special concern, the Act does require management plans to be developed for these species.

More information about how the Act applies on private land can be found at:

Species at Risk Public Registry

AQUATIC BIODIVERSITY BENEFICIAL MANAGEMENT PRACTICES

Comply with applicable aquatic related legislation, including the above, and where appropriate, implement the following beneficial management practices to protect the environment.

Protection of fish and other aquatic life on farm operations includes practices that not only directly protect them but also protect water quantity and quality, riparian areas, and habitats as well.

When planning work in or near a watercourse, seek advice from a Qualified Environmental Professional and/or Fisheries and Oceans Canada to ensure that work does not contravene the *Fisheries Act.* Designs for works in and about a stream should be submitted to Front Counter BC where an approval or licence is required; or to ENV where works are being carried out under regulation (*Water Sustainability Act*, SECTION 11, and *Water Sustainability Regulation*, Part 3).

Fisheries and Oceans Canada- Projects Near Water

FrontCounter BC - Guide to Changes in and about a stream

Aquatic Habitat

For fish and other aquatic life, habitat clearly refers to the water and physical features in watercourses. A holistic view of aquatic habitat includes grassed and wooded areas adjacent to the water that provide various services to aquatic life, the water and the watercourse. Habitat concerns include water quantity, water quality, and the loss of in-stream habitat and riparian vegetation.

Where farm activities are adjacent to watercourses, they will vary from low to high risk but all will require careful management to protect fish and other aquatic life.

Lakes, Ponds and Wetlands. These still and slow moving water environments vary widely through the Province but share important functions within an ecosystem that should be considered when addressing farm impacts. They typically:

- Receive and hold water in a watershed reducing runoff peak flows.
- Depending on their size, have low tolerance for contaminants; water quality may easily be impacted.
- Provide important habitat for a wide range of aquatic life and wildlife.
- Have vegetation that varies greatly, some that may be grazed or browsed by livestock.
- Will have reduced functionality if riparian and buffer areas are impacted.

Wetlands in BC tend to be small and dispersed across the landscape. Some of our most important wetlands occur in off-channel riverine areas. Draining and filling in of wetlands is a major conservation concern, for wetlands tend to be disproportionately important to wildlife, particularly in the more arid regions of the Province.

- Understanding Wetlands: A Wetland Handbook for BC's Interior (available as a book only, not online)
- A Wetland Keeper's Handbook
- Wetlands of British Columbia: A Guide to Identification

Streams, Ditches and Floodplains. These moving water environments vary considerably through the Province but share similar important features:

- Stream bank stability, in-stream structure and sinuosity to dissipate the energy of flowing water without significant erosion.
- Riparian vegetation to provide habitat, organic debris inputs and shade.
- Water quality and quantity for multiple uses, including fish and other aquatic organisms, wildlife, and drinking water supply.
- Floodplains that provide high-water relief to help reduce down-stream erosion and flooding, and to provide nutrients and seasonal rearing habitat for fish.
- Groundwater influence in controlling and moderating watercourse flow and temperature.

Riparian Areas. These areas bordering watercourses usually have vegetation that is different than the surrounding upland area due to the presence of water. Healthy riparian areas are important to aquatic life.

➔ see Riparian Areas, **page 11-17**

Aquatic Life and Aquatic Habitat Protection

To protect stream habitat and riparian areas implement the following practices:

- Protect water quality and quantity by following the water quality protection practices listed.
- Limit the number and use of in-stream crossings by constructing bridges or culverts wherever feasible.
- Perform an annual assessment of riparian health, implement changes identified, and monitor the results of any changes or improvements made (consider the assistance of local environmental enhancement groups).

  Riparian Management Field Workbook

- Use planned grazing systems with separate riparian and upland pastures.
- Avoid grazing in riparian areas or schedule grazing in riparian areas to maintain vegetation diversity.

  Drainage Management Guide

Water Quality. To protect water quality in watercourses that fish and other aquatic life depend on, implement the following practices:

- Keep both dissolved and suspended water contaminants out of watercourses.
- Establish and maintain adequate vegetated buffers directly alongside watercourses.

  ➔ see Buffers, **page 11-4**

- Use special nutrient management practices in buffer areas such as avoiding the spreading of manure in the fall.
- Manage stormwater to maintain watercourse hydrology and water quality in the state it was prior to land development as much as possible.
- Maintain wetlands for reducing peak runoff flows and purifying the water:
  - Where wetlands have been drained, resulting in marginal agricultural land, re-establish the wetland (conservation incentive programs may be available, such as from Ducks Unlimited Canada).
- On annual croplands located near vegetative buffers and riparian areas, use cover crops to limit bare soil areas created by late-season crop harvesting.

  ➔ see Cover Crops, **page 4-8** and

  ➔ see Buffers, **page 11-4**

- Design livestock watering systems to reduce watercourse impacts either by providing controlled access points or no access whatsoever, if appropriate.
- Use pesticide application methods that reduce the risk of direct drift into watercourses or indirect drift onto runoff flows entering riparian areas.
- Manage and control grazing programs to avoid negative impacts such as manure deposition or contaminated runoff flow.

Fish Passage at Control Structures. Water control structures such as reservoir dams, weirs, flood boxes and pump stations on fish bearing watercourses may require fish passage structures. Such structures will be specific to fish species requirements and should be developed after consultation with DFO. Depending on the structure and location, ENV may provide recommendations.

Water Withdrawals. Withdraw irrigation and livestock water at or below the licensed rates, and use acceptable water management practices. During exceptionally dry years, consider the unusual impacts to aquatic life from normal water withdrawals.

➔ see Licensing of Surface Water, **page 9-10**

Surface water withdrawals require screened intakes to protect fish. They are designed for opening size to prevent fish entry and for low water velocity across the screen to prevent fish loss from being drawn against the screen.

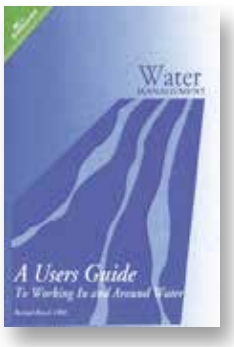
➔ see Water Intakes, **page 9-19**

Changes In and About a Stream

When planning work in or near a watercourse, contact Fisheries and Oceans Canada to ensure that it does not cause serious harm to fish.

Provincial Requirements. Work that involves "changes in and about a stream" (such as water intakes, stream crossings, etc) requires an approval or licence from FrontCounter BC under the *Water Sustainability Act*, Section 11. Notification to ENV is required for works that may be done in compliance with the *Water Sustainability Regulation*, Part 3, such as those that do not involve any diversion of water, can be completed in a short period of time, and have little impact on the environment:

- Installation, maintenance or removal of stream culverts, clear span bridges, docks or wharves, ice bridges, stream fords, and fences;
- Installation or maintenance of pipeline crossings, drain tile outlets;
- Repair and maintenance of dykes, bridge superstructures;
- Cutting of annual vegetation;
- Beaver dam removal for drainage purposes with specific restrictions and in compliance with the *Wildlife Act*.



Working In and Around Water in BC

Standards and Best Practices for Instream Works

Federal Requirements. The *Fisheries Act* requires authorization for work that may impact fish habitat (from Fisheries & Oceans Canada, DFO).

Projects Near Water – Department of Fisheries and Oceans Canada website

Aquatic Life Establishment

Farm projects that include water impoundment or conveyance, such as reservoirs, ditches, etc., may also provide habitat for aquatic life. Consider consulting with Fisheries and Oceans Canada to see if measures can be taken (consistent with the farm goals) that may assist in creation of aquatic habitat.

TERRESTRIAL BIODIVERSITY

TERRESTRIAL BIODIVERSITY CONCERNS

Primary environmental concerns related to terrestrial biodiversity are:

Wildlife

- Contaminants, such as manure, pesticides and sediments, in water from agriculture that results in wildlife health concerns.
- Grazing intensity and timing not properly managed.
- Reduced riparian health that results in wildlife habitat loss.
- Land clearing, drainage of wetlands and introduction of weeds that result in:
  - Wildlife habitat loss,
  - Loss of habitat connectivity,
  - Reductions in woody vegetation or organic soils that are important stores of terrestrial carbon to help mitigate climate change.
- Pesticide management that results in loss of beneficial insects.

Plants

- Invasive pests that result in reduced populations of native plants.
- Pesticide management that results in a loss of beneficial native plants.

For information on these concerns:

➔ see Pest Management and the Environment, **page 5-1**

➔ see Impacts on Biodiversity and Habitat, **page 7-7**, and refer to Farm Activities and Impacts

➔ see Water Quality and Quantity Factors, **page 9-1**, and refer to Contaminants

➔ see Climate Change Factors, **page 12-1**

TERRESTRIAL BIODIVERSITY LEGISLATION

The following is a brief outline of the main legislation that applies to terrestrial biodiversity.

➔ see **page A-1** for a summary of these and other Acts and Regulations

Environmental Management Act

The Code of Practice for Agricultural Environmental Management, which is concerned with agricultural wastes, makes no direct references to wildlife habitat. **Compliance with the AEM Code does not necessarily ensure habitat protection.**

Regulations under this Act provide for the prevention of the spread of designated pests (i.e., insect, plant or pathogen) destructive to specific plants.

Weed Control Act

Administered by AFF, this Act places the responsibility for the control of noxious weeds on the occupiers of the land. It provides for the appointment of inspectors to ensure compliance and, failing that, for a method by which they can control weeds and recover the costs from the occupier. Weed Control Committees may be established by municipal councils to administer the Act within a municipality. Committees report to the municipal council and the Minister.

Wildlife Act

The provincial *Wildlife Act* protects wildlife designated underthe Act from direct harm, except as allowed by regulation (e.g., hunting or trapping), or under permit. Legal designation as Endangered or Threatened under the Act increases the penalties for harming a species. The Act also enables the protection of habitat in a Critical Wildlife Management Area.

- SECTION 4: allows designation of wildlife management areas.
- SECTION 6: regulates endangered and threatened species.
- SECTION 7: makes it an offense, in a wildlife management area, to alter, destroy or damage wildlife habitat; or to deposit a substance harmful to wildlife or wildlife habitat.
- SECTION 9: makes it an offence to disturb, molest or destroy a muskrat or beaver house, den or dam unless you are a licensed trapper or have lawful authority to protect property or maintain irrigation or drainage facilities.
- SECTION 33.1: makes it an offence to intentionally feed or attract dangerous wildlife to any land or premises
- SECTION 34: makes it an offence, except by regulation, to possess, take, injure, molest or destroy a bird or its egg; the nest of an eagle, peregrine falcon, gyrfalcon, osprey, heron or burrowing owl; or the nest of any bird not mentioned above when the nest is occupied by the bird or its egg.

Migratory Birds Convention Act

Under this Act, the federal government is responsible for implementing a Convention between Canada and the U.S. for the protection of migratory birds and nests. The Canadian Wildlife Service of Environment Canada administers the regulations.

- SECTION 5: of the Act states that , no person shall, without lawful excuse,
  - Be in possession of a migratory bird or nest; or
  - Buy, sell, exchange or give a migratory bird or nest or make it the subject of a commercial transaction;
  - Except as authorized by the regulations.
- The *Migratory Birds Regulations* under this Act also has sections of importance:
- SECTION 6: no person shall: disturb, destroy or take a nest, egg, nest shelter, eider duck shelter or duck box of a migratory bird without permit.
- SECTION 24(1): any person may, without a permit, use equipment, other than an aircraft or firearms, to scare migratory birds that are causing, or a likely to cause damage to crops or other property (other control measures require a permit).
- SECTION 33: no person shall introduce into Canada for the purpose of sport, acclimatization or release from captivity a species of migratory bird not indigenous to Canada except with the consent in writing of the Director.

Plant Protection Act

This Act protects plant life and the agricultural and forestry sectors of the Canadian economy by preventing the importation, exportation and transportation of pests.

- The *Plant Protection Regulations* under this Act outline requirements for the importation and/or domestic movement of plant species to avoid transporting pests (e.g., hay and straw may harbour the cereal leaf beetle).

Species at Risk Act

The purposes of this Act are to prevent wildlife species from becoming extirpated or extinct, to provide for the recovery of wildlife species that are extirpated, endangered or threatened as a result of human activity and to manage species of special concern to prevent them from becoming endangered or threatened. Once a species is legally listed, the Act requires that recovery strategies be developed for extirpated, endangered and threatened species, and that action plans be developed where recovery is feasible.

- Schedule 1 of the Act sets out the legal list of species at risk (extirpated, endangered, threatened and special concern) in Canada.

Where the Act applies, it makes it illegal to kill, harm, harass, capture or take a species at risk, or to possess, collect, buy, sell or trade any individual or parts of an individual that is at risk. The Act also prohibits the damage or destruction of either the residence (for example, the nest or den) or the critical habitat of any species at risk. Critical habitat is legally identified in a posted recovery strategy or action plan.

While the Act applies to all land and waters in Canada, these prohibitions only apply to areas of federal jurisdiction including migratory birds, all waters (sea and fresh) in Canada, as well as to all federal lands, including Indian reserves and national parks, and the airspace above them.

- On **private land**, unless an order is made by the government, the SARA prohibitions apply only to:
  - Aquatic species at risk; and
  - Migratory birds listed in the *Migratory Birds Convention Act, 1994* and also listed as endangered, threatened or extirpated in Schedule 1 of the Act.

The provisions of the *Species at Risk Act* (known as the 'safety net') could be invoked on BC crown and private lands using a federal order under the Act if provincial action is not sufficient to protect listed species.

While SARA prohibitions do not apply to species of special concern, the Act does require management plans to be developed for these species.

More information about how the Act applies on private land can be found on:

Species at Risk Public Registry

TERRESTRIAL BIODIVERSITY BENEFICIAL MANAGEMENT PRACTICES

Comply with applicable wildlife biodiversity related legislation, including the above, and where appropriate, implement the following beneficial management practices to protect the environment.

Wildlife habitat concerns include the reduction or loss of habitat due to the establishment or expansion of farms, such as drainage of wetlands for crop production. Wildlife protection on farm operations includes practices that protect both wildlife and their habitat. Assess the type and density of wildlife on or around a farm to ensure that a desired agricultural development, activity, or operation does not cause adverse effects.

Grasslands. Grasslands cover only 1.5% of BC's land area, and about 70% is located on privately owned land. Nevertheless, grasslands are important both as wildlife habitat and as forage for grazing livestock. Grasslands often contain species at risk.

BC Grasslands Stewardship Guide

Woodlands. Farm woodlots may be operated on privately owned and/or Crown land. Impacts from harvesting trees may affect both fish and wildlife. Specific concerns include the growth management activities, the timing and method of tree removal, the size of harvest area, and post-harvest activities.

Riparian Areas. Healthy riparian vegetation supports a diversity of bird and wildlife species with both food and shelter. This vegetation is particularly important to wildlife, including species at risk, as it is very productive and located next to water. ➔ see Riparian Areas, **page 11-15**

Wetlands. These still, and slow moving water environments vary widely through the Province but share important fundamentals when considering farm impacts. Many wetlands do not have fish, and as such do not have direct legal protection, except as they relate to the *Species at Risk Act* and to bird nests.

Wetlands are important to biodiversity because of the presence of a vast range of plant and animal species and the important climate moderating functions they provide.

They typically:

- Receive and hold water in a watershed, reducing runoff peak flows or precipitation events that occur outside normal seasonal patterns, an important adaptation function under a changing climate.
- Depending on their size, have low tolerance for contaminants; water quality may easily be impacted.
- Provide important habitat for a wide range of aquatic life and wildlife.
- Have vegetation that varies greatly, some that may be grazed or browsed by livestock.
- Store large amounts of carbon in wetland vegetation and organic soils.
- Will have reduced functionality if riparian and buffer areas are impacted.
- Perform an annual assessment of habitat health, implement changes identified, and monitor the results of any changes or improvements made.

Understanding Wetlands: A Wetland Handbook for BC's Interior (book only – not available online)

A Wetland Keeper's Handbook

Wetlands of British Columbia: A Guide to Identification

Wildlife and Wildlife Habitat Protection

To protect wildlife habitat, implement the following practices:

- Follow the beneficial practices to protect water quality as previously mentioned in the fish protection section.
- Know the wildlife species on the farm and what habitats are present to determine if there are any threatened or endangered species.
  - BC Conservation Data Centre
  - Canada Species at Risk Public Registry
  - BC Species and Ecosystem Explorer
  - Riparian Management Field Workbook
  - Planning for Biodiversity: A Guide for BC Farmers and Ranchers

- Use planned grazing systems that consider impacts on wildlife habitat, woody vegetation or soil organic matter.
- Improve livestock management to minimize impacts on habitat by:
  - Using cross fencing to move livestock;
  - Installing off-stream or off site-watering.
- Use devices such as flushing bars when cutting hay to reduce wildlife mortality.
- Buffer sensitive habitats from loss or alteration due to road and building construction, outdoor livestock areas, land clearing, wetland drainage, cultivation, crop harvest, soil erosion, compaction, and air contaminants that result from agricultural activities.

➔ see Buffers, **page 11-4**

- Provide wildlife with corridors for moving across the landscape (where appropriate, work with neighbours to establish continuous corridors).
- Conserve wildlife trees and other habitat features.
- Contain and treat livestock diseases.
- Use Integrated Pest Management (IPM) to decide when and how to control pests.

Wildlife Habitat Establishment

Under some circumstances land owners may choose to plant trees and other vegetation specifically for wildlife.

Conservation organizations such as Ducks Unlimited Canada, The Nature Conservancy, The Nature Trust of BC, The Land Conservancy of BC, the Grasslands Conservation Council of BC, or local land trusts work in partnership with producers and may have access to funds or incentives to support stewardship activities, particularly for species at risk.

- Rotten Luck: The Role of Downed Wood in Ecosystems
- Agriculture and Agri-Food Canada: Agroforestry – Wildlife Plantings

PLANT BIODIVERSITY BENEFICIAL MANAGEMENT PRACTICES

Comply with applicable plant biodiversity related legislation, including the above, and where appropriate, implement the following beneficial management practices to protect the environment.

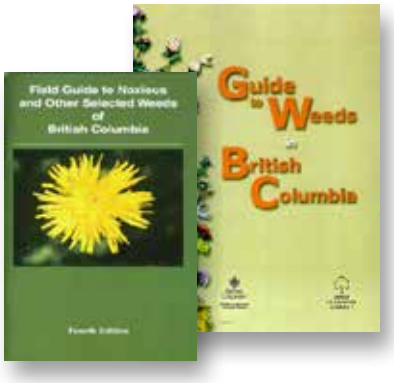
Livestock Management

Livestock may have an impact on plant biodiversity. The main concerns are over grazing and trampling of sensitive vegetation on native grasslands, rangelands and riparian areas.

➔ see Outdoor Livestock Areas, **page 3-8**

Grazing Management Guide

Weeds



Noxious weeds are typically non-native (invasive) plants that have been introduced into British Columbia without the insect predators and plant pathogens that help keep them in check in their native habitats. For this reason, and also because of their aggressive growth characteristics, these invasive plants can be highly destructive, competitive, and difficult to control. Non-native weeds are among the leading causes associated with loss of the natural diversity in the environment.

It is important that any unusual or unfamiliar weeds be reported to AFF or the Canadian Food Inspection Agency so that the species can be identified for appropriate action to be taken to eradicate the pest before it spreads.

CFIA Plants, Pests, and Invasive Species

To reduce the possibility of introducing new weeds to a farm, implement the following practices:

- Before importing plant material from other countries or provinces, check with the Canadian Food Inspection Agency for permit requirements and other restrictions.

  Canadian Food Inspection Agency
- Report the presence of any unusual weeds to the nearest AFF office as soon as possible.

To reduce the impact of weeds, implement the following practices:

- Learn to identify weeds, particularly at the seedling stage.
- Prevent problem weeds from going to seed.
- Always use clean certified seed sources.
- Practice crop rotation to discourage build up of specific weeds.
- Use Integrated Pest Management (IPM) to decide when and how to control weeds.
- Apply appropriate controls at the recommended stage of crop and weed development.
- Control perennial weeds prior to planting crops.
- Prevent the movement of weeds to new locations:
  - Prevent movement that can occur when livestock move from a weed infested area to an uninfested area.
  - By cleaning farm equipment before moving from one location to another.
- Control weeds along farm roads and trails.

➔ see Invasive Pests, **page 5-8**

A Guide to Weeds in British Columbia

Invasive Plants Identification Field Guide

Field Guide to Noxious Weeds and Other Selected Plants of British Columbia

BC Invasive Species Council

BIODIVERSITY CONFLICTS

This chapter has outlined environmental impacts that may occur to biodiversity from a farm operation. However, farms may be affected by impacts from biodiversity.

BIODIVERSITY CONFLICT CONCERNS

While there are many benefits of managing for biodiversity, it is important to recognize that not all species have a positive effect on agricultural production. There a number of animal species, both native and introduced, that can cause significant impacts on agricultural operations, including damage to infrastructure, loss of growing or stored crops, transmission of diseases, and harassment, injury, or death of livestock. The type of impact often varies by species. Examples of concerns related to biodiversity and agriculture conflicts are:

- Deer and rabbits damaging fruit trees.
- Coyotes damaging drip irrigation lines and emitters.
- Birds raiding fruit crops and contaminating feeders.
- Deer and elk consuming standing crops and stored forage.
- Elk damaging fences, irrigation systems and causing pugging and hummocking in fields due to hoof action.
- Bears damaging apiaries and fruit crops.
- Large carnivores such as wolves, coyotes, cougars and bears killing or maiming livestock; or causing damage to fences, equipment and water piping.
- Waterfowl consuming standing crops and compacting soils of cropped fields, particularly during fall migration or overwintering.
- Waterfowl transmitting infectious disease.
- Bats, birds, rodents, skunks, beavers and raccoons and other small wildlife damaging buildings by roosting and nesting in attics, digging and denning under foundations, or sheltering within walls:
  - Causing damage to feed and crops;
  - Carrying pathogens that cause disease in humans, such as Tularemia (rodents, rabbits, hares, Hantavirus (mice), Salmonella (rodents).
- Birds causing a nuisance concern for affected neighbours from the need to use noise makers for bird control.
- Crows and ravens causing harm to newly born livestock and damage of wrapped round bales.
- Starlings flocking inside barns and fouling livestock watering areas and other structures.
- Large predators causing safety concerns for farm workers, visitors, children and pets.
- Bears damaging round bale silage in stack yards and standing silage corn in the field as corn matures and early season oats and barley.
- Bears increasing forage activity in the fall as they prepare for hibernation and frequenting inhabited areas more readily.

When viewed on a provincial scale, most wildlife do not negatively affect agricultural production, but when they do, the impacts to individual producers can be significant. It is important to note that producers can manage for biodiversity without necessarily increasing the risk of wildlife-related conflicts. The key is to find an acceptable balance between the benefits and potential costs of managing for biodiversity.

BIODIVERSITY CONFLICT RESOLUTIONS

Minimize Wildlife Damage. To aid in reducing conflicts or damage, implement the following practices:

- Minimize waterfowl damage:
  - Delay fall tillage of already harvested fields (waterfowl will use the waste grain or crop residue);
  - Straight combine grain crops instead of swathing;
  - Plant lure or sacrifice crops;
  - Post harvested fields as "no-hunting" areas thereby creating your own lure crop and preventing damage to the unharvested crop;
  - Relay crop when possible (i.e., interseeding Italian ryegrass with corn).
- Minimize ungulate (i.e., deer and elk) damage:
  - Stack bales at least two tiers high, keeping stack edges as straight as possible (prevents climbing) and stack bales near human habitation;
  - Use farm machinery to prevent access to stacks;
  - Clean up spilled grain, loose forage and other food sources which may attract wildlife.
- Follow the pest management strategies in Chapter 5.
- Minimize the impact of problem beavers by:
  - by excluding them from habitat, such as screening culverts to exclude beavers.

Control of Beaver Damage

Mitigate Large Predator Impacts and Damage. Large predators such as bears, coyotes, wolves, and cougars are of increasing concern in some areas of BC. In order to reduce potential for conflict or damage, implement the following practices:

- Explore what large predator species may live near your farm operation and familiarize yourself, and any farm workers, with their food and behaviour preferences.
- Identify any problem individual predators and report these to the Conservation Officer Service in your area.
- Use steel hopper bottomed bins or steel bins with a concrete floor and bear-proof door and base to store feed.
- Clean up any feed spills within 24 hours.
- Keep all feed bins in good condition and securely closed when not in use.
- Locate feed bins away from any farm residences and family recreational areas where possible.
- Ensure domestic pet food is kept inside secured buildings and/or bear-proof containers.
- Ensure seed-stock, harvested produce, related supplies and waste materials are stored in bear-proof containers in buildings that are clean, secured, and well-maintained.
- Keep all household garbage inside secured buildings and/or in bear-proof containers.
- Keep barbeques and other recreational outdoor cooking equipment clean and stored inside when not in use.
- Ensure all hunting, trapping, fishing, and home butchering/processing areas and equipment are kept clean and secure. Immediately process and store all carcasses, fish, or other food items in secure buildings and containers.

- Fence growing and beekeeping areas with electrified fencing, where possible, in order to exclude large predators and other wildlife.
- Utilize high-voltage fencing around round bale silage in stack yards to prevent damage by bears.
- Utilize guardian animals (such as donkeys or llamas) that are bonded with livestock to help protect from predators.
- Train domestic pets to herd and discourage predators.
- Monitor regularly for sick or lame livestock, move to secure shelter for treatment.
- Move all livestock to secure on-farm protected areas during birthing season, or if sick and/or injured, and ensure they are frequently monitored.
- Night-pen livestock and use sufficient lighting to illuminate pens and adjacent outside perimeter where possible.
- Dispose of dead stock within 48 hours properly through off-site transport, protected on-farm composting systems, burial to a depth of 2.75 m or incineration.
- Ensure farm workers and family members are trained for and educated in predator conflict prevention.

Mitigating Cattle Losses Caused by Wild Predators in British Columbia: A Field Guide for Ranchers

Preventing and Responding to Conflicts with Large Carnivores

Producers are encouraged to follow normal farm practices as defined by the *Farm Practices Protection (Right to Farm) Act* and as outlined by previous Farm Industry Review Board rulings.

See Farm Industry Review Board

Wildlife Damage Control – Interior BC

Wildlife Damage Control – South Coastal BC

BC Agricultural Fencing Handbook

Bird Predation Management Plan for Blueberries

Netting for Bird Control in Blueberries – A Decision-making Guide

Netting for Bird Control in Cherries – A Decision-making Guide

Netting for Bird Control in Grapes – A Decision-making Guide

Farm Practices – Pest Management Factsheet

- Various projects and programs have been developed in BC to solve local wildlife conflicts including the following examples:
  - The **Delta Farmland and Wildlife Trust** is voluntary on-farm stewardship organization that encourages demonstration and research. The Trust has supported planting lure crops, grassland set-asides, buffers, and public education and awareness projects.
  - The **Livestock Protection Program** is run by the BC Cattlemen's Association. It provides verification and mitigation services to cattle and sheep producers for injury, harassment or death loss caused by wolves and coyote or other large predators.
  - The **Migratory Waterfowl Stewardship Project** was started by the Cowichan Land Trust to address the ongoing regional issues with migratory waterfowl. It is critical that local stakeholders, including farmers, are included in the development, implementation, and monitoring of the stewardship action plan.

Additional wildlife management projects may be found on the Investment Agriculture Foundation website:

Investment Agriculture Foundation

CHAPER 8 METRIC CONVERSIONS

Metric	Imperial Equivalent
50 mm	2 inch
2 cm	0.8 Inch
10 cm	4 inch
50 cm	20 inch
100 m	330 feet
1,300 kg/ha	1,150 pounds/acre
1,700 kg/ha	1515 pounds/acre
5 mm/hr	0.2 in/hr
10 mm/hr	0.4 in/hr
0.4 m/day	1.3 feet/day
1.2 m/day	4 feet/day
2 ds/m	2 mmho/cm
4 ds/m	4 mmho/cm
8 ds/m	8 mmho/cm
1 µg/ml	1 ppm
1 µg/g	1 ppm

Conversions in this table are rounded to a convenient number.
See Appendix E for exact conversion factor.

Values from tables and examples are not included in Metric Conversions

CHAPTER 8 TABLE OF CONTENTS

CHAPTER 8

SOILS

INTRODUCTION

This chapter discusses soil management practices for protection of the environment. It contains introductory information on soil quality. It also contains information on environmental concerns, legislation and beneficial management practices related to:

- soil management

SOIL QUALITY FACTORS

The following soil quality factors are listed in alphabetical order. While these factors can be influenced by agricultural production, they also may be influenced by other human activities and natural phenomenon.

Carbon to Nitrogen Ratio

Applications of soil amendments high in carbon or nitrogen can alter the carbon-nitrogen (C:N) ratio of soils. The median C:N ratio of soils in equilibrium are in the order of 12:1. Wood residue, by comparison, has a C:N ratio near 300:1. The application of materials with a C:N ratio greater than 25:1 will tie up available nitrogen in the soil. Repeated application of high-carbon materials will continue to lower the level of available nitrogen in the soil until a new soil equilibrium is attained. Soils with high C:N ratios will have less nitrogen available for plant use.

Compaction

Soil compaction is the compression of a soil, usually caused by heavy equipment traffic on the site. It results in a loss of soil structure and aggregate stability, and therefore a reduction in soil porosity. Compaction reduces the movement of water, air, nutrients, and soil microbes through the soil. Farm traffic and tillage can result in compaction, particularly when the soil is wet, at either the soil surface or the plow layer. Soils left bare during wet periods, particularly during winter on the South Coast, often have a thin compacted or "puddled" layer at the surface which significantly reduces air and water movement into and out of the soil.

Cover cropping and the incorporation of organic matter in the form of crop residue, mulches, compost, or manure can help to prevent compaction and may actually restore compacted soils. Timely and appropriate tillage and traffic on fields will also reduce the risk of compaction. Livestock may also impact soil structure. Poaching, which is the destruction of structure in the upper layers of the soil, is caused by livestock hoof action in poorly drained conditions.

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Drainage

Soil drainage addresses the challenge of cold and wet soils, which in turn controls the number of workable days in a field. The drainage class of a soil depends partly on the soil texture in the soil profile: coarser-textured soil (e.g., sand) is usually more efficiently drained than finer-textured soil (e.g., silt or clay). Drainage class also reflects the landscape: a deep and coarse permeable soil in a depression, with a high water table, could be an imperfectly drained or poorly drained soil.

FIGURE 8.1 Screen shot of the information that can be obtained from the on-line BC Soil Information Finder Tool (SIFT) tool.

To find information regarding drainage and surface soil texture, the BC Soil Information Finder Tool (SIFT) is a useful resource

Soil Information Finder Tool (SIFT)

Organic Matter

Soil organic matter refers to organic matter that has become part of the humus portion of the soil. It does not refer to plant residue or organic matter which is applied to or remains near the soil surface, and which may be recognizable. Soil organic matter is involved in nutrient cycling by supplying and holding nutrients. Soils high in organic matter are also more efficient in holding water and contribute to aggregate stability or resistance against different types of topsoil loss (erosion). Levels of soil organic matter change relatively slowly over time but are strongly influenced by farming activities and climate.

Potential Soil Contaminants

Agricultural By-Products. Agricultural by-products as defined in the Code of Practices for Agricultural Environmental Management are generally safe to be applied to soil. However, they may sometimes contain elevated levels of metals and nutrients, salt content and pathogens. Examples of agricultural by-products which may be applied to the soil are vegetative debris, such as crop residue, spent mushroom-growing media, manure which may be mixed with bedding or feed.

Non-Agricultural By-Products. Materials that are not agricultural by-products may contain metals, nutrients, pathogens, salts, organic matter, other contaminants, and petroleum products. These are materials such as drywall, glass, biosolids, anaerobic digestate or wood residue. They may be applied to soils as amendments or for other specific purposes.

Nutrients. Spills, improper storage, and over-application of chemical fertilizers or manure may lead to excess nutrient concentrations in soil. An overabundance of particular nutrients can result in toxicity to plants, soil and water pollution, and reduction of crop yield. Excess nutrients not utilized by plants can leach out of the root zone to groundwater or be carried into surface waters.

Pathogens. Most pathogens, such as bacteria, viruses, and parasites die off rapidly when exposed to sunlight and the biological processes which occur in soils. However, there are some that can remain infectious in soils for many years. Some pathogens can be transferred between plants, soils, and animals.

Pesticides. Soils can be polluted with pesticides as a result of excessive application rates, inappropriate application methods, improper disposal, and spills. The extent of contamination depends largely on the characteristics of the pesticide, particularly its persistence and solubility. Soil contamination can result in the elimination of beneficial insects, the inhibition of crop growth, and a reduction in viable crop varieties. In addition, domestic animals and wildlife may be harmed when feeding on contaminated crops or when ingesting soil particles that contain pesticides. A particular risk to humans is that pesticide accumulations in plant and animal products can make foods unfit for consumption.

Petroleum Products. Petroleum products, such as gasoline, diesel, and kerosene, and petroleum byproducts, such as oils, greases, paints, and solvents, are complex organic compounds that may contain metals and other contaminants. Petroleum products that loosely adhere to soil particles are easily washed or leached into surface or groundwater, while petroleum products that firmly bind to soil particles may restrict the growth of plants.

Wood residue. Wood residue leachate is acidic and will cause metals and nutrients to be released from the soil. High application rates of wood residue, either onto the soil surface or by incorporation, will increase the soil carbon-to-nitrogen (C:N) ratio because wood residue is high in carbon.

Leachate. can be generated when soluble materials are dissolved by water passing through them. Soil leachate normally contains soluble nutrients such as nitrates which have not been used by crops. The soil pH is reduced by strongly acidic leachate such as from silage or wood residue. Low pH makes some metals soluble, allowing them to be leached from the soil.

Micro-Elements and Metals

Metals that are beneficial to the soil-crop system are often referred to as trace metals or micronutrients. The application of materials or fertilizers containing excess metals may result in an unwanted accumulation of metals in the soil. Mineral supplements in feed or mineral licks can result in elevated concentrations of micronutrients or metals in soils from manure, typically boron, copper, zinc, and selenium. Crop uptake of metals is generally in low amounts due to the relative immobility of metals in soils, but metal buildup should be avoided to prevent reduced crop production and/or toxicity to plants or animals. Because metal solubility is pH dependent, changing the soil pH will change the potential for metal leaching. Refer to pH and **Figure 8.3, page 8-5**.

Nitrogen (N)

Nitrogen. The nitrogen cycle in agricultural soils is illustrated in **Figure 8.2**, next page. Nitrogen exists in two forms, inorganic and organic. The sum of these two forms of nitrogen is referred to as 'Total Nitrogen.' The inorganic forms (ammonium/ammonia and nitrate/nitrite) are the simple soluble forms that plants use. Inorganic nitrogen represents 2 to 5% of the total nitrogen in soil. The organic forms are complex insoluble forms.

Inorganic Nitrogen – Ammonium (NH_4^+). Ammonium is a common form of inorganic nitrogen used by plants, and it is found in soil, fertilizer, manure, and compost. After application to land, ammonium is converted by soil bacteria to nitrate (NO_3-). Because ammonium and nitrate are soluble, it is found in the liquid fraction of the soil.

Inorganic Nitrogen – Ammonia (NH_3). Ammonia is a gaseous compound of nitrogen and hydrogen that is predominant at high pH and easily volatilizes into the air. The transition between ammonium and ammonia is affected by both pH and temperature. Fertilizer and manure application practices, cultivation, irrigation, and drainage can all affect ammonia movement.

Inorganic Nitrogen – Nitrate (NO_3^-) and Nitrite (NO_2^-). Nitrate is another common form of inorganic nitrogen found in soil, fertilizer, manure, and compost. Nitrate does not generally bind to soil particles and is therefore prone to leaching. This is particularly true in areas such as the Lower Mainland where mild temperatures, intense rainfall events, and wet winters promote the formation and movement of nitrate through the soil. Nitrate leaching also occurs readily in coarse-textured soils that receive high rates of irrigation. The leaching of nitrates into domestic water sources is a significant health concern. Nitrite is an unstable transitional form of nitrate. Both nitrates and nitrites can be toxic to aquatic life.

Soil bacteria, under certain conditions, convert nitrate and nitrite to gaseous nitrogen or oxides of nitrogen, a process called denitrification. This conversion results in the movement of nitrogen from the soil to the air.

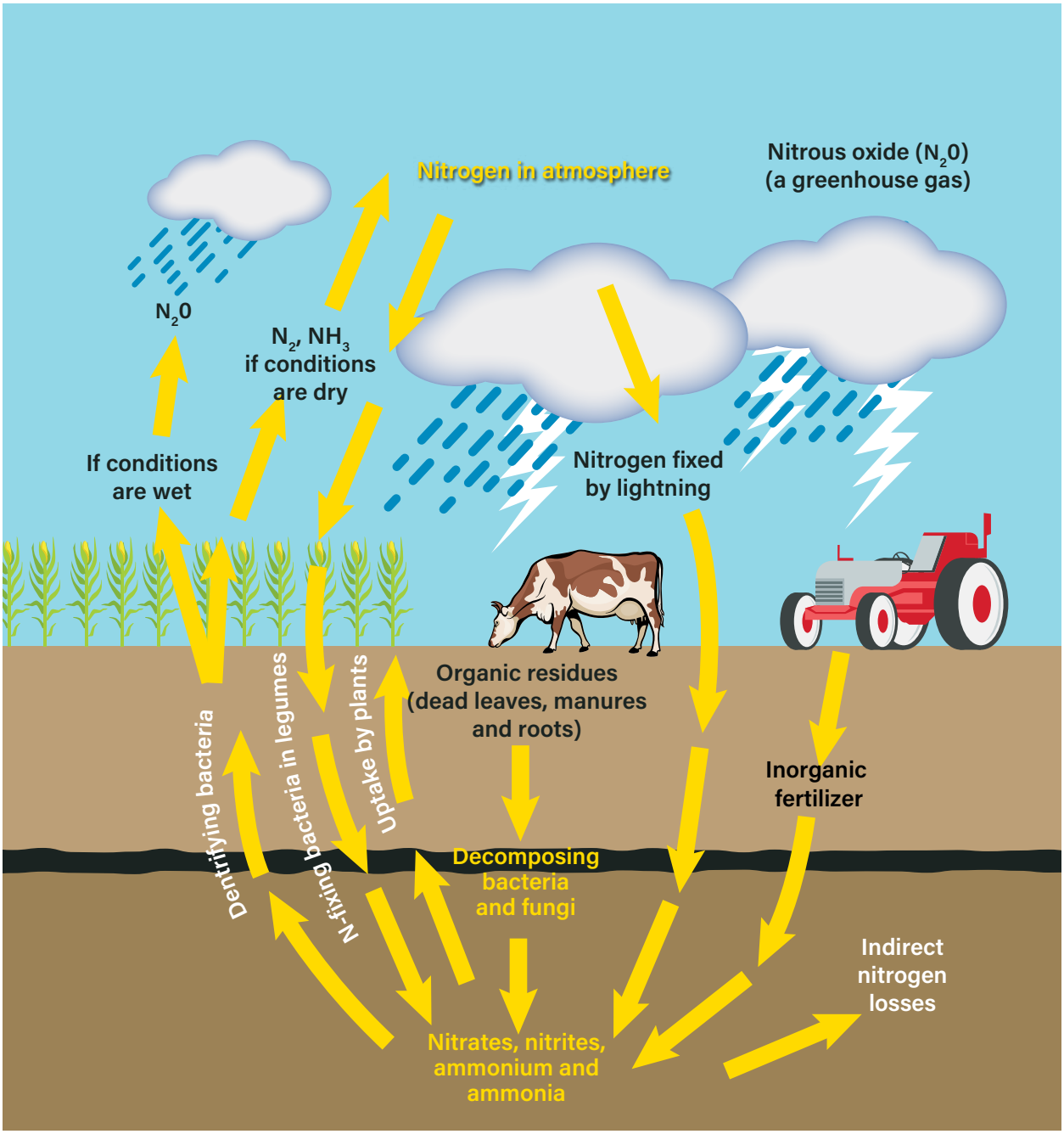


FIGURE 8.2 Simplified Nitrogen Cycle

Organic Nitrogen. The largest pool of nitrogen in soils is in the form of organic nitrogen. As organic matter is broken down by bacteria and other soil organisms, the nitrogen is either converted to the two common inorganic forms of ammonia or nitrate, or returned back to the nitrogen pool as new organic matter in the form of plant or soil microbial biomass.

Additions of manure, crop residue, compost, and other organic nutrient sources can change the size of the pool of organic nitrogen held in the soil. In contrast, cultivation and other cultural practices cause oxidation of organic matter and will result in the loss of nitrogen from the pool

Phosphorus (P)

Phosphorus has a low potential to leach into groundwater because it is normally strongly bound to soil particles. However, in coarse soils and in fields that have experienced repeated phosphorus fertilizer or manure applications over several years, the ability of soils to bind phosphorus can be low. Phosphorus availability is very dependent on soil pH (refer to Figure 8.3) and the presence of mycorrhizal fungi. Aggressive tillage can destroy these valuable fungi resulting in a reduction of immediately available phosphorus. Cultivation can be of value, as it aerates and warms the soil resulting in microbial activity that releases organic phosphorus into available phosphorus forms. Artificial drainage of poorly-drained soils also increases this microbial activity and phosphorus availability, by allowing soils to warm more quickly than if the soil was not drained.

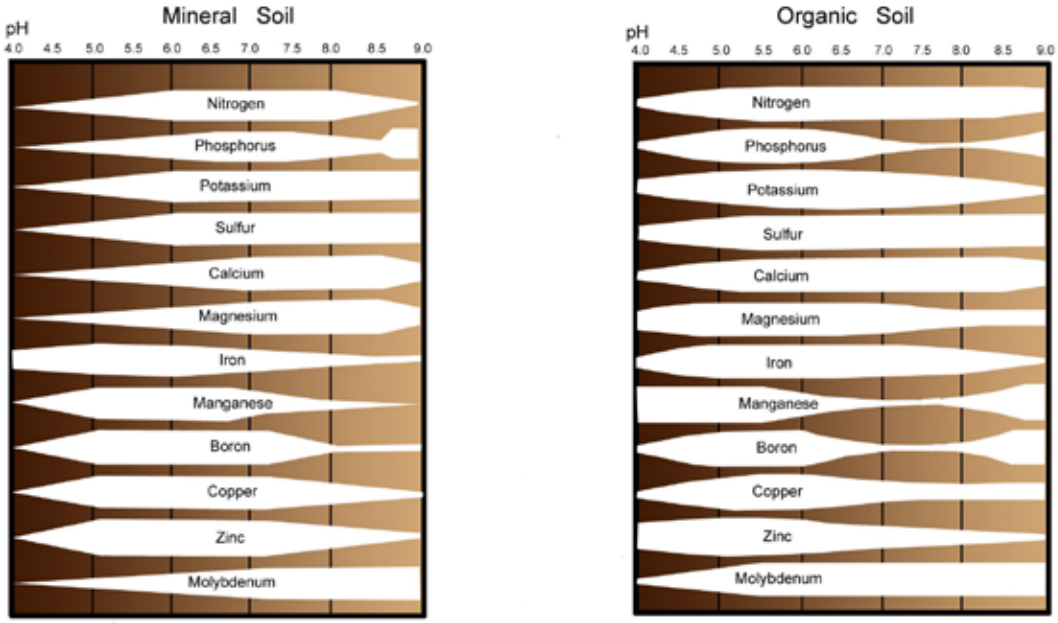
Potassium (K)

Potassium leaches slowly, particularly as the clay content increases in soils that shrink and swell. Potassium is therefore subject to building up in soils similar to phosphorus, if the additions of potassium to soil exceed the removal of potassium in crop harvests, erosion or both. Soil that regularly receives manure is rarely deficient in this nutrient.

pH

pH is a measure of the acidity or alkalinity of a soil. Soil pH has a significant impact on the availability of plant nutrients and micro-elements. It also impacts the activity of soil micro-organisms, and therefore the decomposition of organic soil amendments, such as manure. The impact of pH on nutrient availability varies with the type of soil, with the optimum for mineral soils ranging from 6.0 to 7.0 and for organic soils between 5.0 and 6.0. Optimum soil pH for specific crops may fall outside of these ranges. Figure 8.3, shows the effect of pH on the availability of nutrients in both types of soil.

As pH drops, the availability of many metals increases. A low pH can create a toxic metal environment within the soil that can impact plants negatively or can cause the metals to be more susceptible to leaching. As pH rises to levels above 7.5, certain nutrients such as boron become less available to plants.



The greater the thickness of the band for a given element, the more available the element is at that pH.

FIGURE 8.3 Effect of pH on Availability of Nutrients in Soil

Salts

Soluble salts in soil, which can impact crops, are measured by electrical conductivity (i.e., EC in units of dS/m). Crop species and varieties vary with respect to the levels of salts that they can tolerate. When the electrical conductivity of soils is above 2 dS/m, the soils are considered to be salt affected. Crops are generally broken into three sensitivity groupings based on how well they perform for given ranges of salt concentration: sensitive (0 to 4 dS/m), high tolerance (above 4 to 8 dS/m), and very high tolerance (greater than 8 dS/m). Soils above 4 dS/m are considered saline and will begin to cause a reduction in the yield potential of a wide range of crops. In some coastal areas of B.C. such as Delta, the projected rise in sea level would mean increasing challenges with soil salinity.

Sodicity is characterized by the sodium adsorption ratio (SAR). When the sodium adsorption ratio exceeds 13:1, soil structure is generally degraded, evidenced by a hard cloddy or crusted surface and reduced water infiltration due to loss of soil particle aggregation. In addition, sodium levels begin to become toxic to plants. Farms in Interior BC should be aware of the SAR levels of their soils and SAR levels of irrigation water when used on susceptible fields.

Secondary Nutrients and Micronutrients

Calcium (Ca). Calcium is an essential part of plant cell wall formation. Calcium is not readily mobile and is very important in soil structure formation.

Magnesium (Mg). Magnesium is essential to the formation of the chlorophyll molecule in plants. Magnesium is not readily mobile in soils.

Sulphur (S). Sulphur (also spelled as sulfur) is absorbed by plants in the sulphate (SO_4^{2-}) form, much the same way as nitrogen is absorbed as nitrate (NO_3-). Like nitrate, the plant-available form of sulphur is released by decomposition of organic matter by soil microbes. Traditionally, sulphur has been considered to be mobile like nitrate. However, sulphur adsorption can occur in acidic soils, such as those in the Lower Fraser Valley.

Micronutrients. These include elements like Boron (B), Copper (Cu) and Zinc (Zn). They are required for enzymes and other substances in plants that regulate important functions like photosynthesis, growth and respiration. In general, the range between deficiency and toxicity is narrow; the potential for toxicity to plants (and other organisms) is quite real.

Soil Texture and Structure

Soil texture is the relative proportion of sand, silt, and clay and cannot be easily changed. Soil texture describes the fineness or coarseness of soil (e.g., "sandy loam," or "silty clay"). It is influenced by the level of soil organic matter and activity of soil organisms. It influences drainage and nutrient adsorption and release, amongst other factors. Soil structure is the arrangement of the particles or aggregates in soil and is usually changed slowly by soil management practices, such as cultivation, amendment additions, type of crops grown, and water management.

Soil Texture Calculator

SOIL MANAGEMENT

Soil is a receiving environment just as air and water are. Good soil management promotes healthy plant growth, overall crop quality, and high productivity while preserving soil health. Productive soil depends on the appropriate integration of various field practices such as management of water, crop tillage and nutrient application. Excess water or nutrients will not only create problems associated with crop quality and yield, but will cause environmental degradation as well.

SOIL MANAGEMENT ENVIRONMENTAL CONCERNS

Primary environmental concerns related to soil management are:

- Soil loss through erosion by water or wind that results in air or water pollution.
- Excess soil removal with harvested crops, such as turf grass, nursery plants, and field vegetables, that results in loss of topsoil and eventual reduced crop yield.
- Soil compaction or structure degradation that results in decreased crop yield and increased runoff.
- Loss of soil organic matter that decreases an important sink for carbon and lowers the resilience of soils to adapt to climate change.
- Excess application of nutrients, micronutrients, metals, and contaminants that results in soil or water pollution.

For detailed information on these concerns:

➔ see Soil Quality Factors, **page 8-1**, and refer to Compaction, and to Potential Soil Contaminants

➔ see Nutrient Application, **page 6-1**

➔ see Water Quality and Quantity Factors, **page 9-1**, refer to Contaminants, and to Overland Flow

➔ see Air Contaminants, **page 10-1**

➔ see Impacts of Agricultural Activities on Greenhouse Gas Emissions, **page 12-6**

SOIL MANAGEMENT LEGISLATION

The following is a brief outline of the main legislation that applies to soil management.

➔ see **page A-1** for a summary of these and other Acts and Regulations

Agricultural Land Commission Act

The *Agricultural Land Commission (ALC) Act S.B.C. 2002, c. 36*, and *Agricultural Land Reserve (ALR) Regulations* are the legislative framework for the establishment, administration, and procedures of BC's agricultural land preservation program. The ALC Act takes precedence over, but does not replace other legislation and bylaws that may apply to the land. Local and regional governments, as well as other provincial agencies are expected to plan in accordance with the provincial policy of preserving agricultural land.

The *ALR General Regulation, B.C. Reg. 171/2002*, identifies the procedures for submitting applications and notices of intent.

The *ALR Use Regulation, B.C. Reg. 30/2019* specifies land uses permitted in the ALR.

- SECTION 7(2): the storage and application of soil amendments (fertilizers, manures, mulches and soil conditioners), other than compost
- SECTION 7(3):
  - (a) The production, storage and application of Class A compost in compliance with the *Organic Matter Recycling Regulation, B.C. Reg. 18/2002*, if all the compost produced, stored and applied is used on the agricultural land on which it was produced.
  - (b) The production, storage and application of any other compost that is from agricultural by-products that were produced for a farm use.
- SECTION 35: permitted soil or fill uses on agricultural land
- SECTION 36: prohibited fill materials

The ALC's Policy L-23 provides further information reflecting the regulations regarding the placement of fill for soil-bound agricultural activities.

Placement of Fill for Soil Bound Agricultural Activities

Bylaw No 2: Placement of Fill in the ALR, outlines the conditions under which an application for Non-Farm Use must be made, and which exemptions exist.

Information Bulletin regarding Bylaw No. 2: Placement of Fill in the ALR

Drinking Water Protection Act

The *Drinking Water Protection Act* and its Regulations have requirements to protect drinking water quality and regulate domestic water systems (those serving more than one single-family residence).

- SECTION 23(1): subject to subsection (3), a person must not (a) introduce anything or cause or allow anything to be introduced into a domestic water system, a drinking water source, a well recharge zone or an area adjacent to a drinking water source, or (b) do or cause any other thing to be done or to occur if this will result or is likely to result in a drinking water health hazard in relation to a domestic water system

Environmental Management Act

The Code of Practice for Agricultural Environmental Management requires persons to use environmentally responsible and sustainable agricultural practices when carrying out agricultural operations, for the purpose of minimizing the introduction of waste into the environment and preventing adverse impacts to the environment and human health.

Other regulations under the Act address soil quality parameters to protect human and soil health, including the following regulations:

The Contaminated Site Regulation (CSR) outlines the identification, investigation, and remediation of contaminated sites. Contaminated sites are areas where hazardous waste or organic and inorganic substances are in soil or groundwater at levels potentially toxic to humans, animals and the environment. Contaminated sites are typically the result of past industrial and commercial uses. They are unlikely to be found in areas located in the natural environment or where land uses, and the use of adjacent land, has exclusively been farming or forestry.

The CSR may also be relevant when landowners import soil onto their property as they may be liable for the remediation of the land if the soil that has been deposited turns out to be contaminated.

The CSR is administered by the Ministry of Environment and Climate Change Strategy.

SCHEDULE 2 of the CSR contains a list of activities at a site that may trigger an investigation and remediation. Agricultural and forest activities are not included.

SCHEDULES 3.1 TO 3.3 of the CRS contain standards (threshold) for soil and water to protect humans, livestock and the environment. Where those standards are exceeded, a site remediation may be required. It is unlikely that those limits are exceeded in the natural environment or where land, and the adjacent land, has been exclusively under agricultural and/or forestry production.

The Organic Matter Recycling Regulation and *Soil Amendment Code of Practice* govern the land application of particular residual materials, and these regulations refer to the *Contaminated Sites Regulation* to limit the accumulation of contaminants in soils.

Public Health Act

Administered by the Ministry of Health, this Act has a specific prohibition that "a person must not willingly cause a health hazard, or act in a manner that the person knows, or ought to know, will cause a health hazard". This prohibition would apply to farm practices that may result in a health hazard, such as when nutrients, contaminants or pathogens are discharged to land, water or air to pose a public health problem. Any situation that entails a health hazard will enable health officers to investigate using their powers under the Act. Under the *Public Health Act,* the local Health Authority must investigate any health hazard and has authority to order that a person prevent or stop a health hazard, or mitigate the harm or prevent further harm from a health hazard amongst other powers. Similar regulatory provisions exist for addressing health hazards to drinking water supplies under the *Drinking Water Protection Act*.

The Act has conditions under the *Health Hazards Regulatio*n:

- SECTION 8(1): provides separation distance from wells to be at least.
- 30 m from any probable source of contamination (probable source of contamination could include nutrients from agricultural by-products).
- 120 m from any dumping ground.

Wildlife Act

The provincial *Wildlife Act* protects wildlife designated under the Act from direct harm, except as allowed by regulation (e.g., hunting or trapping), or under permit. Legal designation as Endangered or Threatened under the Act increases the penalties for harming a species. The Act also enables the protection of habitat in a Critical Wildlife Management Area.

Fisheries Act

Administered by both Fisheries and Oceans Canada and Environment and Climate Change Canada, this Act is established to manage Canada's fisheries resources, including fish habitat. The Act can also be administered provincially by FLNRORD and ENV. The Act applies to all Canadian waters that contain fish, including ditches, channelized streams, creeks, rivers, marshes, lakes, estuaries, coastal waters and marine offshore areas. It also applies to seasonally wetted areas that provide fish habitat such as shorelines, stream banks, floodplains, intermittent tributaries and privately owned land. The Act includes provisions for stiff fines and imprisonment to ensure compliance.

The purpose of this Act is to provide a framework for (a) the proper management and control of fisheries; and (b) the conservation and protection of fish and fish habitat, including by preventing pollution.

This Act was updated in 2019 and now empowers the Minister to make regulations for the purposes of the conservation and protection of biodiversity.

The definition of fish habitat is:"water frequented by fish and any other areas on which fish depend directly or indirectly to carry out their life processes, including spawning grounds and nursery, rearing, food supply and migration areas". The quantity, timing and quality of the water flow that are necessary to sustain fish habitat are also deemed to be a fish habitat. Furthermore, serious harm to fish includes the death of fish or any permanent alteration to, or destruction of, fish habitat.

Provisions of the *Fisheries Act* relevant to agricultural operations include:

- Protection for all fish and fish habitats;
- Prohibition against the death of fish or the 'harmful alteration, disruption or destruction of fish habitat';
- A permitting framework and codes of practice to improve management of large and small projects impacting fish and fish habitat;
- Protection of fish and/or fish habitats that are sensitive, highly productive, rare or unique; and
- Consideration for the cumulative effects of development activities on fish and fish habitat.

Specific SECTIONS of the Act include:

- SECTION 34.2 (1) The Minister may establish standards and codes of practice for:
  - (a) The avoidance of death to fish and harmful alteration, disruption or destruction of fish habitat;
  - (b) The conservation and protection of fish or fish habitat; and
  - (c) The prevention of pollution.
- SECTION 34.4 (1) No person shall carry on any work, undertaking or activity, other than fishing, that results in the death of fish.
- SECTION 35 (1) No person shall carry on any work, undertaking or activity that results in the harmful alteration, disruption or destruction of fish habitat.

Every person who contravenes subsection 34.4(1) or 35(1) is guilty of an offence and liable.

Notifying authorities about serious harm to fish or deposit of a deleterious substance:

- SECTION 38 (4.1) Every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations of a harmful alteration, disruption or destruction of fish habitat that is not authorized under this Act, or of a serious and imminent danger of such an occurrence, if the person at any material time
  - (a) Owns or has the charge, management or control of the work, undertaking or activity that resulted in the occurrence or the danger of the occurrence; or
  - (b) Causes or contributes to the occurrence or the danger of the occurrence.
- SECTION 38 (5) If there occurs a deposit of a deleterious substance in water frequented by fish that is not authorized under this Act, or if there is a serious and imminent danger of such an occurrence, and detriment to fish habitat or fish or to the use by humans of fish results or may reasonably be expected to result from the occurrence, then every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations.
- SECTION 38 (7) As soon as feasible after the occurrence or after learning of the danger of the occurrence, the person shall provide an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations with a written report on the occurrence or danger of the occurrence.

Species at Risk Act

The *Species at Risk Act* has sections that protect listed species, their residence, and critical habitat. It applies to federal lands, internal waters (i.e., all watercourses), territorial sea of Canada, and the air space above them.

The provisions of the *Species at Risk Act* (known as the "safety net") could be invoked on BC Crown and private lands using a federal order under the Act if provincial action is not sufficient to protect listed species.

On private land, unless an order is made by the government, the Act prohibitions apply only to:

- Aquatic species at risk.
- Migratory birds listed in the *Migratory Birds Convention Act, 1994* and also listed as Endangered, Threatened, or Extirpated in Schedule 1 of the Act.

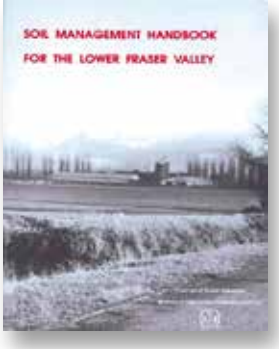
SOIL MANAGEMENT BENEFICIAL MANAGEMENT PRACTICES

Comply with applicable soil related legislation, including the above, and where appropriate, implement the following beneficial management practices to protect the environment.

Soil Cultivation

Cultivation plays a critical role in crop management and environmental protection. Implement the following practices:

To reduce the risk of erosion and compaction, cultivate fields only when testing has shown that soils are at the correct moisture content, such that when soil is squeezed by hand:



- Soils should be dry enough to easily crumble.
- If too dry, they will be either very hard or very powdery.
- If too wet, they will smear and compact more easily.
- Cultivate fields if the chance of significant rain in the forecast that could cause erosion is not expected.

Cultivate to incorporate nutrients in order to:

- Maximize nutrient retention.
- Improve infiltration and thereby reduce the risk of runoff flow.
- Interrupt excessive subsurface percolation.

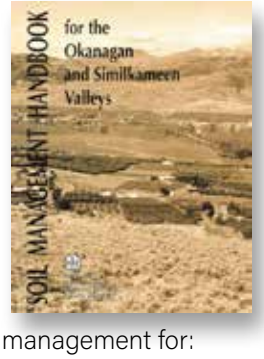
Cultivate prior to liquid manure application to:

- Break macropores (macropores are formed by soil cracks, worm holes, and animal burrows and can lead to direct discharge of manure to surface water via subsurface drainage tiles).

Cultivate for weed control to maximize crop yield and crop nutrient use by reducing competition

- Effectiveness is dependent on timeliness, since even small weeds can cause significant crop growth reduction.

Cultivate after harvest to:



- Incorporate crop residue if the risk of being carried off by wind or runoff is present.
- Break traffic or cultivation pans for improved water infiltration.

Time cultivation for renovation of perennial forages to:

- Minimize risk of erosion;
- Minimize nutrient loss;
- Maximize germination and crop cover.

Cultivate the subsoil to improve aeration, to remove compacted layers, and to improve water management for:

- Better crop growth and nutrient use.
- Increased infiltration of water.

Soil Management Handbooks for BC

Soil Management Handbook for the Lower Fraser Valley

Soil Management Handbook for the Okanagan & Similkameen Valleys

Soil Management Handbook for Vancouver Island

Precautions. Consider the following precautions when cultivating:

- Do not over-cultivate since soil with reduced structure will have an increased risk of soil erosion.
- Do not use a conventional rototiller for repeated cultivation, residue incorporation, and/or weed control since too much cultivation with a rototiller will pulverize the soil and compact the subsoil over time.
- Establish and maintain adequate buffers between cultivated fields and sensitive areas to keep soil erosion and dust from causing a nuisance or pollution.

➔ see Buffers, **page 11-4**

Soil Erosion Risk

Erosion refers to the loss of soil due to water, wind or tillage. Erosion risk depends not only on management practices, but on the topography and climate of a region. Water erosion can be the result of surface runoff caused by rapid snowmelt, heavy rainfall, or excessive irrigation. Wind and water erosion occurs if soils are allowed to remain bare for extended periods of time. Wind and water erosion can each lead to loss of soil productivity and environmental problems. Eroded soil nutrients or fine-grained materials, such as silt or clay, can impact watercourses. Wind-blown soil can cause dust nuisance and respiratory health problems. Wind-blown sand in particular causes physical damage to stems and leaves. The damaged plants are then susceptible to diseases and other pests.

The susceptibility of a site to soil erosion depends on several factors, some of which apply to both wind and water, and others to wind or water alone. The following list may help to assess the site for its erosion risk.

Soil Texture and Structure. Soil texture and structure play a role in both wind and water erosion. Medium-textured soils, such as very fine sand, silt, and silt loam, are highly susceptible to erosion. Soils with good structure (arrangement and stability of soil particles and pores) are more resistant to erosion than are individual particles. Organic matter helps to create good structure, with the result that soils high in organic content are more resistant to erosion.

Soil Condition. Saturated or compacted soil conditions facilitate erosion because excess water will flow over the soil surface rather than seep into the ground. Similarly, very dry soil conditions create an environment where wind erosion is more probable.

Topography. Topographic conditions play a major role in whether a site is prone to water erosion. In general, the greater the slope, the greater the risk that erosion may occur. Erosion potential increases at a rate of more than 2.5 times for each twofold increase in slope. Slopes of greater than 2% are considered to present a moderate risk of soil loss if left bare, while slopes of more than 5% are considered to have high risk of eroding. Erosion potential increases by 1.5 times for each twofold increase in slope length. If slopes are longer than 100 m, the erosion risk is considered high.

Rainfall Intensity. Sites subject to high-intensity rainfall events or subject to rapid snowmelt runoff over frozen soils require extra management to prevent severe erosion. With predicted changes in rainfall intensity as a result of climate change, it is becoming increasingly important to address an increasing risk of soil erosion.

Wind Exposure. Winds with sufficient velocity and of high frequency can contribute to the movement of significant amounts of soil if low soil moisture is coupled with the absence of surface cover or wind barriers.

An Introduction to Wind Erosion Control

Surface Cover. Bare and exposed soils increase both water and wind erosion potential. Bare soils are susceptible to a hundredfold increase in erosion potential when compared with grass-covered soils.

Detailed Assessment of Erosion Risk. Producers who wish to do a more complete water and wind erosion risk assessment on their sites can use a tool known as the Revised Universal Soil Loss Equation (RUSLE). This is a mathematical equation that predicts annual soil loss.

The RUSLEFAC - Revised Universal Soil Loss Equation for Application in Canada

Field Soil Erosion by Water

Orientation of Rows. Crop rows that are planted up and down slopes facilitate the overland flow of water and therefore promote soil erosion. Similarly, crop rows planted in the direction of prevailing winds promote wind channeling effects that increase erosive forces.

The potential for soil erosion due to runoff flow varies between operations depending on the risk factors discussed above. To reduce the erosion potential, implement the following practices:

- Establish cover crops or maintain crop residue between plant rows, along headlands, and on fields during non-cropping periods to reduce the destructive impact of rain drops (Figure 8.4).
- Maintain a suggested minimum 30%–50% cover crop foliage on the soil surface during high rainfall or runoff periods.
- Plant crop rows along contours instead of up and down slopes to slow down and filter runoff flow.
- Install and manage drainage systems to maintain unsaturated soil conditions.
- If cover crops are impractical or result in too much competition for water, cover the soil with organic mulches, such as straw. In areas where frequent winds are expected, the straw will need to be anchored by disking or crimping.
- Establish and maintain adequate vegetated buffers between fields and watercourses to protect ditch and stream banks, and to filter and slow down runoff flow.

➔ see Buffers, **page 11-4**

- Modify tillage practices to keep crop residue on the surface for greatly reduced erosion potential.
  - Practice conservation tillage in all regions of the province.
  - Maintain a suggested minimum of 30%–50% anchored cover crop residue on the soil surface when crops are not growing.

Estimating Crop Residue Cover for Soil Erosion Control

- Use grassed waterways, drop structures, lined channels, or terraces to control more severe water erosion problems (technical advice may be needed to implement some of these special measures).

Soil Erosion Control BC

Minimizing the Effects of Runoff Flow. Runoff flow results from rainfall events, snowmelt or excess irrigation water. Controlling rainfall-generated stormwater on the farm can be a critical factor in reducing soil erosion in areas around buildings, yards, roadways, ditches, and fields. Uncontrolled stormwater flow is very erosive to soil, as it tends to be high in intensity. Such flow readily carries soil, crop residue, and agricultural by-products by virtue of its high velocity and turbulence. Minimizing runoff flow effects will have added importance with projected increased frequency and intensity of precipitation events occurring with climate change.

Stormwater from roofs should be collected and diverted into ponds or grassed waterways. Stormwater from roadways and yards should be collected and filtered to remove suspended solids, nutrients, and other contaminants. Clean water can be diverted directly into drainage systems if they have been designed to handle the peak flows characteristic of stormwater events.

➔ see Runoff, **page 9-50**

The interception of surface and subsurface flow from adjacent properties can reduce soil erosion:

- Drain areas on hillsides with shallow soils overlying compact subsoil, or areas subject to saturation, with tile lines placed across the slope and backfilled with a porous medium.
- Use porous interceptors, also know as French drains, to capture runoff.
- Maintain the land surface above such drains in a porous, open condition by establishing permanent vegetation directly over the drain line or by growing a winter cover crop.

➔ see Drainage, **page 9-42**

Grassed Waterways. Grassed waterways are designed to collect and transport water from fields while protecting the soil from the erosive force of rapidly-moving concentrated water flow. Grassed waterways may be integrated into fields from which forage may be directly harvested; however, they are usually designed to contain different species, and are subject to different management practices than the rest of the field.

Grassed Waterways

Soil Erosion Along Watercourses

Soil erosion along watercourses often occurs when the vegetation surrounding the watercourse, known as the riparian area, is in poor condition. Healthy riparian areas are critical in protecting stream banks from erosion, and, by extension, farmland. Well-vegetated riparian areas have a root mass that binds the soil together for good erosion resistance. If a watercourse starts eroding, especially if water flow volumes and velocities are high, soil loss can be dramatic and every difficult to stop. ➔ see Riparian Areas, **page 11-17**

Field Soil Erosion by Wind

Susceptibility to wind erosion is greatest when the ground is bare, when plants are young, or when land is unprotected from the effects of wind. Options for the control of wind erosion include reduced tillage, strip cropping, crop residue cover, mulches, windbreaks, shelterbelts, and wind barriers such as fences.

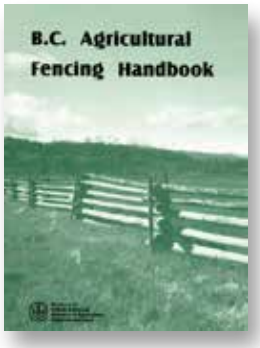
Strip Cropping. This management-intensive practice involves planting strips of crops with varying growth characteristics (e.g., alternate rows of grain and forage).

Cover Crops. Cover crops are useful for protecting the soil surface from erosion by wind. The taller and denser the crop, the better protected the soil will be. Planting cover crops provides additional benefits such as tying up nutrients until productive crops can utilize them. Most soils require a minimum 30% ground cover to prevent wind erosion. This means that choice of species, seeding rates, and planting dates are critical for cover crops to be effective. Suitable cover crops for early summer planting are cereal/legume mixes or annual ryegrass. Appropriate cover crops to follow late harvested annual crops include fall rye, winter wheat or winter barley.

Fences. Fences can provide protection from wind erosion where vegetative windbreaks are impractical. Fencing is a management tool which will be most successful when properly planned as part of an overall system for a farm or ranch.

B.C. Agricultural Fencing Handbook (series of Factsheets)

Mulches. The most effective mulches to reduce or control wind erosion are straw, coarse wood chips or larger pieces of crop residue. In order to be an effective erosion control practice the mulch must be anchored.



Crop Residue Cover. Crop residue left on the fields after harvest also provides erosion protection. To be effective, at least 30% of the soil surface needs to be covered by residue. Crop residue protects soil from wind erosion by reducing wind speeds at the soil surface. Residues can take the form of standing stubble or post harvest crop waste. In the case of cereal crops, a 30% cover is equivalent to about 1,300 to 1,700 kg/ha of residue. Highly erodible soils may require double this amount of residue to effectively reduce erosion.

Estimating Crop Residue Cover for Soil Erosion Control

Reduced Tillage. The risk of both wind and water erosion is decreased by reduced tillage practices. These include minimizing or eliminating cultivated fallow, decreasing the number of tillage events, and choosing implements and methods that minimize soil and residue disturbance. In areas where erosive winds are expected but field preparation requires bare soil for a limited time, try to leave a rough surface as opposed to smooth surface.

Protecting Pastures. Overgrazing reduces long-term pasture productivity and leaves soil prone to erosion. Manage grazing to leave adequate plant cover at all times.

Windbreaks. Establish and maintain adequate vegetative buffers in strategic locations around the farm to minimize soil erosion by wind and to prevent dust from creating a nuisance or causing pollution. Agroforestry practices, including shelterbelts, timber belts, and alley cropping can also be implemented to provide windbreak functions. All vegetative buffers and agroforestry practices improve carbon sequestration in farming systems, providing an important means to mitigate climate change.

➔ see Buffers, **page 11-4**

Soil Loss by Harvest

The degree of soil loss caused by certain harvest practices is dependent on the type of crop grown and the soil moisture conditions at harvest. Harvesting of balled and burlapped nursery stock, turf, and field vegetable crops commonly remove soil from fields. In the case of field vegetables, most of this soil remains on the farm after crop washing and eventually should be returned to the field. In cases where soil loss is unavoidable, rebuild the soil by adding amendments, such as sand, and by implementing practices that improve soil organic matter content, such as cover cropping.

➔ see **Chapter 6**, Nutrient Application

FIGURE 8.4 Relay Cover Crop in Corn Stubble

The following practices are recommended to reduce soil loss.

Field-Grown Nursery Stock. Prune roots, use large pot sizes when planting out stock, market bare root plants in place of ball & burlapped when possible, and avoid wet soils during harvest.

Turf Nursery. Reduce the depth of cut, use ground netting, and avoid wet soils during harvest.

Field Vegetables. Avoid cultivation activities on wet soils which causes clodding. Avoid harvesting in wet soils. Use soil eliminators on mechanized harvesting equipment.

Nutrient Management

Nutrient requirements are likely to be different for each field and crop. It is important to understand specific nutrient requirements to minimize excess soil nutrients and their losses from the field. This is best accomplished by following a Nutrient Management Plan.

➔ see **Chapter 6**, Nutrient Application, for general information on nutrient management

Leachate Formation in Soil

Leaching is the removal or transfer of soluble compounds by water from soils or other materials such as manure, silage, compost or wood residues which have been incorporated into or placed on the soil. The primary concern is the potential for leachate nutrients or metals reaching surface or groundwater.

➔ see Leachate, **page 9-58** for information on leachate management

Leaching of metals from soils occurs when soil pH decreases, causing metals in the soil to become more soluble, contributing to a greater risk of toxic leachate formation. In order to reduce the risk of leachate generation containing metals, implement the following practices:

- Know the effect of various soil amendments and mulches on soil pH and maintain soil pH above 4.5.
- Wood residue added to soil will lower soil pH.

➔ see Wood Residue, **page 2-40**

Contaminant Movement in Soil

The movement of contaminants in soil, such as petroleum, nutrients, pesticides, or leachate, is affected by:

- The amount of water moving through the soil, such as from rainfall, irrigation or runoff.
- The infiltration and permeability of the soil, in particular the presence of preferential soil paths caused by cracks or macro-pores.
- The ability of the soil to bind contaminants.
- The breakdown of contaminants by soil microbes.

The rate at which contaminants on the soil surface enter the soil is controlled by the soil's infiltration rate. Permeability is a measure of the rate at which water moves through the soil. The size and continuity of soil pores control both permeability and infiltration, and thus the risk of contaminant leaching. Factors which influence infiltration and permeability are shown in **Table 8.1**. Soil texture and structure have the highest weighting with respect to the risk of leaching.

There is generally an inverse relationship between the risk of leaching and the risk of runoff. For example, a fine textured clay or silt soil with large pores or cracks will have a higher risk of leaching, at least to the depth of a dense compacted layer or to subsurface tile drains. If this same soil was cultivated to eliminate macropores, the risk of leaching, would be low. Soils with a low risk of leaching generally contribute to a higher risk of runoff. **Table 8.1,** describes the factors which contribute to increased risk of leaching and in reduced risk of runoff. Soils that are moderately to well drained are generally most desirable for cropping, also have an inherent, yet manageable risk of leaching.

Coarse-textured soil has a specific meaning in the *Code of Practice for Agricultural Environmental Management.* The term refers to soils with a saturated hydraulic conductivity (K_{sat}) of more than 10^{-3} cm per second. **Table 8.2** lists the soils in B.C. that have been mapped and can be expected to have K_{sat} values greater than 10^{-3} cm per second. This list is meant to be used with the BC Soil Information Finder Tool, (SIFT) can be used as guidance to avoid sites of coarse-textured soil if required by the *Code of Practice for Agricultural Environmental Management*.

Hydrologic Soil Groups, United States Department of Agriculture

Soil Information Finder Tool (SIFT)

TABLE 8.1 Factors that Affect Risk of Contaminant[a] Leaching — Worksheet 1

Factor	Soils with High Leaching Risk [b]	Soils with Low Leaching Risk [c]
Soil Texture	▪ Coarse textured sandy or gravelly. ▪ Fine-textured soil that shrinks and cracks during drying, if cracks connect with subsurface tile drains, bedrock, or the water table.	▪ Fine-textured, silty or clay, with low potential for shrinking and swelling. ▪ Greater than 15% clay. ▪ Homogeneous texture throughout the profile.
Soil Structure/ Pores	▪ Well structured, blocky or large crumbs with large or abundant pores (macropores) and/or column structures.	▪ Poorly structured, platey or smeared with few or fine pores (micropores). ▪ The presence of a self-sealing layer below the soil surface that forms in animal feedlots.
Soil Organic Matter Content	▪ Organic matter in well-structured mineral soil, resulting in significant large pores. ▪ Poorly decomposed organic soils (peat soils).	▪ Poorly structured mineral soil. ▪ Well decomposed organic soils (muck soils).
Soil Bulk Density	▪ Loose, with large lumps that do not easily break into smaller lumps.	▪ Dense, compacted or cemented.
Animals	▪ Abundant soil animals or burrowing insects.	▪ Soil animal or burrowing insects channels are absent.
Roots	▪ Abundant coarse roots and root channels.	▪ Few root channels and many fine roots.
Soil Depth to a Restrictive Layer or Water Table	▪ Shallow soils over gravel or fractured bedrock. ▪ Soils with shallow water tables.	▪ Deep, well defined topsoil and subsoil over slowly pervious rock or clay.

[a] Contaminants, such as manure, pesticides, petroleum, leachate, etc.
[b] High Risk of contaminant movement = infiltration more than 10 mm/hr & permeability more than 1.2 m/day
[c] Low Risk of contaminant movement = infiltration less than 5 mm/hr & permeability less than 0.04 m/day
Note - there is an inverse relationship between risk of leachate and risks of runoff:
- soils with a low risk of contaminant (leachate) movement generally contribute to a higher risk of runoff
- soils with a high risk of contaminant (leachate) movement are generally most desirable for cropping

TABLE 8.2	Soils[a] with saturated hydraulic conductivity of more than 10^{-3} cm/second			
Abbotsford	Debeck	Haynes	Onyx	Skaha
Abbot	Dub Lake	Isar	Paradise	Skins
Alix	Eena	Kammat	Parkill	Sitkum
Allison	Ellison	Kaslo	Peta	Stemwinder
Asp	Errington	Kaleden	Pillar	Snodgrass
Avis	Fishertown	Kitsumgallum	Pope	Stolle
Badshot	Fleet Creek	Kuhushan	Pari	Sprucebark
Beddis	Frog	Kinkade	Purjue	Stepney
Brennan	Galena	Kinert	Quamichan	Squally
Big Fish	Granite Creek	Kluk	Qualicum	Shass
Bohan Creek	Giscome	Kenneth	Quennell	Steepland 2
Banshee	Godey	Kennedy	Ragbark	Steepland 1
Barkerville	Gisborne	Kruger	Rainbowl	Succour
Bellhouse	Glade	Kiwigana	Ramsey	Suskwa
Burtontown	Gillis	Kwikoit	Rockface	Shuswap
Beaufort	Gammil	Kye	Roaring	Swift
Beaverdell	Glimpse	Larch Hill	Rockbluff	Solly
Cavanaugh	Gang	Layton	Rouke	Talus
Celista	Henning	Mapes	Rossland	Tamihi
Colony	Hellroarer	Malakwa	Rosewall	Trehearne
Canyonview	Hiller	Miner	Ruault	Trurans
Comiaken	Hooligan	Morice	Rutland	Tatton
Corporation	Haney	Moulton	Ryanier	Trewitt
Cassidy	Honeymoon	Neilson	Salalakim	Tzuhalem
Cultus	Holden	Nissen	Salmo	Vermelin
Dragon	Hester	Nighthawk	Saunier	Valemount
Dahl	Hastings	O'keefe	Sawtooth	Vedan Meadow
Decker	Huffer	Oona	Shepherd	Whipsaw
Dog Creek	Hupel	Ormond	Seaton	
Dil Dil	Hawks	Oyama	Shegunia	
Desperation	Hawarth	Osoyoos	Sechelt	

[a] The following soil series are described as rapidly drained in soil surveys. Rapid drainage is often associated with coarse-textured soils, many of which can have a saturated hydraulic conductivity exceeding 10-3 cm/sec. However, the user should be aware that drainage at a specific may substantially vary from the general description. This table must, therefore, be used with some caution and can only be considered as guide. Canadian Soil Information Service http://sis.agr.gc.ca/cansis/soils/bc/soils.html

Use the Soil Information Finder Tool to determine the soils most likely to be found at a given location based on soil maps. At any point on a soil map, up to three different named soils are likely to be present. The presence of any of these soils at a particular point is not guaranteed. One or more soil pits may need to be evaluated to confirm soil characteristics, including saturated hydraulic conductivity.

Soil Contamination

Contaminants may include non-organic compounds (e.g., salts, metals, pesticides, excessive nutrients) and organic compounds (e.g., hydrocarbons, oils, dioxins, furans, weed seeds, pathogenic organisms). To prevent soil contamination it is necessary to know the chemical characteristics of all materials used on the farm, including pesticides, fertilizers, manure, compost, and other soil amendments. Off-farm organic materials must be fully identified before use as well. Numerous beneficial off-farm organics are identified in Schedule 12 of the *Organic Matter Recycling Regulation*.

Implement the following practices to monitor and prevent soil contamination.

➔ see Farm Waste, **page 2-19**

➔ see Petroleum , **page 2-32**

➔ see Pesticides, **page 5-15**

➔ see Chapter 6, Soil Amendments, **page 6-4**

If contamination is suspected or does occur, consult ENV and a qualified environmental professional for remediation procedures.

pH Check. pH levels in soil may be affected by application of soil amendments or cultivation. Implement the following practice:

- Check pH levels every three to six years, or more frequently if soil pH levels are suspected of restricting crop growth and adjust pH in the soil as required.
- When soil pH is lower than 5.5 or higher than 7.5 on mineral soils special management is required to adjust pH, such as liming or acidifying the soil.
- Blueberries and cranberries are notable exceptions among crops with respect to soil pH tolerance; these crops thrive in low pH (4.5 to 5.5) conditions that are typical in bog soils, although these crops may be grown in mineral soils as well.

Soil pH Resources

Soil pH

Liming Acid Soils in Central B.C.

Understanding Different Soil Test Methods

Acidifying Soils

Salt Check. Salt levels in soil may be affected by application of farm nutrients, chemical fertilizers, or irrigation water. Monitor the salt level by measuring electrical conductivity (EC) and sodium adsorption ratio (SAR) on a regular basis. Implement the following practices:

- Check electrical conductivity every three to six years, or more frequently if soil salts are suspected of restricting crop growth.
- In the Interior of BC, check the sodium adsorption ratio of the soil every three to six years, or more frequently if levels are suspected of negatively affecting soil structure.
- Reduce salt and sodium levels in soil amendments as required.
- Check irrigation water quality.

➔ see Irrigation Water Quality, **page 9-25**

If salt levels within the soil are found to be high (when soil salt level exceeds 2 dS/m or when the sodium adsorption ratio exceeds 5:1), and if leached salts have been determined to not cause an environmental impact:

- remove the salt from the crop root zone by applying irrigation water at a rate that causes leaching to occur and/or improve drainage
- if the sodium adsorption ratio is found to be high, apply gypsum to the soil prior to applying water to cause leaching

Soil Management Handbook for the Okanagan and Similkameen Valley

Micronutrients and Metals Check. Micronutrient and metal levels in soil may be affected by the application of farm nutrients or chemical fertilizers. Implement the following practices:

- Check concentrations of micronutrients and metals in both soils and soil amendments:
  - In soils every three to six years, or more frequently if the soil tests indicate levels greater than soil limits shown in **Table 8.3.**
  - In manure every three to six years, or more frequently if the manure tests indicate levels greater than organic nutrient limits shown in **Table 8.3.**
- Reduce metal levels in farm nutrient sources as required by:
  - Changing to feeds with lower metal levels.
  - Altering soil pH to reduce metal uptake in crops.
- Reduce metal build-up in soil where required by moving manure applications to fields with low metal levels.

TABLE 8.3 Suggested Concentration Limits of Metals in Nutrient Sources and Soils

Metal		Organic Nutrient Limit [1] (total µg/g dry weight) [3]	Soil Limit [2] (total µg/g dry weight)
Name	Symbol		
Arsenic	(As)	13	25 [4]
Cadmium	(Cd)	3	10 [4]
Chromium	(Cr)	100	150 [4, 5]
Cobalt	(Co)	34	45
Copper	(Cu)	400	150 [6]
Lead	(Pb)	150	350 [4]
Mercury	(Hg)	2	0.6 [4]
Molybdenum	(Mo)	5	80
Nickel	(Ni)	62	150
Selenium	(Se)	2	1.5
Zinc	(Zn)	500	200 [4]

[1] Organic nutrient source limit (Class A Compost) from *Organic Matter Recycling Regulation, Schedule 4*
[2] Soil limit from *Organic Matter Recycling Regulation, Schedules 10.1* (Agricultural Land). Specific soil standards for environmental protection based on toxicity to soil invertebrates and plants.
[3] 1 µg/g is one part per million, or 1 ppm
[4] Specific soil standards for environmental protection based on livestock ingesting soil and fodder.
[5] Specific soil standard for Chromium +6
[6] Recommend lowering the standard to 40 µg/g for land which sheep are grazing and 150 µg/g for all other livestock

Soil Compaction

Soil compaction reduces pore spaces between soil particles, resulting in decreased air and water movement through the soil, deteriorated drainage conditions, and slower warming of the soil. The effects of severe soil compaction on crops include insufficient nutrient uptake, root damage, and premature aging. Environmental concerns caused by compaction are the excessive runoff flow due to the low infiltration rate of compacted soil and the associated discharge of nutrients to watercourses, and some metals will become mobile and susceptible to leaching.

Compaction is often caused by the operation of heavy machinery on wet soils and by inappropriate tillage techniques, such as those producing plow pan. Excessive tillage breaks soil aggregates, disrupts structure, and encourages quick decomposition of organic matter, all leading to a low organic matter content. The resulting low organic matter, in turn, contributes to the soil being even more susceptible to compaction.

Examine the sides of a constructed soil pit to determine if compaction is present. Check for soil layers, including thin crusts near the surface, which restrict root or water movement.

Surface Soil Compaction. It is difficult to reverse surface soil compaction. Freeze-thaw cycles, root activity, and soil animal activity are not sufficient to overcome annual compaction events. To prevent surface soil compaction, implement the following practices:

- Avoid working with equipment on wet soils.
- Keep livestock off wet soils.
- Ensure that fields are well drained during the growing season.
- Reduce the number of trips over a field with equipment.
- Minimize tillage, particularly operations which pulverize the soil.
- Use a wide variety of tillage implements including chisel plows or subsoilers, and vary tillage depth.
- Limit the weight on an individual axle to less than five tonnes.
- Install flotation or radial tires on equipment to better distribute weight.
- Ensure that tires are properly inflated following manufacturer's instructions.
- Use four-wheel-drive tractors for better weight distribution between axles.
- Ensure wheels are aligned with implement and follow the same tracks.
- Limit equipment and foot traffic to the same areas in a field (e.g., establish lanes and roadways).
- Employ good crop rotation practices with deep-rooted crops and cover crops.
- Delay entry into fields until the water table is 50 cm (suggested) below the soil surface.

Subsoil Compaction. Compaction of soils below the plow layer is more difficult to deal with than surface compaction. To prevent subsoil compaction, implement the following practices:

- Follow the steps outlined above for preventing surface soil compaction.
- Work soils only if they are dry within the tillage zone.
- Plant deep-rooted cover crops.
- Use a crop rotation program.
- Install a subsurface drainage system.

If subsoil compaction has occurred, subsoilers may provide some relief. However, this equipment may create other problems such as unwanted root pruning or increased compaction at the working level if the soil is too wet or if subsoiling occurs below the critical depth. Critical depth is the maximum working depth at which the soil can be cracked and lifted upwards rather than being laterally compressed. Below this depth, the subsoilers compact the soil and smearing occurs along the channels they create. Considering that much can go wrong when subsoiling, test subsoiling in a small area first to check whether it works for your specific case. Only use subsoiling equipment when the soil below the normal tillage layer is dry enough to fracture rather than smear.

Soil Compaction – A Review of its Origin and Characteristics

Soil Organic Matter Content

Soil organic matter is generated from the decomposition of crop residue and other organic materials. Soil organisms and microorganisms digest plant residues to form humus, the earthy, dark coloured material, often associated with topsoil. Humus breaks down very slowly, and provides fertility to the soil. In addition it binds mineral soil particles together, resulting in increased stability when the soil is wetted or cultivated. The impact of higher levels of organic matter in the soil not only improves soil fertility, but contributes to soil structure and plant vitality by:

- Holding essential nutrients for plant growth.
- Increasing resistance to erosion, crusting and compaction.
- Facilitating water and air movement through the soil.
- Increasing water retention capacity.
- Improving conditions for beneficial soil microbes.

Maintaining a high organic matter content in soils may reduce the amount of irrigation water, fertilizers and pesticides required. Soils with higher organic matter content are generally characterized by better tilth and are therefore less susceptible to damage caused by improper tillage. Soil organic matter is also a very important store of carbon in farms and ranches, mitigating greenhouse gas emissions and helping to adapt to changing climate conditions.

Cover Crops. Increasing the organic content of a soil by utilizing a "green manure" requires the growing of a legume or grass crop for deliberate incorporation into the soil before seeding or planting a new cash crop.

Mulches. Mulches are generally recognized as a tool for soil moisture conservation, weed suppression and soil temperature modification. Mind, however, that it may delay drying of the soil in spring and harbor diseases. Suitable mulch materials include straw, leaves, hay, grass clippings, crop residues, compost and wood residues. Mulch depths range from 2 to 10 cm. Mulches will decay over time and become part of the stable organic matter pool in soil. If high carbon-nitrogen ratios mulches, such as straw or wood residue, are incorporated by cultivation the amount of available nitrogen in the soil may be reduced.

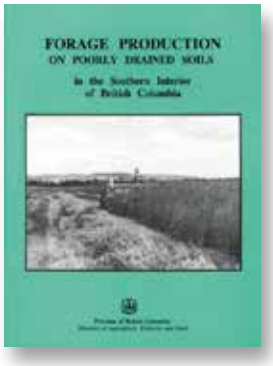
Wood Residues. Wood residues can be used as a soil conditioner to increase organic matter levels. Fine particle material or material that has been partially decomposed or composted is most appropriate. The amount of wood residues incorporated into the soil should not raise the carbon-nitrogen ratio above 50. If the carbon-nitrogen ratio is taken above this level, available nitrogen will be tied up for two to three years. The nitrogen will be released over time as the wood residue continues to decompose.

➔ see Wood Residue, **page 2-37**

Livestock Manure. Manure may be utilized as a source of organic matter; however, do not apply at rates higher than required for its fertilizer value. If manure is used as an organic amendment, it is recommended that its use be in conjunction with a cover cropping program to trap excess nutrients.

➔ see Chapter 6, Soil Amendments

Organic Soil Subsidence



Organic soil subsidence is the loss of organic material through erosion or decomposition. Subsidence can be prevented through effective water management, cultivation practices, nutrient management, and cropping.

An effective water management program will balance the drainage required to provide soil strength and aeration, with the supply of sufficient water to both promote crop growth and minimize organic soil decomposition.

Maintain waterlogged soil conditions to retard decomposition of some organic soils. Use caution when flooding organic soils, particularly muck soils that are highly decomposed or soil with shallow organic layers; flooding can create restrictive layers near the surface that reduce the effectiveness of drainage systems.

Drainage systems in wetland areas should be managed to regulate water table levels in response to changing crop and habitat requirements. Do not allow organic soils to dry out since excessive drying may discourage re-wetting and may result in the loss of the surface layers from erosion.

Avoid tillage practices that pulverize and leave organic soils exposed to air as this promotes rapid decomposition. Use minimum tillage practices for all organic soils.

Forage Production on Poorly Drained Soils - in the Southern Interior of British Columbia

CHAPER 9 METRIC CONVERSIONS

Metric	Imperial Equivalent
2.54 mm	1/10 inch
25 mm	1 inch
50 mm	2 inch
30 cm	12 inch
0.3 m	12 inch
15 m	50 feet
30 m	100 feet
30.5 m	100 feet
60 m	200 feet
100 ml	3.3 oz (US liquid)
1 mg/litre	1 ppm
10 mg/litre	10 ppm
100 mg/litre	100 ppm
1 ha	2.47acre

Conversions in this table are rounded to a convenient number.
See Appendix E for exact conversion factor.

Values from tables and examples are not included in Metric Conversions

Leachate Capture in Soil 9-50

CHAPTER 9 TABLE OF CONTENTS

CHAPTER 9

WATER

INTRODUCTION

This chapter discusses water management practices for protection of the environment. It contains introductory information on the relationship between agriculture and water quality and quantity. It also contains information on environmental concerns, legislation and beneficial management practices related to:

- Water supply systems (domestic and livestock),
- Drainage,
- Leachate,
- Irrigation,
- Storm water and runoff,
- Water conflicts.

WATER QUALITY AND QUANTITY FACTORS

The primary water quality factors associated with potential environmental impacts for drinking water are contaminants. For fish and other aquatic life, the primary factors are water temperature, dissolved oxygen and contaminants. For water quantity, the primary factor is water withdrawal.

The Health of Our Water

A valuable resource for farmers is www.waterbucket.ca, managed by the Partnership for Water Sustainability in BC (PWSBC). There is an "Agriculture and Water" section of the website where resources include the irrigation calculators, and the Agriculture Water Demand Model (AWDM), and other information.

www.waterbucket.ca

The following water quality and quantity factors are listed alphabetically. While these factors can be influenced by agricultural production, they may also be influenced by many other human activities and natural phenomena.

Contaminants

Total Ammonia. Ammonia (NH_3) and ammonium (NH_4^+) exist in urine, manure, fertilizer and compost. Contaminated runoff from fertilized cropland and uncovered manure or compost piles is characterized by a high total ammonia concentration. Water containing elevated levels of total ammonia may be toxic to fish and other aquatic life. Ammonia is more harmful to aquatic life when compared to ammonium. In the pH range of most natural waters, ammonia nitrogen will exist principally as ammonium.

Micronutrients and Metals. Specific metals of concern include arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel and zinc. Although trace quantities of some metals are necessary for life, even low metal concentrations are undesirable. Elevated metal concentrations can directly kill fish and other aquatic life or cause accumulation in tissues, making them unfit for human consumption. Some sources of metals include manure, waste oil, hydraulic fluids and fertilizers. Wood residue leachate, by virtue of its acidity, can increase the rate of metal release from soils as well.

Nitrate (NO_3^-). The organic and ammonium nitrogen in manure or fertilizer eventually converts to the nitrate (NO_3^-) form of nitrogen in soil. Because nitrate does not attach to soil particles as ammonium tends to do, nitrate is moved easily by water that moves through soil.

Nitrates in groundwater are often an early indication of contamination elsewhere. Elevated levels of nitrates in drinking water are a particular hazard for infants. The maximum allowable concentration of nitrates as recommended in the Canadian Drinking Water Guidelines is:

- 45 mg/litre as nitrate (10 mg/litre as nitrate nitrogen) for human consumption:

Blue-green Algae (Cyanobacteria) Blooms

Canadian Drinking Water Guidelines

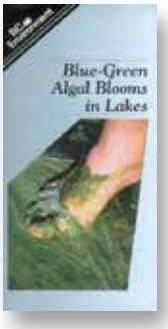
British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture Summary Report

British Columbia Approved Water Quality Guidelines

The maximum allowable concentration of nitrates as recommended in the Canadian Water Quality Guidelines for the Protection of Agriculture Water uses is:

- 100 mg/litre total nitrate nitrogen (where nitrate and nitrite are determined separately, levels of nitrite should not exceed 10 mg/litre) for livestock consumption.

Canadian Water Quality Guidelines for the Protection of Agricultural Water Uses:



Phosphorus. Elevated phosphorus levels in watercourses can be caused by manure or fertilizer entering a watercourse directly, by contaminated runoff flowing from fertilized fields, or by nutrient-rich soil being eroded from croplands. Phosphorus is generally the limiting nutrient in lake systems (i.e., the addition of phosphorous alone will accelerate eutrophication); however, both nitrogen and phosphorus can be limiting. The most common effects of eutrophication in surface waters are harmful algal blooms which result in depleted oxygen levels. Blue-green algae (cyanobacteria) in sufficient quantities is toxic to livestock. Phosphorus may be dissolved or suspended as solids (particulates) in water.

Blue-Green Algal Blooms in Lakes

Pathogens. Many organic wastes, including manures, contain microorganisms, such as, bacteria (e.g., fecal coliform, E. coli), viruses and other parasites. Some of these microorganisms may be pathogenic (disease causing) to animals of the same or different species. Many diseases are transmissible between animals and humans, and water can be a pathway for the transmission of infection. Pathogen contamination of shellfish beds is not uncommon, rendering shellfish unfit for human consumption.

Pesticides. Pesticides, including fungicides, insecticides and herbicides hold great potential to pollute both surface and groundwater. Water polluted by pesticides can be the result of application drift, leaching, erosion of contaminated soil, spills, and direct introduction. Pesticide-contaminated water can have harmful effects on aquatic life, animals and humans.

Petroleum. Petroleum, antifreeze, paints, solvents, hydraulic fluids and other oil-based substances can cause direct and indirect harmful effects on watercourses and groundwater. Examples of adverse effects caused by petroleum products include acute toxicity to a variety of aquatic organisms and respiratory distress in fish. Waterfowl, amphibians and insects are sensitive to petroleum pollution as well.

Other negative impacts caused by petroleum products in water include the destruction of fish food organisms such as algae and other plankton, the smothering of fish spawning areas, the reduction in the rate of photosynthesis in plants and poor stream aeration. In addition, petroleum products can taint the flavour of aquatic food products.

Solids. Solids exist either in dissolved or suspended form in water. Both may include nutrients and metals, can elevate the biological oxygen demand of water, and cause long-term damage (refer to "Oxygen Demand", next page). Some types of dissolved solids, such as, ammonia, can be toxic to fish.

Suspended solids are larger in size than dissolved solids. Unlike dissolved solids, suspended solids can be removed by settling or filtering. Suspended solids are primarily silts and clays, but can also include oils, pathogens, wood residue components, and other materials attached to particles in the water. Suspended solids in watercourses can clog the gills of fish, affect fish vision and, upon settling, fill in pore spaces between pebbles, thereby destroying spawning grounds or smothering the eggs of aquatic organisms.

Turbidity is a measure of the cloudiness of water. Turbidity may affect water treatment processes, reducing the appeal of drinking water or the effectiveness of wash water disinfection. As a result, higher levels of chlorine may need to be added to drinking water or wash water to achieve acceptable safety levels. High levels of chlorine are toxic to fish. Turbidity also blocks the sunlight required by photosynthesizing aquatic plants, resulting in decreases in fish food plant biomass and lowered oxygen levels in water. Ultraviolet disinfection of turbid wash water is less effective than disinfection by chlorination. Food safety may be compromised as a result.

Wood Residue Leachate. Wood residue (e.g., sawdust, shavings, chips, bark) can cause negative impacts on surface and groundwater. Exposure to water, air and microorganisms will cause wood residue to break down and release dissolved compounds. Some of these compounds, particularly tannins, tropolones and resin acids, are not only human health hazards, but are also acutely toxic to aquatic life.

Wood residue leachate entering surface water also causes indirect effects. Reduced oxygen levels, due to high biological oxygen demand and chemical oxygen demand values, result in lower photosynthesis rates in aquatic plants. The colour of wood residue leachate will also reduce light transmission and thereby reduce photosynthesis. In addition, wood residue leachate is acidic, facilitating the unwanted movement of metals and nutrients out of the soil and into receiving waters (refer to Oxygen Demand below).

➔ see Wood Residue, **page 2-40**

Contaminant Pathways

Infiltration. Water movement into and through soils is governed by the permeability of the soil. Coarse textured soils or soils with large numbers of macropores will have high infiltration and percolation rates. Rapid water movement through soil can lead to increased risk of leaching, loss of nutrients or contaminants to groundwater or subsurface drains.

Overland Flow. Overland water flow occurs either because the soil is saturated and unable to absorb more water or because water is applied at a rate greater than the soil can absorb. This can result in erosion or the movement of contaminants to surface water. Farmstead buildings, roads and impermeable farmyards will intensify the effects of rainstorm events. Peak stormwater discharges to watercourses are increased whenever a high proportion of impermeable surfaces exist.

Wells. The direct entry of overland flow into groundwater via poorly constructed wells or well casings is another potential contaminant pathway.

Oxygen

Oxygen Demand. High oxygen-demanding materials, such as, manure, silage, fruit, vegetables and composting juices use dissolved oxygen in water directly as they decompose. Increased nutrient levels in water can also indirectly cause high oxygen demand by encouraging the growth of aquatic organisms. After these organisms die, natural decay accelerates the depletion of oxygen to levels below that required by fish and aquatic life. The rate of oxygen depletion is measured as Biological Oxygen Demand (BOD).

Dissolved Oxygen. Dissolved oxygen is measured as a percentage of saturation. If wastes with high oxygen demand or high nutrient levels are allowed to enter watercourses, the result is a drop in dissolved oxygen levels. Reduced oxygen levels are harmful to fish and aquatic life.

Temperature

Elevated water temperature has direct and indirect impacts on water quality. As water temperature increases, its oxygen-holding capacity decreases. This will become harmful to fish and aquatic life. Watercourse temperature thresholds are set to protect fish. Indirectly, elevated water temperature contributes to the growth of aquatic organisms which accelerates the depletion of oxygen levels.

Water Withdrawal

The excessive removal of water for uses, such as, irrigation may result in a water shortage for fish food production, fish and fish habitat, wildlife abundance, and in elevated water temperatures. Also, reduced water levels will typically exacerbate water quality concerns and may increase the risk of fish predation due to easier access for predators.

Surface water withdrawals required intakes to be screened to protect fish. The screens are designed with various opening sizes to reduce the velocity of water flow in order to prevent fish entry and fish loss from being drawn against the screen.

Surface water withdrawals required intakes to be screened to protect fish. The screens are designed with various opening sizes to reduce the velocity of water flow in order to prevent fish entry and fish loss from being drawn against the screen. With increased frequency and severity of drought events, conserving and limiting water use will take on added importance.

This “licensing” sentence doesn’t need to be in its own paragraph. Bring this sentence up, so it is the last sentence of the previous paragraph.

WATER SUPPLY

WATER SUPPLY ENVIRONMENTAL CONCERNS

Primary environmental concerns related to water supply systems are:

Water Quantity

- Groundwater withdrawals that result in:
  - Lowering of the water table.
  - Reduced groundwater input to surface water.
- Surface water withdrawals causing low stream flows and velocities that result in impacts to fish and other aquatic species.
- Surface water or groundwater withdrawals that do not factor in the potential for extended drought events, resulting in less resilience to adapt to changing climate.

Water Quality

- Cross connection of water supply lines to lines carrying contaminants that results in pollution of water supply.
- Poor well construction (e.g., lack of sealing), location (e.g., down gradient from contaminate source) or well abandonment, that results in groundwater pollution.
- Disturbances to watercourses during installation of intakes that results in water pollution and habitat loss.
- Livestock access to watercourses that results in pollution of surface water, habitat disturbances, or trampling of stream banks.

For information on these concerns:

➔ see Water Quality and Quantity Factors, **page 9-1**
➔ see Impacts to Biodiversity and Habitat, **page 7-7**, and refer to Farm Activities and Impacts

WATER SUPPLY LEGISLATION

The following is a brief outline of the main legislation that applies to farm water supply.

➔ see **page A-1** for a summary of these and other Acts and Regulations

Local Bylaws

The BC Building Code has requirements for backflow prevention and **is enforced only where proclaimed by local governments.**

BC Building Code

Part 7 of the BC Building Code addresses plumbing services and provides information on protection from contamination from cross connections.

Drinking Water Protection Act

- This Act and Regulations have requirements regarding the protection of drinking water quality and regulate domestic water systems (those serving more than one single-family residence).
- SECTION 6: requires water suppliers to provide potable water to water users.
- SECTION 23(1): subject to subsection (3), a person must not (a) introduce anything or cause or allow anything to be introduced into a domestic water system, a drinking water source, a well recharge zone or an area adjacent to a drinking water source, or (b) do or cause any other thing to be done or to occur if this will result or is likely to result in a drinking water health hazard in relation to a domestic water system.
- The *Drinking Water Protection Regulation* defines potable water as "water from a domestic water system" that has the following characteristics:
  - Water that meets the standards prescribed by the regulation and that is safe to drink and fit for domestic purposes without further treatment.
  - No detectable fecal coliform bacteria or *Escherichia coli* per 100 ml.
  - No detectable total coliform bacteria per 100 ml for a sample in 30 days.
  - At least 90% of samples have no detectable total coliform bacteria per 100 ml and no sample has more than 10 total coliform bacteria per 100 ml for more than one sample in 30 days.
  - Is within limits on chemical and physical parameters (such as nitrates and heavy metals).

Guidelines for Canadian Drinking Water Quality

Environmental Management Act

The *Code of Practice for Agricultural Environmental Management* requires persons to use environmentally responsible and sustainable agricultural practices when carrying out agricultural operations, for the purpose of minimizing the introduction of waste into the environment and preventing adverse impacts to the environment and human health.

- The *Code of Practice of Agricultural Environmental Management* has requirements regarding access to watercourses by livestock or poultry:
- SECTION 64 (1): A person responsible for a grazing area, seasonal feeding area or temporary holding area in which livestock or poultry have direct access to a water course must ensure that effective controls are in place to minimize:

  (a) Trampling and erosion of soil into the water course, and

  (b) Contaminated runoff, leachate, and solids entering the watercourse.

Riparian Areas Protection Act

The Riparian Areas Protection Act creates the authority for government to enact Provincial directives to protect areas that border streams, lakes, and wetlands.

With this Act, and through the *Riparian Areas Regulation* (RAR), local governments in certain regions of the Province are able to protect riparian areas during residential, commercial, and industrial development by ensuring that a Qualified Environmental Professional (QEP) conducts a science-based assessment of proposed activities. This includes residential buildings on land zoned for agricultural purposes. SECTION 12 provides Provincial directives on streamside protection.

The RAR only applies to the residential portion of the farm and only in the southern half of BC. The RAR does not apply to *farm practices* as defined in the *Farm Practices Protection Act* (FPPA). In some cases, this can lead to the misunderstanding that the RAR does not apply to lands zoned for agriculture, or in the Agricultural Land Reserve (ALR). The RAR does apply to these lands for activities that are not *farm practices*, for example residential construction. It is important to note that local governments have the ability to establish bylaws that apply to agricultural lands, and some have implemented setbacks for agricultural buildings that complement the setbacks designated under RAR.

Public Health Act

Administered by the Ministry of Health, this Act has a specific prohibition that "a person must not willingly cause a health hazard, or act in a manner that the person knows, or ought to know, will cause a health hazard". This prohibition would apply to farm practices that may result in a health hazard, such as when nutrients, contaminants or pathogens are discharged to land, water or air that pose a public health problem. Any situation that entails a health hazard will enable health officers to investigate using their powers under the Act. Under the *Public Health Act*, the local Health Authority must investigate any health hazard and has authority to order that a person prevent or stop a health hazard, or mitigate the harm or prevent further harm from a health hazard amongst other powers. Similar regulatory provisions exist for addressing health hazards to drinking water supplies under the *Drinking Water Protection Act*.

This Act has conditions under the *Health Hazards Regulation*:

- SECTION 8(1): provides separation distance of wells to be at least 30 m from any probable source of contamination.

Water Sustainability Act

Water Sustainability Act (WSA) is the principal law for managing the diversion and use of water in British Columbia. The WSA establishes that all water in streams (surface water) and aquifers (groundwater) in British Columbia is owned by the Crown on behalf of the residents of the Province. Surface water is very broadly defined as water in any above ground natural water body or watercourse, including springs, glaciers, lakes, ponds, rivers, creeks, and wetlands. Groundwater is defined as any water that is found naturally beneath the surface of the earth.

Under the WSA, no person may divert water from a stream or from aquifer unless the person holds an authorization or the diversion and use of water is allowed by the Act or under a regulation. An authorization can take the form of a "use approval", which allows for short term use of water for up to 24 months, or a water licence which establishes a long term water right. Authorization holders have some responsibilities including the need to pay water fees and rentals and make beneficial use of the water they are authorized to divert, store and use.

Other key aspects of the WSA include:

- Managing water during scarcity, which involves the regulation of diversion of water use to manage periods when there is insufficient water to meet licensed demand or if a fish population is threatened.
- Changes in and about streams: There are two processes that allow a change to be made in and about a stream. A "Change Approval" is a written authorization to make changes in and about a stream and normally involve a more significant or larger change. A "Notification" is for low risk changes that have minimal impact on the environment or third parties.

The following SECTIONS of the WSA may be of interest to agricultural operators in particular:

- SECTION 6: Prohibits diverting water without a licence except in limited circumstances for fire suppression, domestic use and mineral prospecting.
- SECTION 11: Requires approvals for making changes in and about streams.
- Sections 16 & 17: May require mitigation measures on (sensitive) streams where a water diversion or use is authorized.
- SECTION 45: No new dams on protected rivers.
- SECTION 86: Declarations of significant water shortage.
- SECTION 87: Critical environmental flow protection orders.
- SECTION 88: Fish population protection orders.
- SECTION 128: Regulations respecting sensitive streams.

In the case of low or impending low streamflow, temporary protection orders (Sections 86, 87, 88) may be used. These orders are used for the purposes of protecting environmental flow thesholds or fish populations.

The right to divert and use surface water or groundwater is authorized by a licence or approval. Licences and approvals are granted in accordance with the statutory requirements of the *Water Sustainability Act*.

If you use surface water for any purpose including domestic, or groundwater for any non-domestic purpose, a water licence is required under the *Water Sustainability Act*. The requirement for groundwater licensing came into force on February 29, 2016 which applies to new groundwater users as well as existing groundwater users who began using groundwater prior to February 29, 2016. A water licence may be applied for from FrontCounter BC in person or online. Approval is also required for any work in or about a stream.

Apply for a Water Licence

Wildlife Act

The provincial *Wildlife Act* protects wildlife designated under the Act from direct harm, except as allowed by regulation (e.g., hunting or trapping), or under permit. Legal designation as Endangered or Threatened under the Act increases the penalties for harming a species. The Act also enables the protection of habitat in a Critical Wildlife Management Area.

Fisheries Act

Administered by both Fisheries and Oceans Canada and Environment and Climate Change Canada, this Act is established to manage Canada's fisheries resources, including fish habitat. The Act can also be administered provincially by FLNRORD and ENV. The Act applies to all Canadian waters that contain fish, including ditches, channelized streams, creeks, rivers, marshes, lakes, estuaries, coastal waters and marine offshore areas. It also applies to seasonally wetted areas that provide fish habitat such as shorelines, stream banks, floodplains, intermittent tributaries and privately owned land. The Act includes provisions for stiff fines and imprisonment to ensure compliance.

The purpose of this Act is to provide a framework for (a) the proper management and control of fisheries; and (b) the conservation and protection of fish and fish habitat, by preventing pollution.

This Act was updated in 2019 and now empowers the Minister to make regulations for the purposes of the conservation and protection of biodiversity.

The definition of fish habitat is: "water frequented by fish and any other areas on which fish depend directly or indirectly to carry out their life processes, including spawning grounds and nursery, rearing, food supply and migration areas". The quantity, timing and quality of the water flow that are necessary to sustain fish habitat are also deemed to be a fish habitat. Furthermore, serious harm to fish includes the death of fish or any permanent alteration to, or destruction of, fish habitat.

Provisions of the *2019 Fisheries Act* relevant to agricultural operations include:

- Protection for all fish and fish habitats;
- Prohibition against the death of fish or the 'harmful alteration, disruption or destruction of fish habitat';
- A permitting framework and codes of practice to improve management of large and small projects impacting fish and fish habitat;
- Protection of fish and/or fish habitats that are sensitive, highly productive, rare or unique; and
- Consideration for the cumulative effects of development activities on fish and fish habitat.

Specific sections of the Act include:

SECTION 34.2(1) The Minister may establish standards and codes of practice for:

(a) The avoidance of death to fish and harmful alteration, disruption or destruction of fish habitat;

(b) The conservation and protection of fish or fish habitat; and

(c) The prevention of pollution.

SECTION 34.4(1) No person shall carry on any work, undertaking or activity, other than fishing, that results in the death of fish.

SECTION 35 (1) No person shall carry on any work, undertaking or activity that results in the harmful alteration, disruption or destruction of fish habitat.

Every person who contravenes subsection 34.4(1) or 35(1) is guilty of an offence and liable.

Notifying authorities about serious harm to fish or deposit of a deleterious substance:

SECTION 38 (4.1) Every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations of a harmful alteration, disruption or destruction of fish habitat that is not authorized under this Act, or of a serious and imminent danger of such an occurrence, if the person at any material time

(a) Owns or has the charge, management or control of the work, undertaking or activity that resulted in the occurrence or the danger of the occurrence; or

(b) Causes or contributes to the occurrence or the danger of the occurrence.

SECTION 38 (5) If there occurs a deposit of a deleterious substance in water frequented by fish that is not authorized under this Act, or if there is a serious and imminent danger of such an occurrence, and detriment to fish habitat or fish or to the use by humans of fish results or may reasonably be expected to result from the occurrence, then every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations.

SECTION 38 (7) As soon as feasible after the occurrence or after learning of the danger of the occurrence, the person shall provide an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations with a written report on the occurrence or danger of the occurrence.

Migratory Birds Convention Act

Under this Act, the federal government is responsible for implementing a Convention between Canada and the U.S. for the protection of migratory birds and nests. The Canadian Wildlife Service of Environment Canada administers the regulations.

Under the Regulations:

- SECTION 6: no person shall: disturb, destroy or take a nest, egg, nest shelter, eider duck shelter or duck box of a migratory bird without permit;
- SECTION 24(1): any person may, without a permit, use equipment, other than an aircraft or firearms, to scare migratory birds that are causing, or are likely to cause damage to crops or other property (other control measures require a permit);
- SECTION 35(1): prohibits the deposit of oil, oil wastes or any other substance harmful to migratory birds in any area frequented by migratory birds.

Species at Risk Act

This Act has sections that protect listed species, their residence and critical habitat. It applies to federal lands, internal waters (i.e., all watercourses), territorial sea of Canada, and the air space above them.

The provisions of the *Species at Risk Act* (SARA) (known as the 'safety net') could be invoked on BC crown and private lands using a federal order under the Act if provincial action is not sufficient to protect listed species.

On private land, unless an order is made by the government, the SARA prohibitions apply only to:

- Aquatic species at risk; and
- Migratory birds listed in the *Migratory Birds Convention Act*, 1994 and also listed as endangered, threatened or extirpated in Schedule 1 of the Act.

WATER SUPPLY BENEFICIAL MANAGEMENT PRACTICES

Comply with applicable water supply related legislation, including the above, and where appropriate, use the following beneficial management practices to protect the environment.

Licensing of Water

As per the *Water Sustainability Act*, the use of surface water and groundwater requires a water licence. Application for a licence can be made online at FrontCounter BC (FCBC) or at a FCBC office. Domestic groundwater users (use in one's own home) do not require a licence. Water licences can set terms and conditions, such as, the purpose of use, the quantity of water, the amount of storage (if any), the time period during which it can diverted, and the location of withdrawal and use.

Water Licences and Approvals

Rights and Obligation of a Water Authorization Holder

Water Licensing & Rights

Water Withdrawal Rates. Some water licences have a peak water diversion (withdrawal) rate (e.g., a maximum pumping rate in gallons per minute). For irrigation purposes, this rate is often calculated based on the availability of water in the water source and/or proper irrigation methods. When diverting water, implement the following practices:

- If the licensed withdrawal rate is specified, check that the rate being used does not exceed this amount (*Water Sustainability Act*).
- If the licensed withdrawal rate is not specified, check that the rate does not exceed the calculated peak flow rate for the region (suggested) or established by Irrigation/Improvement Districts or purveyors.
- For either of the above , see Irrigation Water Use Checks, page 9-24, or check with the BC Agriculture Water Calculator.

  BC Agriculture Water Calculator
- Follow fish clauses listed on the licence, if present (*Water Sustainability Act*).
- Reduce water withdrawal if fish may be negatively impacted (*Fisheries Act*).

Annual Water Use. The actual annual water use must not exceed the annual water volume permitted in the water licence. For a more efficient and interactive way to determine the actual water use, please refer to the online tool called the B.C. Irrigation Water Use Calculator.

➔ see Irrigation Water Use Checks, **page 9-30**

BC Irrigation Water Use Calculator

Irrigated Area. In addition to a maximum annual water withdrawal volume, a water licence also specifies a maximum irrigated area that irrigation water is permitted to be applied on.

Water Storage. A water licence may permit water storage, such as, in a reservoir. In some regions, dugouts do not need to be licensed if the water stored is collected from on-farm only with snowmelt or runoff water. However, it is uncommon for a dugout to contain only snowmelt and runoff and in most cases some of the water in the dugout will be either surface water or groundwater, which will require a water licence to use or store. If the dugout stores water coming from a watercourse or groundwater, a storage purpose must be identified on the water licence. The maximum storage amount and timing of filling and use of water from storage will generally be defined on the water licence.

- Factsheet 510.100-1 Farm Water Storage
- BC Farm Practices and Climate Change Adaptation: Water Storage
- Cowichan Agricultural Water Storage and Management Knowledge Transfer Project

Rainwater Collection and Storage. A water licence is not required to collect or harvest rainwater from the roof of a building. Rainwater harvesting systems have gained popularity in commodities with large rooftop structures, e.g., greenhouse, nursery, poultry, swine and dairy. These large structures allow rainwater harvesting systems to be economically viable for smaller water uses, such as, stock water, wash water, and supplemental irrigation during peak season. Keep in mind that at least 10% of the operation land base will be required for building a pond/dugout to store the captured rainwater. Whether it is cost effective to specific regions will depend on the amount of rainfall in the regions, (e.g., Vancouver Island and Lower Mainland that receive at least three times as much rainfall as in the Interior may have a shorter payback period of investment). Many greenhouses and nurseries already have rainwater harvesting systems.

While there has been a shortage of water supply across various drier/driest regions in the Province, rainwater harvesting could alleviate the situation to some degree when implemented properly. An economic analysis of a specific water storage system on a specific farm should be conducted to determine the return of investment, and to evaluate if this specific commodity and its operational size have the best chance of beneficial management of our water resources.

Measuring and Reporting. Water licences can also include conditions that require the licence holder to measure and report water use. *The Water Sustainability Act* also includes provisions that would enable government to create a regulation that sets measuring and reporting requirements, although there is as yet no such regulation requiring this as a general rule in BC (2018).

The Ministry of Agriculture, Food and Fisheries worked with the Okanagan Basin Water Board (OBWB) has developed a pilot online tool called the BC Water User Reporting Centre (BCWURC) to allow municipalities to report and track their water use. The tool includes many different ways to measure water use, such as, from the records of a water meter, pumping rate, or operating hours of an irrigation system. The Ministry of Agriculture, Food and Fisheries also collaborated with the Partnership for Water Sustainability in BC (PWSBC) to use the BCWURC as the basis, and develop an online tool called the BC Irrigation Water Use Calculator for farmers to determine their actual annual water use.

Beneficial Use: As a general condition the *Water Sustainability Act* requires that the water licence holders make beneficial use of water that they are authorized to use in a licence.

- BC Agriculture Water Calculator
- BC Irrigation Water Use Calculator

Water Volume Requirement

Farm Requirements. Whether farm water originates from surface water, groundwater or is supplied by purveyors, all water use should not exceed the following suggested rates:

- For livestock use, volume requirements given as peak daily use rate per animal and annual volume.
  - Factsheet 590.301-1 Livestock Watering Requirements – Quantity and Quality
- For irrigation purposes, volume requirements given as peak flow rate and annual volume.
  ➔ see Irrigation Water Use Checks, **page 9-30** or BC Agriculture Water Calculator
  - BC Agriculture Water Calculator

It is in the best interest of a farm to use only the proper volume of water as needed daily to ensure the water source has sufficient water supply to meet the annual water requirement. Where possible, implement the following practices:

- Use the BC Irrigation Water Use Calculator to determine the actual annual water use for a farm

  BC Irrigation Water Use Calculator

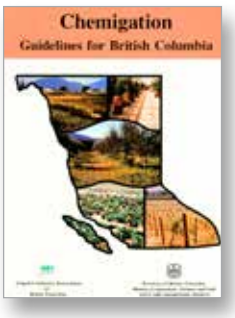
- Install water meters to better monitor and measure the volume of water used for operations that have multiple irrigation systems and cropping, e.g., nurseries, where measuring usage is particularly challenging (note that metering is generally not economically feasible or practical for most farms in BC.)
- Collect, store, and use non-contaminated water wherever feasible.
- Conserve water use, allowing other users access to water.
- Conserve existing water source to reduce the cost of developing new sources:
  - Reduced water use to minimize the requirement for additional water storage or water delivery.
  - Improve water use efficiency by using (or converting old irrigation systems to) more efficient irrigation systems since irrigation typically provides for the greatest opportunities for water conservation on most farms.

  Factsheet 500.310.1 Irrigation Tips to Conserve Water on the Farm

- Schedule irrigation to ensure irrigation water is applied at the proper rate, duration, and frequency based on crop type, soil type and weather condition.

  Farmwest Weather Station Network

  Agricultural Irrigation Scheduling Calculator



Fertigation

Fertigation or chemigation is the introduction of chemicals into an irrigation system that presents a potential hazard to public health. The irrigation system acts as a cross-connection between the chemical solution tank and the water source.

see Chemigation Guidelines for British Columbia

Groundwater Use. Withdrawal of groundwater at rates faster than it can be recharged will lower the water table, and may impact levels and flows in adjacent watercourses that are hydraulically connected to the aquifer. If the withdraw rates are substantially lower than normal during times of the year when water demand is highest, it is an indication that the recharge rate is not fast enough to meet the withdrawal rate resulting in a lowered water table. Water conservation strategies as described above should be explored to manage usage; otherwise, it may be necessary to deepen the well to maintain flows or to acquire additional water sources to meet the annual volume requirement.

To reduce the overuse of groundwater, implement the following practices:

- Monitor water tables regularly by measuring the static water level in wells at the same time of the year, each year (note some variations are normal).
- If the water table is lowering progressively over time (note that it may be due to changing climate or off-farm conditions or uses beyond control), reduce withdrawal to a sustainable level where the water table re-stabilizes.

Surface Water Use. Producers using surface water must be aware of fish requirements. Excessive peak withdrawals may deplete water volume in a watercourse to the point of impacting fish and fish habitat. Also, removing volumes of water over the course of a season in amounts greater than allowable may deplete systems to such an extent that supply is insufficient for downstream users.

Water Supply. When water supply is diminished in the late summer, agriculture still needs water to grow a productive crop and raised a productive herd. Storage can provide the water when natural stream flows can no longer meet the water demand. Storage can also provide benefits to fisheries and improve stream health by increasing baseflow.

Farms often need storage facilities to supply farmstead water or to back up water licences from streams and rivers for irrigation, livestock, crop washing, frost protection, crop cooling, flushing, processing, and other on-farm uses. Storages can be in the form of small dugouts or reservoirs that are impounded behind licensed dams.

Improving rainwater management is a tool that is becoming more widely adopted in regions of Europe and North America. The Water Balance Model (WBM) is fully operational across Canada, and can be used to assess anthropogenic developments to determine if an appropriate amount of rainwater is captured and infiltrated to ground, replenishing baseflows in stream and increasing storage in aquifers.

Water Balance Model

Water Storage. Design and maintain water storage structures to prevent excessive evaporation and leakage. Minimizing the exposed surface area of water storage is important in dry, warm areas. Follow dam safety protocols for monitoring and maintaining water storage structures and prevent catastrophic water release.

For more information on water conservation and safety for stored water visit:

Water Storage: Dams

Dam Safety Regulation

Dam Safety Pocketbook

Dam Safety Technical Resources

BC Farm Practices & Climate Change Adaptation – Water Storage

Dam Safety Management Binder

Linking Drainage and Water Supply. If feasible, link drainage or stormwater capture infrastructure (detention ponds, ditching, roof water collection) to supplement farm water supply needs (supplemental irrigation, stock water), to make beneficial use of precipitation that exceeds the immediate needs of farm operations.

Drought. With climate change, hot, dry summers will continue to become more frequent and more intense across British Columbia. Drought can result in shortage of water supply or in severe cases, restrictions to water withdrawal for agricultural use. It is important to plan for sufficient water resources in times of drought by implementing efficient irrigation and watering systems as well as being aware of how water restrictions can affect farming operations.

Drought in Agriculture BC

Dealing with Drought: A Handbook for Water Suppliers in British Columbia

BC Provincial Drought Portal

Cowichan Agriculture Extreme Weather Event Preparedness & Mitigation Pilot Project

Water Quality Protection

Backflow Prevention. Backflow of contaminated water from any farm practice into a water source may occur through pipes that are cross connected. Implement the following practices:

- Maintain a 30 cm (suggested) air gap between the water supply line and any tank containing a substance other than potable water to prevent backflow of non-potable water into the water supply
- Install a backflow prevention device on water lines that can come into contact with contaminated water

➔ see Chemicals Added to Irrigation Water, **page 9-37**

Overland Water Flow. Consider how climate change and landscape changes at higher elevations in your watershed may increase the freqency and severity of overland flow. Protect the water supply from overland flow of contaminated water.

➔ see Runoff Flow Management, **page 9-53**

Leachate. Since surface water and groundwater sources are often used for drinking water, potential contamination with substances, such as, pesticides and nitrates poses a serious health hazard. Groundwater contamination is particularly difficult and very costly to clean up, and therefore should be avoided.

➔ see Runoff Flow Management, **page 9-53**

➔ see Leachate, **page 9-57**

Springs. Springs are groundwater that becomes a "stream" (surface water) if the water flows to the surface of the ground without any pumping. They are defined as "streams" under the *Water Sustainability Act*. Protect springs from farm impacts by implementing the following practices:

- Protect springs with a grassed buffer zone.
- Where a buffer zone is impractical, berm spring areas to prevent any contaminated runoff from entering.
- Direct spring flows away from contaminated farm areas.

➔ see Changes In and About a Stream, **page 7-17**

Pumps. Water pumps powered by petroleum-powered engines located near watercourses or water bodies create a risk of water contamination if fuel spills or leaks occur. To minimize the possibility of such contamination, use secondary containment for any fuel tanks. Even small quantities of petroleum products can cause extensive water pollution.

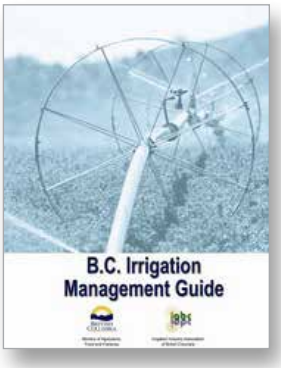
Changes In and About a Stream. When planning any work in or near a "stream", which includes nearly all surface watercourses, contact the FrontCounter BC to ensure that it does not harmfully alter fish habitat or cause a deleterious substance to enter water.

➔ see Changes In and About a Stream, **page 7-17**

Water Quality Treatment

In cases where water does not meet appropriate water quality standards, treatment for water quality may be an option. The following resources provide some guidance on appropriate water treatment options for several scenarios.

- Chemigation Guidelines for British Columbia
- Factsheet 590.301-4 Enhancing Livestock Water Quality
- Factsheet 512.000-2 Treatment of Greenhouse Recirculation Water – Biosand Filtration
- BC Irrigation Management Guide – Chapter 2 Environmental Concerns of Irrigation Water Supply
- Ontario Factsheet 200/560 Improving On-Farm Food Safety Through Good Irrigation Practices



Wells and Groundwater Protection

Groundwater contamination is particularly difficult and very costly to clean up, and therefore should be avoided. Environmental concerns related to wells are associated with contaminants entering groundwater either because of improper well construction or abandoned wells. Annual test should be conducted to ensure groundwater is potable and nitrate levels are acceptable and not increasing above background levels. Possible additional concerns revolve around groundwater withdrawal rates that could decrease flow of connected watercourses.

Well Construction. Licensing is required for all new and existing non-domestic wells under the *Water Sustainability Act.*

- Water Sustainability Act Overview

There are also requirements that wells be constructed by Qualified Well Drillers and pumps installed by Qualified Pump Installers that are registered with the Province.

- Register of Qualified Well Drillers
- Register of Qualified Pump Installers in the Province of BC
- Information regarding groundwater licensing is available through FrontCounter BC
- New Requirements for Groundwater Users
- Information for Water Well Drillers & Well Pump Installers
- Brochure - Information for Well Drillers and Well Pump Installers

Approval is not required to construct a well or to conduct a test for water quality or quantity. However, prior to making regular use of the water, a licence is required.

Wells must be constructed in a manner that meets the standards set out in the *Groundwater Protection Regulation*, and in particular must be located and constructed in a manner to prevent seepage of contaminated runoff and shallow groundwater. Water in all wells should be sampled and the necessary field and laboratory tests conducted to determine whether the groundwater chemical and bacteriological quality of the well is suitable for its intended use.

Once groundwater quantity and quality has been confirmed and a licence has been obtained, locate and construct wells to prevent seepage of both contaminated runoff and shallow groundwater. Water in all wells should be sampled and the necessary field and laboratory tests made to determine the groundwater chemical and bacteriological quality of the well and its suitability for drinking water. The following parameters should be analyzed: total alkalinity, calcium, total hardness, total iron, magnesium, fluoride, nitrate, nitrite, pH, dissolved solids, electrical conductivity, turbidity and total coliforms.

Implement the following practices:

- Construct new wells as required by the *Groundwater Protection Regulation:*
  - Sealing of the well casing surface to prevent entry of contamination.
  - Capping the well to prevent contamination entering.
- Locate new wells at least 30 m from storage and preparation areas for fertilizer, pesticides, petroleum products, manure, silage, etc (*Health Hazards Regulation*).
- Locate wells in high areas, wherever possible, to prevent runoff from collecting around the well head and seeping into the water supply.
- Construct wells with durable materials.
- Construct well casings 0.3 m (suggested) above the level of surrounding land.
- Construct well casings above 100-year-flood levels (suggested).
- Use a pitless adapter installed in the well casing where water lines may freeze (rather than terminating the casing in the ground below frost level).
- Construct upland berms to prevent contamination of wells.
- Grade land areas near wells to direct surface water flows away.
- Plant and maintain grass covers around well heads to slow down and filter any nearby runoff.

Groundwater Protection Regulation, Water Sustainability Act

Deactivation of Wells Not in Use. As per the *Groundwater Protection Regulation,* wells that are not in use must be deactivated by taking the well pump out of operation by shutting off the power supply to the well pump, or removing or disconnecting a manual pump handle.

Decommissioned and Abandoned Wells. A well that is not in use for more than 5 years must be decommissioned in accordance with *Groundwater Protection Regulation* requirements. Groundwater can be easily polluted if runoff flows into or around well casings. Seal materials should not compromise human health or drinking water quality, and should be more impervious than the native soils adjacent to the well. A Qualified Well Driller can advise on requirements for decommissioning a well.

Wells Near Watercourses. Of particular concern are wells located near watercourses where water levels are sensitive to water withdrawal rates. A water licence for a well in such circumstances will likely include conditions governing pumping flows and timing of pumping.

Domestic Water

Only use domestic water supplied from protected sources or treat appropriately. Surface water sources are particularly susceptible to contamination and therefore require constant monitoring. Under the *Drinking Water Protection Act*, if a system supplies more than one household or the general public the water provided must be potable. A regional health authority Drinking Water Officer may request that a source-to-tap assessment be done in these cases..

- Canadian Drinking Water Guidelines
- Cryptosporidium Infection
- Giardiasis ("Beaver Fever")
- How to Disinfect Drinking Water
- Water-borne Diseases in BC

Livestock Watering

To reduce possible impacts to water quality from livestock or poultry manure, various systems are available that supply livestock water away from sensitive watercourse areas. A watering system is required where direct access to watercourses is not allowed, such as, in confined livestock areas. Systems may also be worthwhile for other outdoor areas experiencing less frequent animal activity. An outdoor watering system may include an intake, energy source, distribution system, and trough. Implement the following practices (refer to **Figure 9.1**):

- Use a watering system that reduces livestock impacts on watercourses.
- Meet intake regulations.

➔ see Changes In and About a Stream, **page 7-17**

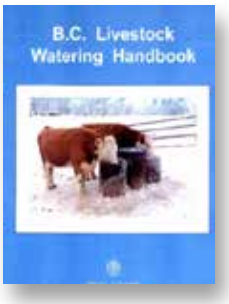
- Meet water intake fish screen requirements.

➔ see Water Intakes, **page 9-19**

- Locate intakes on gravity-fed systems at as high an elevation as practicable to avoid impacts from low water levels during drought.
- Locate troughs 30 m or more (suggested) from a watercourse.
- Install troughs on a firm base such as concrete, wood, compacted soil or soil and gravel.
- Install water troughs to prevent the introduction of fecal contamination to the water that could contribute to disease and parasite problems.
- Use water conservation practices with troughs to minimize water usage:
  - Maintain a water freeboard of 25 to 50 mm (suggested) to avoid spillage.
  - Keep all water troughs maintained to eliminate leakage.
  - Minimize the exposed surface area of water troughs to slow the rate of evaporative losses.
- Where required, ensure adequate drainage for spillage, overflow or leakage.
  - Contaminated overflow water must not pollute watercourses.
- Ensure that containment for fuel leaks from petroleum powered pumps.
- Re-vegetate ground disturbed for pipeline burial and system installation.
- Operate sites to prevent manure from contaminating watercourses.
- In high-use situations, install an extended concrete apron or other suitable hard surface material around the waterer to minimize muddy conditions.
- If natural or constructed ponds are used as part of a stock water system, consider the risks of climate change to water level fluctuations, and evaluate the pond hydrology before modifying the pond shape or depth.

- Climate Change Impact Risk Assessment Tool for Ponds Used as Livestock Water Sources
- B.C. Livestock Watering Handbook (series of Factsheets)
- Livestock Surface Water Assessment and Options

Watering Livestock Directly from Watercourses



Livestock may impact a watercourse by activities in the uplands or the riparian area, or in the watercourse. Direct access to a watercourse by livestock may be either managed or unrestricted. Various factors will determine the preferred choice of access, including:

- Livestock management, including timing, duration and intensity of use.
- Moisture content, and type of soil and vegetation within the riparian area.
  - Sites with bare soil or with sparse vegetation; sandy soils; saturated soils; clay soils; are more prone to erosion and may require improvements.
- Stream bottom composition.
  - Solid, gravely areas, while providing good footing for livestock, are typically ideal for fish habitat (the habitat values of such sites must be known to determine the best type of access, if any).
- Watercourses that experience high spring freshet flows may require managed access if their banks are highly eroded.
- Sensitive riparian areas with easily eroded stream banks.
  - Such areas may be limited to little or no access for long-term protection.
- Instream (such as fish) and downstream uses (e.g., domestic water intakes) of the water.

Factsheet 590.302-1 Watering Livestock Directly from Watercourses

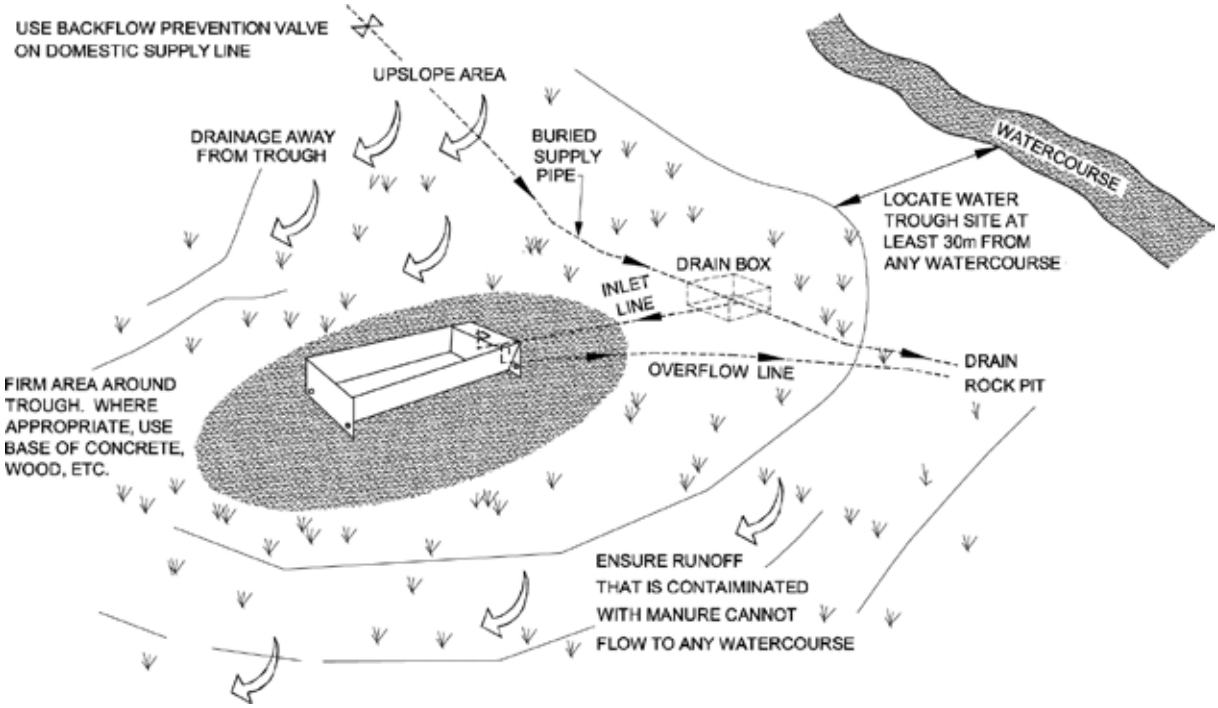


FIGURE 9.1 An Outdoor Livestock Water Trough Installation

Implement the following practices for livestock access to watercourses:

- Do not reduce riparian function.

  ➔ see Riparian Areas, **page 11-15**

- Contact the appropriate agencies when planning any work near or in any watercourse that may impact the water or habitat.

  ➔ see Changes In and About a Stream, **page 7-17**

- Place salt, minerals or supplemental feeds away from riparian areas to encourage animals to be in less sensitive locations.
- Use berms to prevent upland runoff flows from entering the watercourse at access locations, as shown in **Figure 9.2**, next page.
- Provide good footing and grades for livestock at access points.
- Clean up any accumulated manure, especially from the sloped access from time to time.
- For managed access, where possible, enclose the end of the access to prevent livestock from entering the watercourse as shown in **Figure 9.2** (use removable panels on streams subject to high freshet flows).
- For managed access, fence or otherwise block unneeded access areas.

Unrestricted Access. This option may have the greatest risk of pollution unless carefully matched to the livestock use. Evaluate such accesses with the characteristics of the site and degree of expected livestock activity in mind. This type of access is commonly used on sites of low density grazing, such as, on dryland pastures. It may not be appropriate for high-use sites, such as summer-long grazing on irrigated pastures.

Ontario Factsheet 400/751 Livestock Access to Watercourses

Managed Access. Restricting access will limit livestock impacts on water quality and sensitive streambank areas but will concentrate impacts onto the access site. Choose low-risk sites as access points. They may require some maintenance depending on the concentration of livestock. Use a fence or other means to control access and a small berm to redirect runoff away from directly flowing into the watercourse at the access location. **Figure 9.2** illustrates a managed watercourse access.

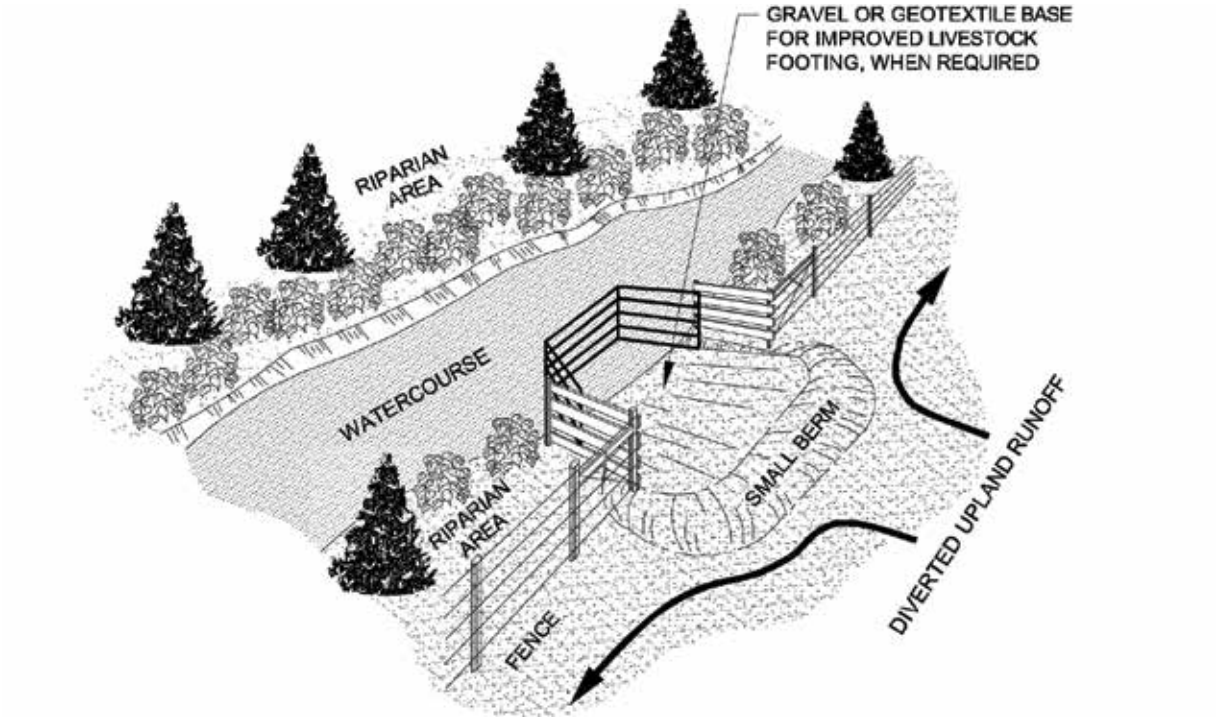


FIGURE 9.2 A Managed Access to a Watercourse for Livestock

In some cases improvements to the access may be needed because of soil, streambank, or intensity of use on the site. High-use, direct-access locations may benefit from improvements such as, added gravel, a combination of added gravel and geosynthetics, or grading to modify slopes.

- Factsheet 590.302-2 Improved Livestock Access to Water Using Geosynthetics and Gravel
- Factsheet 590.302-3 Offstream Watering to Reduce Livestock Use of Watercourses and Riparian Areas
- Riparian Grazing and Off-Stream Livestock Watering

Water Control Structures

The construction of any structures such as, dams, ditches, water diversions, bridges, and culverts located in watercourses are subject to fish-protection regulations. These govern such things as fish passage and timing, fish screening, and by-pass facilities. Prior to any work, ensure the fish requirements for the watercourse are known and regulations followed.

Water Intakes

Intake Screen Sizing. While intakes are usually screened to prevent debris from entering pipes, specific guidelines have been developed for fish bearing watercourses. The guidelines contain information on appropriate screen size for the intake flow rate. The following can be used to determine general compliance:

- Ensure there is sufficient total screen area to match flow rate.
- Use **Worksheet #6, page 9-20.**
- Use screen mesh sizes with clear openings that do not exceed 2.54 mm (1/10 inch).
- Use screen mesh with open areas that are not less than 50% of the total screen area, **Table 9.1.**

B.C. Sprinkler Irrigation Manual

Freshwater Intake End-of-Pipe Fish Screen Guideline

Intake Construction. Installing an intake may require working along side or in a watercourse. Any work requiring "changes in and about a stream" requires an approval, licence or compliance with regulations.

➔ see Changes In and About a Stream, **page 7-17**

Intake Maintenance. The maintenance of intake works authorized by a water licence must be conducted in a manner and during a period that minimizes water quality impacts on existing licensed users and fish. If in doubt, contact FrontCounter BC (FCBC) or Fisheries and Oceans Canada.

➔ see Changes In and About a Stream, **page 7-17**

TABLE 9.1	Screen Mesh Open Area				Worksheet #6
Mesh	Wire Diameter		Width of Opening		Open Area %
	[inch]	[mm]	[inch]	[mm]	
4 x 4★	0.063	1.60	0.188★	4.78★	56
6 x 6★	0.035	0.889	0.132★	3.35★	63
8 x 8	0.028	0.711	0.096	2.44	60
10 x 10	0.025	0.635	0.074	1.88	55
12 x 12	0.023	0.584	0.060	1.52	52

Source: B.C. Sprinkler Irrigation Manual
★ Screen mesh size openings exceed the maximum fishery opening size of 2.54 mm (1/10 inch)

WORKSHEET #6
Screen Area Check for Fishery Requirements of Water Intakes

Workbook Question 314

Question: **Does the screen surface area match fishery requirements for the flow rate?**

Information:

Irrigation system flow rate, from Box 9 on Worksheet #7 or #8	963	1	US gpm
Screen mesh size used	8x8	2	mesh size
Percent screen open area of mesh size used (Table 9.1*)	60	3	% open area
Check if end area is screened: ☐	No		

Calculation:
Step 1 **Calculate required screen surface area**

EQUATION: Required Screen Surface Area

$$\frac{\text{Flow Rate}}{0.448 \times \text{\% Open Area}} = \text{Required Screen Surface Area}$$

$$\frac{963 \text{ (1) gpm}}{0.448 \times 60 \text{ (3)}} = 35.8 \text{ (4) sq. feet}$$

Step 2 **Calculate actual screen area using one of the following methods: (Add end area if screened)**

Method 1: Flat screen

EQUATION: Flat Surface Area Total

No. of flat Screen Surface x Length x Width = Flat Surface Area Total

4 (5) x 5 (6) ft x 2 (7) ft = 40 (8) ft²

EQUATION: End Surface Area

Length x Width = End Surface Area

(9) ft x (10) ft = 0 (11) ft²

Total Area (8 + 11) = 40 (12) ft²

Method 2: Cylindrical screen

EQUATION: Cylindrical Surface Area

3.14 x diameter x length = Cylindrical Surface Area

3.14 x (13) x (14) ft = 0 (15) ft²

EQUATION: Circular End Area

$$\frac{3.14 \times \text{diameter}^2}{4} = \text{Circular End Area}$$

$$\frac{3.14 \times (\text{(13)})^2}{4} = \text{(16) ft}^2$$

Total Area (15 + 16) = 0 (17)

Answer:

Step 3

is 35.8 (4) sq. feet

less than 40.0 (12 or 17) sq. feet ?

No **screen area is too small** **or** YES **screen area is OK**

Note: Refer to Tables in BC Environmental Farm Plan Reference Guide

IRRIGATION

IRRIGATION ENVIRONMENTAL CONCERNS

Primary environmental concerns related to irrigation are:

- Irrigating with poor quality water that results in contamination of edible crops with pathogens, or in salt build up in the soil.
- Over irrigation that results in:
  - Poor conservation of water.
  - Leaching of contaminants into groundwater or surface water.
  - Overland flow leading to soil erosion.
- Ability to maintain operations during a drought without impacting critical environmental flows.
- Adapting to climate change.
- Chemigation products or other additives that results in water or soil pollution.

For information on these concerns:

➔ see Soil Quality Factors, **page 8-1**, and refer to Contaminants, and to Salts

➔ see Water Quality and Quantity factors, **page 9-1**, and refer to Contaminants

IRRIGATION LEGISLATION

The following is a brief outline of the main legislation that applies to irrigation.

➔ see **page A-1** for a summary of these and other Acts and Regulations

Local Bylaws

Municipalities, irrigation districts and other water purveyors may have bylaws governing the application of chemicals through irrigation system.

BC Building Code

Part 7 of the *BC Building Code* addresses plumbing services and provides information on protection from contamination from cross connections.

Environment Management Act

The Code of Practice for Agricultural Environmental Management requires persons to use environmentally responsible and sustainable agricultural practices when carrying out agricutural operations, for the purpose of minimizing the introduction of waste into the environment and preventing adverse impacts to the environment and human health.

The Code of Practice of Agricultural Environmental Management under the Act has a requirement for irrigation:

SECTION 26: A person who irrigates on land in a vulnerable aquifer recharge area must ensure that the quantity and timing of irrigation does not exceed crop needs.

Vulnerable aquifer recharge areas are described in Schedule B of the *The Code of Practice of Agricultural Environmental Management*. These areas are also described in the interactive High Risk Areas map.

Map of BC High Risk Areas

Water Sustainability Act

Water Sustainability Act (WSA) is the principal law for managing the diversion and use of water in British Columbia. The WSA establishes that all water in *streams (surface water)* and aquifers (*groundwater)* in British Columbia is owned by the Crown on behalf of the residents of the Province.

Surface water is very broadly defined as water in any above ground natural water body, including springs, glaciers, lakes, ponds, rivers, creeks, and wetlands. Groundwater is defined as any water that is found naturally beneath the surface of the earth.

Under the WSA, no person may divert water from a stream or from aquifer unless the person holds an authorization or the diversion and use of water is allowed by the Act or under a regulation. An authorization can take the form of a "use approval", which allows for short term use of water for up to 24 months, or a water licence which establishes a long term water right. Authorization holders have some responsibilities including the need to pay water fees and rentals and make beneficial use of the water they are authorized to divert, store and use.

Other key aspects of the WSA include:

- Managing water during scarcity, which involves the regulation of diversion of water use to manage periods when there is insufficient water to meet licensed demand or if a fish population is threatened.
- Changes in and about streams: There are two processes that allow a change to be made in and about a stream. A "Change Approval" is a written authorization to make changes in and about a stream and normally involve a more significant or larger change. A "Notification" is for low risk changes that have minimal impact on the environment or third parties.

The following SECTIONS of the WSA may be of interest to agricultural operators in particular:

- SECTION 6: Prohibits diverting water without a licence except in limited circumstances for fire suppression, domestic use and mineral prospecting.
- SECTION 11: Requires approvals for making changes in and about streams.
- SECTIONS 16 & 17: May require mitigation measures on (sensitive) streams where a water diversion or use is authorized.
- SECTION 45: No new dams on protected rivers.
- SECTION 86: Declarations of significant water shortage.
- SECTION 87: Critical environmental flow protection orders.
- SECTION 88: Fish population protection orders.
- SECTION 128: Regulations respecting sensitive streams.

In the case of low or impending low streamflow, temporary protection orders (SECTIONS 86, 87, 88) may be used. These orders are are used for the purposes of protecting environmental flow thesholds or fish populations.

The right to divert and use surface water or groundwater is authorized by a licence or approval. Licences and approvals are granted in accordance with the statutory requirements of the *Water Sustainability Act*.

If you use surface water for any purpose including domestic, or groundwater for any non-domestic purpose, a water licence is required under the *Water Sustainability Act*. The requirement for groundwater licensing came into force on February 29, 2016 which applies to new groundwater users as well as existing groundwater users who began using groundwater prior to February 29, 2016. A water licence may be applied for from FrontCounter BC in person or online. Approval is also required for any work in or about a stream.

Apply for a Water Licence

Wildlife Act

The provincial *Wildlife Act* protects wildlife designated under the Act from direct harm, except as allowed by regulation (e.g., hunting or trapping), or under permit. Legal designation as Endangered or Threatened under the Act increases the penalties for harming a species. The Act also enables the protection of habitat in a Critical Wildlife Management Area.

Fisheries Act

Administered by both Fisheries and Oceans Canada and Environment and Climate Change Canada, this Act is established to manage Canada's fisheries resources, including fish habitat. The Act can also be administered provincially by FLNRORD and ENV. The Act applies to all Canadian waters that contain fish, including ditches, channelized streams, creeks, rivers, marshes, lakes, estuaries, coastal waters and marine offshore areas. It also applies to seasonally wetted areas that provide fish habitat such as shorelines, stream banks, floodplains, intermittent tributaries and privately owned land. The Act includes provisions for stiff fines and imprisonment to ensure compliance.

The purpose of this Act is to provide a framework for (a) the proper management and control of fisheries; and (b) the conservation and protection of fish and fish habitat, including by preventing pollution.

This Act was updated in 2019 and now empowers the Minister to make regulations for the purposes of the conservation and protection of biodiversity.

The definition of fish habitat is: "water frequented by fish and any other areas on which fish depend directly or indirectly to carry out their life processes, including spawning grounds and nursery, rearing, food supply and migration areas". The quantity, timing and quality of the water flow that are necessary to sustain fish habitat are also deemed to be a fish habitat. Furthermore, serious harm to fish includes the death of fish or any permanent alteration to, or destruction of, fish habitat.

Provisions of the *2019 Fisheries Act* relevant to agricultural operations include:

- Protection for all fish and fish habitats;
- Prohibition against the death of fish or the 'harmful alteration, disruption or destruction of fish habitat';
- A permitting framework and codes of practice to improve management of large and small projects impacting fish and fish habitat;
- Protection of fish and/or fish habitats that are sensitive, highly productive, rare or unique; and
- Consideration for the cumulative effects of development activities on fish and fish habitat.

Specific sections of the Act include:

SECTION 34.2(1) The Minister may establish standards and codes of practice for:

(a) The avoidance of death to fish and harmful alteration, disruption or destruction of fish habitat;

(b) The conservation and protection of fish or fish habitat; and

(c) The prevention of pollution.

SECTION 34.4 (1) No person shall carry on any work, undertaking or activity, other than fishing, that results in the death of fish.

SECTION 35 (1) No person shall carry on any work, undertaking or activity that results in the harmful alteration, disruption or destruction of fish habitat.

Every person who contravenes subsection 34.4(1) or 35(1) is guilty of an offence and liable.

Notifying authorities about serious harm to fish or deposit of a deleterious substance:

SECTION 38 (4.1) Every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations of a harmful alteration, disruption or destruction of fish habitat that is not authorized under this Act, or of a serious and imminent danger of such an occurrence, if the person at any material time

(a) Owns or has the charge, management or control of the work, undertaking or activity that resulted in the occurrence or the danger of the occurrence; or

(b) Causes or contributes to the occurrence or the danger of the occurrence.

SECTION 38 (5) If there occurs a deposit of a deleterious substance in water frequented by fish that is not authorized under this Act, or if there is a serious and imminent danger of such an occurrence, and detriment to fish habitat or fish or to the use by humans of fish results or may reasonably be expected to result from the occurrence, then every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations.

SECTION 38 (7) As soon as feasible after the occurrence or after learning of the danger of the occurrence, the person shall provide an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations with a written report on the occurrence or danger of the occurrence.

Species at Risk Act

This Act has sections that protect listed species, their residence and critical habitat. It applies to federal lands, internal waters (i.e., all watercourses), territorial sea of Canada, and the air space above them.

The provisions of the *Species at Risk Act* (SARA) (known as the 'safety net') could be invoked on BC crown and private lands using a federal order under the Act if provincial action is not sufficient to protect listed species.

On private land, unless an order is made by the government, the SARA prohibitions apply only to:

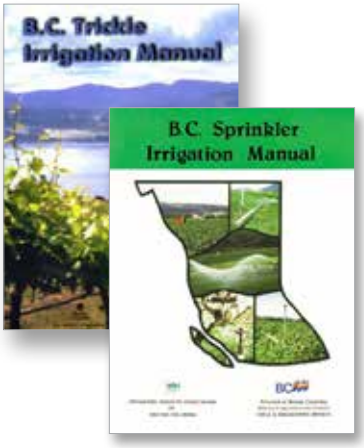
- Aquatic species at risk; and
- Migratory birds listed in the *Migratory Birds Convention Act*, 1994 and also listed as endangered, threatened or extirpated in Schedule 1 of the Act.

IRRIGATION BENEFICIAL MANAGEMENT PRACTICES

Comply with applicable irrigation-related legislation, including the above. Where appropriate, use the following beneficial management practices to protect the environment. It is particularly important to avoid over-irrigation that leaches nutrients down towards vulnerable aquifers, yet realizing it is important in all agricultural areas to irrigate efficiently.

A key objective of irrigation management is the efficient use of water to match the crop's needs while preventing the loss of water due to surface flow, leaching or drift. Appropriate irrigation designs, equipment and good management and scheduling will conserve water supplies while supporting crop growth.

The Role of Soil in Irrigation

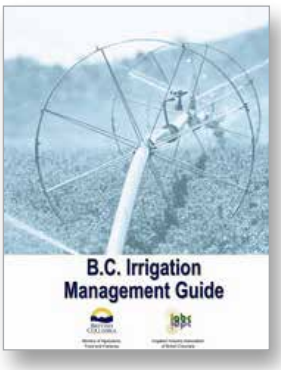


Good irrigation practices combine proper irrigation system design, system operation and maintenance and irrigation scheduling. Soil characteristics determine how an irrigation system should be designed and operated:

- Coarse textured sandy soils generally have low water holding capacity and high infiltration rates:
  - Water is therefore unlikely to pond on or run off the surface.
  - However, water may be lost beyond the root zone quickly and may carry with it nutrients, posing a hazard to groundwater quality.
  - Irrigate when required and only long enough to fill the root zone.
- Medium to fine-textured silt and clay soils are very susceptible to surface sealing or puddling of soil, which can lead to very low infiltration rates:
  - Water droplets from sprinkler systems may damage soil structure on bare soils - protect surface from sealing with crop cover or mulch.
  - Reduce droplet size and operation time on bare soil (e.g., new seedings).
  - A sealed soil surface discourages infiltration and promotes ponding and runoff flow causing erosion.
  - Allow soil to dry out between irrigations letting surface cracks to appear which may improve infiltration.
- Operate sprinkler systems in the spring and fall with a longer time between each irrigation than during periods with peak water use.
- Manage trickle systems to keep the soil water level within the optimum range, but definitely not saturated.
- Poorly drained soils may experience a salt build up when irrigated (from salt already in the soil or in the water) – when the soil dries, 'salty' water is drawn up to the soil surface, the water evaporates and the salt stays.
  - Irrigation system may need to be designed with a leaching factor to remove salt build up.

Factsheet 619.000-1 Soil Water Storage Capacity and Available Soil Moisture

Irrigation Water Quality



Irrigating with water of poor quality can not only harm or contaminate the crop, but may also harm the environment. Salts, heavy metals and pathogens make their way into the soil and may be taken up by the crop or build up in the soil to unacceptable levels.

see BC Irrigation Management Guide Chapter 2 - Page 9

➔ see Soil Contamination, **page 8-18**

Table 9.2 below provides threshold values for irrigation water quality tests. For pathogens, E. Coli and fecal coliforms are measured in colony forming units (cfu). If these values are exceeded, the water should be further investigated and treated appropriately; otherwise, the water should not be used. For high pathogens levels, producers are encouraged to eliminate potential sources of contamination by implementing beneficial management practices. If on-farm changes in practice do not improve water quality, producers should seek an alternate source or treat the water. For pathogens, test a water sample for *E. Coli* and fecal coliforms, measured in colony forming units (cfu).

More water quality information can be found at:

Irrigation Industry Association of British Columbia (IIABC)

B.C. Sprinkler Irrigation Manual, Chapter 11

B.C. Trickle Irrigation Manual, Chapter 12

B.C. Irrigation Management Guide, Chapter 2 Environmental Concerns of Irrigation Water Supply

TABLE 9.2	Irrigation Water Quality Guidelines[1]		
Threshold Values to Protect Soil [2]			
Salts	sodium adsorption ratio (SAR) less than 13 and electrical conductivity (ECw) less than 0.2 dS/m		
Boron	less than 0.5 mg/litre		
Chloride	less than 100 mg/litre		
Threshold Values for Food Safety [3]			
		E.Coli	Fecal Coliform
		cfu/100ml	cfu/100ml
Pathogens [4]	Crops Eaten Raw	less than 77	less than 200
	All Other Crops	less than 1,000	less than 1,000

[1] If these values are exceeded, the water should be further investigated and treated appropriately; otherwise, the water should not be used.
[2] from the Water Encyclopedia 2nd ed. Van der Leeden, Fritz et al. 1990, Lewis Publishers. Chelsea Michigan, USA.
[3] from BC ENV
[4] Note: Pathogen levels for crop washing are 0 cfu/100ml for both *E.coli* and fecal coliform

Irrigation Systems

The type of irrigation system most suited to a particular site depends on crop characteristics, climate and soil conditions. When selecting an irrigation system, implement the following practices:

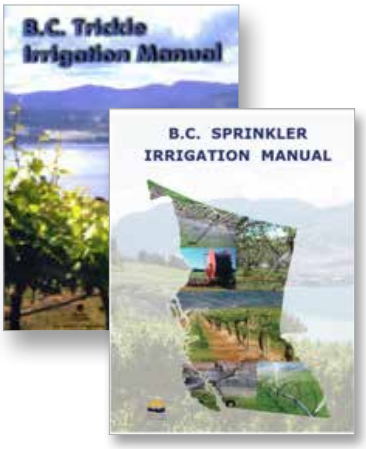
- Consider water and soil conservation issues as well as economics.
- When appropriate, select an irrigation system with efficient water use such as trickle or subsurface system.

➔ see Application Efficiency, **page 9-27**

- Apply water using scheduling techniques.

➔ see Irrigation Water Scheduling, **page 9-29**

- Where appropriate, install electronic timing devices to automate the system and adjust the device regularly to irrigate according to changing climate conditions over the irrigation season.



Trickle. If managed properly, trickle irrigation systems can be the most water use efficient systems for certain crops with appropriate soil conditions and water quality. In the BC Trickle Irrigation Manual, trickle refers to frequent, low pressure application of water to crops, including tape, drip emitters and spray emitter systems.

Sprinkler. Some sprinkler systems can be very water use efficient while others with poor uniformity or poor management will have water and nutrient loses due to deep percolation and overland flow.

Gun. These systems operate at much higher flows and pressures than regular sprinkler systems. They are susceptible to wind drift, resulting in higher evaporation losses and lower operating efficiencies. Stationary guns have a very high application rate requiring short set times that may be difficult to properly manage. Traveling guns also have lower efficiencies, but overcome the short set time by moving the gun over a large area each set.

Centre Pivot. These systems are automated and travel in a circle or part circle around a field. Those with higher efficiencies use pressure regulated rotator heads on drop tubes that hang just above the crops.

Flood. Flood irrigation is an inexpensive irrigation option. However, it is an inefficient method of irrigating, especially when fields are not laser leveled. Flood systems can have water losses due to tail end losses (which are not recycled) and deep percolation if too much water is applied. The excess water can contain nutrients or contaminants that may impact surface water or groundwater.

Subirrigation. These systems use subsurface drainpipes to irrigate by raising the water table to the crop's roots. Drainpipes require a closer spacing than a system that only provides drainage. If managed properly, subirrigation systems can irrigate efficiently. If the drainage system is controlled and closed, nutrients that may have leached into the drainage water can be recycled. These systems are not appropriate for crop cooling or chemigation.

- B.C. Agricultural Drainage Manual Chapter 11: Controlled Drainage/Subirrigation
- Drainage and Sub-Irrigation as a Climate Change Adaptation Strategy
- Climate & Agriculture Initiative BC – Irrigation Resources

Irrigation System Design

The design of the irrigation system should match the application rate of the irrigation system to the soil type and the crops' water requirements. Proper design and operation should prevent water from being wasted, and minimize surface flow or leachate that may contain fertilizer and pesticide residues. An irrigation system that is not correctly designed will be nearly impossible to manage properly. Manage excess water to avoid the following consequences:

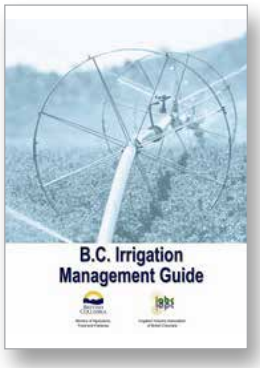
- Erosion – adjust system or rate of application to reduce overland flow.
- Transport of nutrients via leaching out of the root zone and into the groundwater – this is expensive and can cause pollution.
- Transport of nutrients into runoff flow.
- Insufficient water may allow salts to build up in the soil.
- Match the irrigation flow rate and water use with the recommended values.
  - Producers should be able to reduce their water use if rates exceed recommended values.

➔ see Irrigation Water Use Checks, **page 9-30**

- Have secondary containment for fuel tanks on petroleum powered pumps near watercourses.

- Irrigation Industry Association of British Columbia (IIABC)
- B.C. Sprinkler Irrigation Manual, Chapter 5
- B.C. Trickle Irrigation Manual, Chapter 5 and 7
- Climate & Agriculture Initiative BC – Irrigation Resources

Application Efficiency. Application efficiency is the percentage of water applied by the irrigation system that is actually available to the crop. A lower efficiency system loses more water during the application process to evaporation, wind drift, or runoff and is not available to the crop. Efficiencies can vary due to:



- The type of irrigation system;
- Operating conditions, such as, wind, system pressure, sprinkler trajectory, etc…;
- Time of day;
- Hot or cool weather.

Table 9.3 gives efficiencies of commonly used systems. When considering irrigation system efficiency, implement the following practices:

- For new systems, choose the most efficient system suitable for the crop.
- For upgrading existing systems, choose a system that is at least 15% greater efficiency than the present one (e.g., for tree fruits, converting an undertree solid set sprinkler system at 75% efficiency to a trickle system at 92% efficiency).

Irrigation System Operation

When operating irrigation systems, implement the following practices:

- Operate a sprinkler irrigation system at the recommended operating pressure.
  - Excessive pressure can be inefficient and result in water loss due to evaporation and wind drift.
- Avoid excess irrigation that causes runoff flow, such as, in compacted low areas that are prone to ponding and/or runoff flow.
  - Runoff flow can cause soil erosion.
- Avoid excess irrigation that causes leachate movement.
- Irrigate the crop only.
  - Avoid applying water to non-productive areas, such as, roads.
- Use automated systems to apply the amount of water required for the crop during that time period to reduce over and under watering.
- Avoid irrigating with high volume sprinklers on steep hills (over 10 percent gradient).

Factsheet 500.310-2 Irrigation Tips to Conserve Water on the Farm

Climate & Agriculture Initiative BC – Irrigation Resources

TABLE 9.3 Irrigation System Application Efficiency — **Worksheets #9, #10**

Crop Type★	Irrigation System Type		Application Efficiency (%)	
			range	typical
Row	Trickle	Microjet	80 – 90	85
		Trickle	85 – 95	92
		Drip – Subsurface	85 – 95	95
Row Field	Sprinklers	Handmove	60 – 75	72
		Wheel line	60 – 75	72
		Overhead Solid Set	60 - 75	72
		Undertree Solid Set	65 - 75	75
		Microsprinklers	70 - 85	80
Field	Center Pivot	Sprinklers	65 – 75	72
		Spray heads	65 – 80	72
		Drop tubes	75 – 85	80
Row Field	Guns	Stationary	50 – 65	58
		Travelling	55 – 70	65
Field	Flood		30 – 50	50

★ these are typical crops irrigated with these systems:
Row = crops, such as, tree fruits, grapes Field = crops, such as, forages, field vegetables

Irrigation Scheduling

Irrigation scheduling is the process used to match the application of irrigation water to the soil and crop needs. The key objective of irrigation scheduling is to reduce water loss due to overland flow or leaching.

There are a number of ways that the system can be operated to match climate conditions. Some farms alter the operating time throughout the season to match climate conditions and crop growth requirements. Others keep the operating time the same but change the frequency of operation. Either method can be used to match system operation with climate conditions.

Irrigation scheduling requires knowing:

- The soil water holding capacity.
- The amount of evapotranspiration (ET) and precipitation (climate information).
- The application rate of the irrigation system.

For appropriate irrigation scheduling, implement the following practices:

- Irrigate according to crop requirements instead of a rigid time-table.
- Monitor soil moisture (refer to below).
- Monitor climate information and be aware of the forecast (refer to below).
- Consider recent rainfall events, and evapotranspiration:
  - I.e., the amount of water to be added to the soil depends on how much has been removed by the crop and added by rainfall since the last irrigation.
  - Irrigation begins when a significant amount of water has been removed from the soil in the root zone, 50% for sprinkler systems and 20 to 30% for trickle systems.
- Use a water budget method to determine when and how long to irrigate.

The online Irrigation Scheduling Calculator has been developed specifically for use in British Columbia. The calculator takes the following information into account in the development of an irrigation schedule:

- Crop water requirements.
- Soil water holding capacity.
- Amount of effective rainfall that is useable by the crop.
- How much irrigation water is needed to make up the moisture deficit.

Irrigation Industry Association of British Columbia (IIABC)

Agriculture Drip Irrigation Scheduling Calculator Users Guide

Agriculture Sprinkler Irrigation Scheduling Calculator Users Guide

Factsheet 577.100-3 Sprinkler Irrigation Scheduling Using a Water Budget Method

Factsheet 577.100-4 Trickle Irrigation Scheduling Using Evapotranspiration Data

Soil Moisture. The need for irrigation should never be gauged by the moisture content of the soil surface layer alone. It is important to determine the moisture content throughout the root zone to make an educated decision on when to start irrigating by using the hand feel method or monitoring devices such as tensiometers, gypsum blocks or electrical resistance blocks.

Irrigation Scheduling Techniques

Irrigation Scheduling with Tensiometers

Climate Monitoring. The crop's water use is directly related to the climate. Climate information can be gathered on the farm or taken from regional sources such as Farmwest.com on the Internet. www.Farmwest.com and go to "Evapotranspiration" under the Climate tab.

Irrigation System Maintenance

To ensure an irrigation system performs as designed, it must be maintained properly. Implement the following practices:

- Check irrigation equipment for leaks.
  - Common faults include leaking gaskets, defective sprinkler bearings and uneven pressure due to incorrect pipe sizes or difference in elevation.
- Check nozzles annually for wear.
  - Worn, oversized nozzles will apply excess water to the crop.
  - In areas where the water contains sediment check more frequently.
- Check trickle system emitters annually for signs of clogging.
  - Plugged emitters cause uneven water distribution.
- Have a maintenance routine for water pumps, checking for impeller wear.

BC Irrigation Management Guide, Chapter 6 and 7 Irrigation System Maintenance

Irrigation Water Use Checks

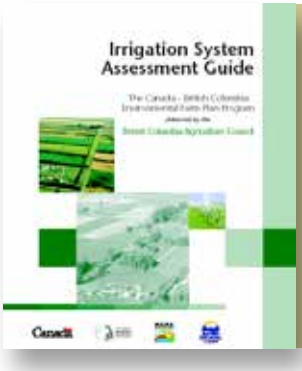
Two water use checks can be done on **existing systems** to determine if the irrigation water use is appropriate. Implement the following practices:

- Do a Peak Flow Rate Check for water withdrawal rate:
  - Explanatory text on **page 9-31,** see **Worksheet #7** for sprinkler systems, **page 9-33.**
  - See **Worksheet #8** for trickle systems, **page 9-34.**
- Do an Annual Water Use Check for total water use:
  - Explanatory text on pages **9-35** to **9-37.**
  - See **Worksheet #9** for sprinkler systems, **page 9-38.**
  - See **Worksheet #10** for trickle systems, **page 9-40.**

  The Ministry of Agriculture, Food and Fisheries collaborated with the Partnership for Water Sustainability in BC (PWSBC) to develop an online tool called the BC Irrigation Water Use Calculator for farmers to determine their actual annual water use by using pump energy consumption, irrigation system operating time, or metered data.

  BC Irrigation Water Use Calculator

These worksheets are available in the **Environmental Farm Planning Workbook** for individuals to use with actual farm numbers. If either check fails, a more detailed system assessment should be done; go to **Irrigation System Assessment**.



Irrigation System Assessment Guide is a publication that forms part of the Environmental Farm Plan series on Beneficial Management Practices. Its purpose is to provide a more detailed assessment than provided by the following Water Use Checks.

These Water Use Checks will indicate which producers should refer to this publication for further assistance. The publication will also be of interest to producers who want to improve irrigation management or have experienced water shortages. **Table 9.4**, below, will direct producers who have systems that need a more detailed review.

TABLE 9.4	Steps to Complete an Irrigation System Assessment
1. Conduct the two Water Use Checks (using either the Sprinkler or Trickle worksheets)	
▪ Check the irrigation system Peak Flow Rate – match farm rate to the licensed rate or the calculated rate. ▪ Check the irrigation system Annual Water Use – match farm use to the licensed rate and the calculated rate. If both checks are answered "Yes", the irrigation system water use is appropriate and no further action is necessary.	
2. If Either of the Water Use Checks are Answered "No", Assess the System	
▪ Conduct a detailed assessment using the **Irrigation System Assessment Guide** publication. ▪ This publication builds on the Water Use Checks with more detailed information. ▪ It includes additional worksheets as well as Actions that can be taken to adjust the system to use water appropriately. ▪ This level of assessment is useful for systems that require only minor adjustments. If the irrigation system still does not meet water use requirements, professional assistance is needed.	
3. Where Required, Have an Irrigation Management Plan Done by a Professional	
▪ At this level the irrigation system requires significant analysis. ▪ This should be done by a professional certified by the Irrigation Industry Association of BC.	

Irrigation System Peak Flow Rate Check

The irrigation system should be designed and operated so that the peak flow rate of the system matches the climate, crop and soil requirement. This check compares a calculated peak flow rate to the actual irrigation system flow rate. Complete the following three steps as given in **Worksheet #7** (Sprinkler), **page 9-33** or **Worksheet #8** (Trickle), **page 9-34**.

STEP 1 Calculated Peak Flow Rate.

The calculated peak flow rate is the rate of water withdrawal determined by using the estimated rate for the farm location in BC. These are established rates, given in **Appendix Table B.2, page B-4**. The rate is multiplied by the acreage being irrigated to give a Calculated Peak Flow Rate.

STEP 2 Actual System Peak Flow Rate.

The actual system flow rate can be determined using any one or more of the following methods:

- **Water Meter.** A system water meter can be used to determine the peak flow rate. If the meter does not directly provide the rate, measure the time the meter indicates a certain amount of water has passed, then divide this volume by the time to determine flow rate.
- **Water Purveyor.** Water purveyors will allocate a flow rate to the farm based on acreage. Most often these flow rates are regulated using flow control valves. Contact your water purveyor to find out how much water you are allowed to take if you are on a municipal system or in an irrigation district.
- **Pump Curve.** The system flow rate can be determined by estimating the flows using the pump curve. When using a pump curve to estimate flow, the impeller diameter, pump rpm, and system operating pressure must be known. Contact your pump supplier for pump curve information.
- **Sprinkler Nozzle.** The irrigation system flow rate can be determined by measuring the flow rate (using a pail and stop watch) from selected sprinklers, averaging the flow and multiplying this number by the number of sprinklers operating. Alternatively, nozzle manufacturer table values can be used once the operating pressure and nozzle sizes are known.

It is important that all sprinkler nozzles are the same size and operating at close to the same pressure (i.e., they have similar flow rates) or the check will be inaccurate. Loss or gain of pressure is evident if the sprinklers at the end of the lateral do not have the same flow rate as those at the start. The lateral lines should be operated on the contour whenever possible. If the laterals run up or down a steep slope, each sprinkler will be operating at a different pressure. For sprinkler system output flow using nozzle flow, use **Worksheet #7**.

- **Trickle Systems.** These systems are much more efficient than sprinkler systems and can therefore operate at lower flow rates, if desired. However, to conduct a peak flow rate check, the same estimated peak flow rate is used for the sprinkler check. The reasons for this are:
  - The farm may convert to an alternate crop requiring a sprinkler irrigation system; the farm flow rate should be able to accommodate the change.
  - Water licences under the *Water Act* did not incorporate system types into the determination of flow rates; the allowable withdrawal is based on the sprinkler flow rate. Irrigation districts provide flows based on sprinkler flow requirements. New water licences under the *Water Sustainability Act* may consider irrigation system type in order to allow a water licence to be approved.
  - An advantage of trickle systems is that they do not need to operate 24 hours a day during peak season as compared with sprinkler systems.

For trickle output flow using drip emitter flow, use **Worksheet #8.**

STEP 3 Compare the Flow Rates.

The actual peak flow rate cannot exceed the peak flow rate indicated on the water licence. If the licence does not include a peak flow rate, it is recommended that the actual peak flow rate be no greater than the calculated rate.

WORKSHEET #7
System Peak Flow Rate Check - Sprinkler

Workbook Question 321

Question: **Does the system flow rate match either the licensed withdrawal rate (if stated) or the calculated peak flow rate for the farm?**

Information:

Irrigated area	170	1	acres
EITHER peak flow rate on water license (if stated)	n/a	2	US gpm
OR, select location to look up peak flow (Table B.2*):	5	3	US gpm/acre

Calculation: Step 1

Determine calculated peak flow rate

EQUATION: Calculated Peak Flow Rate

Estimated Peak Flow Rate Requirement per Acre			x	Irrigated Area			=	Calculated Peak Flow Rate		
5	3	US gpm/acre	x	170	1	acres	=	850	4	US gpm

Step 2

Determine actual irrigation system flow rate using one or more of the following methods:

Method 1. Water purveyor restriction or measured flow rate using a meter

Flow rate measured using a meter or provided by district		5	US gpm

Method 2. Pump peak flow rate

Irrigation pump peak flow from pump curve	825	6	US gpm

Method 3. Determine flow rate using sprinkler nozzles

Nozzle flow rate from supplier's tables	8	7	US gpm
Number of nozzles	105	8	nozzles

EQUATION: Sprinkler System Output Flow Rate

Nozzle Flow Rate			x	Number of Nozzles			=	Sprinkler System Output Flow Rate		
8	7	US gpm	x	105	8	nozzles	=	840	9	US gpm

Answer: Step 3

Is the calculated peak flow rate or Water Licence peak flow rate greater than the actual sprinkler irrigation system peak flow rate determined in methods 1, 2 or 3

is	840	maximum of 5, 6 or 9	US gpm
less than	850	2 or 4	

No **flow rate is exceeded** **or** YES **flow rate is ok**

Note: Refer to Tables in BC Environmental Farm Plan Reference Guide

WORKSHEET #8
System Peak Flow Rate Check - Trickle

Workbook Question 321

Question: **Does the system flow rate meet either the licensed water withdrawal rate (if stated) or the calculated peak flow rate?**

Information:

Irrigated area	14	1	acres
EITHER peak flow rate on water license (if stated)		2	US gpm
OR, select location to look up peak flow (Table B.2*):	6	3	US gpm/acre

Calculation:

Step 1 **Determine calculated peak flow rate**

EQUATION: Calculated Peak Flow Rate

Estimated Peak Flow Rate Requirement per Acre x Irrigated Area = Calculated Peak Flow Rate

6		US gpm/acre	x	14	1	acres =	84	4	US gpm

Step 2 **Determine actual irrigation system flow rate using one or more of the following methods:**

Method 1: Water purveyor restriction or measured flow rate using a meter

Flow rate measured using a meter or provided by district		5	US gpm

Method 2: Pump peak flow rate

Irrigation pump peak flow from pump curve		6	US gpm

Method 3: Determine flow rate using trickle emitters

Emitter flow rate from supplier's tables	Number of emitters operating at one time	5.7	7	gph emitters
		756	8	# of emitters

EQUATION: Trickle System Output Flow Rate

Emitter Flow Rate x No. of Emitters x 0.0167 = Trickle System Output Flow Rate

5.7	7	x	756	8	x	0.0167	ft =	72.0	9	US gpm

Answer:

Step 3 **Is the calculated peak flow rate or Water Licence peak flow rate greater than the actual sprinkler irrigation system peak flow rate (methods 1, 2 or 3).**

is	72.0	Maximum of 5, 6 or 9
less than	84	2 or 4

No **Flow rate is exceeded** **or** YES **Flow rate is OK**

Note: Refer to Tables in BC Environmental Farm Plan Reference Guide

Irrigation System Annual Water Use Check

This check compares the annual water use of an existing irrigation system against the licensed amount and against the calculated annual water requirement for the farm location (surface water use, groundwater use or purveyor-supplied water). If the check indicates that the annual water use exceeds the licensed rate or the calculated requirement the system design then the operation of the system needs to be reviewed. Complete the following three steps as given in **Worksheet #9** (Sprinkler), **page 9-38** or **Worksheet #10** (Trickle), **page 9-40.**

If licensed, water volume is checked against both the licence and the calculated water requirement. This double check ensures that the licence is not exceeded and water use meets the expected amount for the location.

It is possible that the water licence allows for more water than the calculated annual water requirement would indicate for either of two reasons:

- Water licences are not always issued for the exact amount of water required but may be "rounded off" to the next one-half acre-foot of water.
- An old water licence may have been issued for flood irrigation with up to twice as much water as a newer water licence for sprinkler irrigation.

Therefore, when checking actual annual water use against older licensed volumes, there may still be opportunities for water savings, even if using less than the amount stated on the licence.

Water Licences and Approvals

Irrigation System Assessment Guide

For systems that have large conveyance losses between the diversion and the irrigation system intake, the conveyance losses must be determined before the annual water use check can properly be completed.

BC Irrigation Management Guide

BC Irrigation Management Guide, Chapter 4

STEP 1 Calculated Annual Water Requirement

The calculated annual water requirement is determined by using an estimated value for crop water requirements and irrigation system efficiency factors.

It is accepted that some years are wetter or drier than others and annual water use will vary. Regardless, the annual withdrawal amounts stated on a water licence cannot be exceeded. Farmers using a well or other water source should adhere to the annual water requirement figures calculated in this chapter whenever possible.

- **Sprinkler System.** To calculate the sprinkler annual water requirement used, use **Worksheet #9**. This calculation requires the system efficiency to be considered. Typical system efficiencies are given in **Table 9.3, page 9-28**.
- **Trickle System.** The trickle system irrigates less of the crop area than a sprinkler system. The trickle emitters apply water only to the plant roots and not the centre of the crop row. The efficiency of a trickle irrigation system is also much higher than sprinkler systems, which provides additional savings. **Table 9.5** provides factors that can be used to adjust the annual crop water requirement values in **Appendix Table B.3, page B-7** for trickle irrigation systems. Use **Worksheet #10**.

TABLE 9.5 Crop Adjustment Factors for Trickle Irrigation Systems	Worksheet #10
Crop Type	Adjustment Factor
Tree Fruits – High Density	1.00
Apples, Cherries – Medium Density	0.90
Apricots, Peaches, Pears – Medium Density	0.80
Tomatoes	0.90
Vegetables	0.80
Blueberries	0.80
Strawberries	0.75
Raspberries	0.70
Grapes	0.70

STEP 2 Actual System Annual Water Use

The annual water use by an irrigation system can be determined using meter data, pumping information or irrigation system operation information. Any of the following methods can be used to estimate the annual water use. More than one method may be used to determine as accurately as possible the amount of water used each year.

- **Water Meter.** A water meter will provide accurate information on annual water use. Metered systems are usually on municipal or irrigation district water supplies. Trickle irrigation systems often have a flow meter to monitor system performance but these meters do not provide annual data. The meter reading can be converted into annual water use.
- **Pump Operating Hours.** The pump operating hours of an electric irrigation pump may be determined from the hydro bill provided by the hydro supplier. The amount of energy used can be converted into operating hours and annual water use.

To determine the pump horsepower, use the pump curve to determine the actual horsepower. You will need to know the flow rate, which is calculated in **Worksheets #7 or #8**, and the pressure at the pump. Relying on the motor face plate information may mean that the horsepower used in the calculation is too large.

- **Sprinkler System.** Annual water use for a sprinkler system can be estimated by determining how many days it takes the irrigation system to cover the field, the number of irrigations that are applied each year and the peak flow rate of the irrigation system. Use **Worksheet #9**.
- **Trickle System**. Trickle irrigation systems are more efficient than most other irrigation systems. They are also operated more frequently than other systems, usually every day or numerous times every week. Use **Worksheet #10** to convert system information into annual water use.

The Ministry of Agriculture, Food and Fisheries collaborated with the Partnership for Water Sustainability in BC (PWSBC) to develop an online tool called the BC Irrigation Water Use Calculator for farmers to determine their actual annual water use by using pump energy consumption, irrigation system operating time, or metered data.

BC Irrigation Water Use Calculator

STEP 3 Compare the Water Use Rates

To complete the Annual Water Use Check, compare the calculated annual water requirement to the annual water use. It is recommended that the annual water use be no more than 110% of the calculated annual water requirement (i.e., the requirement is not exceeded by more than 10%).

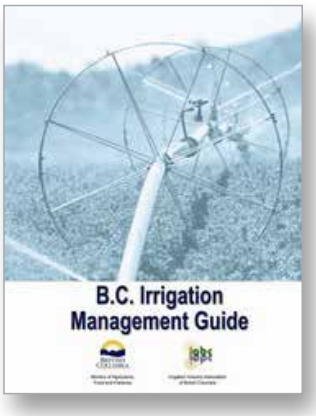
STEP 4 Water Licence Check

Convert the actual annual water use calculated in inches to acre-feet (**Worksheets #9** and **#10**). The acre-foot value is required if the actual annual water use is to be checked against the water allocation in the irrigation licence. The annual water use in acre-feet should not exceed the amount stated on the water licence.

Chemicals Added to Irrigation Water

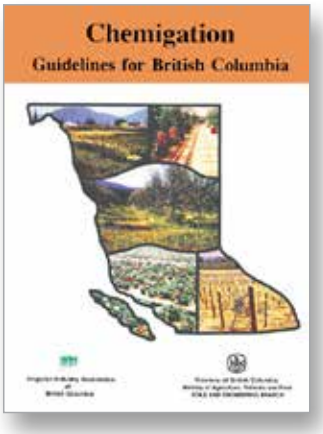
Chemigation is the practice of injecting chemicals into an irrigation system for application to a crop or field. Chemicals that are injected include fertilizers, herbicides, insecticides, fungicides, nematocides and growth regulators. Chemigation may reduce the amount of fertilizers required as nutrients are applied more efficiently.

Uniformity is essential to prevent over application of fertilizer or pesticide. The risk of contamination of the water source due to back-siphonage and back-pressure (as in unexpected shutdown of the irrigation system during injection) is an additional concern. Implement the following practice:



- Have an irrigation system designed to ensure uniformity:
  - Sprinkler systems should have a minimum uniformity of 80%.
  - Trickle systems should have a minimum uniformity of 90%.
  - Have new systems designed by a certified irrigation designer.
- Calibrate equipment and follow proper chemigation procedures to minimize the risk of excessive application and chemical drift.
- Have a proper backflow prevention device.
- Follow the information and regulations in the Chemigation Guidelines.

Producers who add chemicals to irrigation water should refer to the following publications for system detail required to be able to apply chemicals without impacting the environment.



- BC Trickle Irrigation Manual, Chapter 14
- Chemigation Guidelines for British Columbia
- Irrigation System Cross Connection Control
- B.C. Irrigation Management Guide, Chapter 9

WORKSHEET #9
Annual Water Use Check -Sprinkler

Workbook Question 321

Question: **Does the system annual water use match the calculated annual irrigation water requirement for the farm, and if surface water is used, does the annual use also match the licensed water quantity for the farm?**

Information:

Irrigated area	170	1	acres
Water withdrawal amount on water license (if applicable)	262	2	ac-ft
Estimated annual crop water requirement (Table B.3*)	12	3	inches
Application efficiency (Table 9.3*)	85	4	%

Calculation:

Step 1 **Determine the calculated annual water requirement.**

EQUATION: Calculated Annual Water Requirement

$$\frac{\text{Estimated Annual Crop Water Requirement}}{\text{Application Efficiency}} \times 100\% = \text{Calculated Annual Water Requirement}$$

$$\frac{12 \ (3)}{85 \ (4)} \times 100\% = 14 \ (5) \text{ inches}$$

Step 2 **Determine actual annual water use using one or more of the following methods:**

Method 1: Metered water use

Meter reading at start of year		6	US gallons
Meter reading at end of year		7	US gallons

EQUATION: Annual Water Use

$$\frac{\text{Meter Reading at End of Year - Meter Reading at Start of Year}}{27027 \times \text{Irrigated Area}} = \text{Annual Water Use}$$

$$\frac{0 \ (7) \text{ US gal} - 0 \ (6) \text{ US gal}}{27027 \times 170 \ (1) \text{ acres}} = 0 \ (8) \text{ inches}$$

Method 2: Pump water use

Pump horsepower from supplier's table	125	9	hp
Energy consumption for entire year from hydro bill	140.337	10	KWh
Pump flow rate from pump curve	825	11	US gpm

EQUATION: Pump Power

$$\text{Pump Horsepower} \times 0.746 \text{ KW/hp} = \text{Pump Power}$$

$$125 \ (9) \text{ hp} \times 0.746 \text{ KW/hp} = 93.3 \ (12) \text{ KW}$$

EQUATION: Pump Operating Hours

$$\frac{\text{KWh for Entire Year}}{\text{Pump Power}} = \text{Pump Power}$$

$$\frac{140.337 \ (10) \text{ KWh}}{93.3 \ (12) \text{ KW}} = 1505.0 \ (13) \text{ hr}$$

EQUATION: Annual Water Use

$$\frac{\text{Pump Operating Hours x Pump Flow Rate x 0.0022}}{\text{Irrigated Area}} = \text{Annual Water Use}$$

$$\frac{1505.0 \text{ (13) US gpm} \times 825 \text{ (11) US gpm} \times 0.0022}{170 \text{ (1) acres}} = 16.1 \text{ (14)}$$

Method 3: Sprinkler system annual water use

Sprinkler system output flow rate (max of boxes 5, 6 or 9 on Worksheet 7)	840	15	US gpm
Irrigation Interval	15	16	days
Number of irrigations per year	4	17	

EQUATION: Annual Water Use

$$\frac{\text{System Flow Rate x Irrigation Interval x No. of Irrigations x 0.053}}{\text{Irrigated Area}} = \text{Annual Water Use}$$

$$\frac{840 \text{ (15) US gpm} \times 15 \text{ (16) days} \times 4 \text{ (17) Number} \times 0.053}{170 \text{ (1)}} = 16 \text{ (18) ac-ft}$$

Answer: If there is a Water Licence, 3(a), and as a double check, do step 3(b). If using groundwater or if water supplied by a purveyor (no licence requirement), do step 3(b) only.

Step 3 Check annual water use with Water Licence.
Convert annual water use to acre-feet and compare to the licensed annual volume

EQUATION: Annual Water Use acre-feet

$$\frac{\text{Actual Annual water use x Irrigated Area}}{12} = \text{Annual Water Use acre-feet}$$

$$\frac{16 \text{ (8, 14 or 18) inches} \times 170 \text{ (1) acres}}{12} = 228 \text{ (19) ac-ft}$$

is 228 (19) ac-ft

less than 262 (2) ac-ft

YES water license is OK No water use is exceeded

Step 3(b). Calculate percent difference of peak flow rate.
Use the metered water use if available because it is the most accurate method.

EQUATION: Percent Difference

$$\frac{\text{Actual Annual Water Use}}{\text{Calculated Annual Water Requirement}} \times 100\% = \text{Percent Difference}$$

$$\frac{16 \text{ (8, 14 or 18) inches}}{14 \text{ (5) inches}} \times 100\% = 114 \text{ (20) \%}$$

is 114 (20) less than 110%?

No **Reduce water use** or YES **Water use does not exceed requirement by more than 10%**

Refer to Irrigation Assessment Guide' to find ways to reduce water use

WORKSHEET #10
Annual Water Use Check - Trickle

Workbook Question 321

Question: **Does the system annual water use match the calculated annual irrigation water requirement for the farm, and if surface water is used, does the annual use also match the licenced water quantity for the farm?**

Information:

Irrigated area	14	1	acres
Water withdrawal amount on water license (if applicable)		2	ac-ft
Estimated annual crop water requirement (indicate location Table B.3*)	19	3	inches
Crop adjustment factor (indicate crop type Table 9.5*)	1	4	
Application efficiency (indicate system type Table 9.3*)	92	5	%

Calculation:

Step 1 **Determine the calculated annual water requirement.**

EQUATION: Calculated Annual: Water Requirement

$$\frac{\text{Estimated Annual Crop Water Requirement} \times \text{Crop Adjustment factor}}{\text{Application Efficiency}} \times 100\% = \text{Calculated Annual Water Requirement}$$

$$\frac{19\ (3)\ \text{inches} \times 1\ (4)}{92\ (5)} \times 100\% = 21\ (6)\ \text{inches}$$

Step 2 **Determine actual annual water use using one or more of the following methods:**

Method 1: Metered water use

Meter reading at start of year Meter reading at end of year	100	7	US gallons
Meter reading at end of year	12,116,400	8	US gallons

EQUATION: Annual Water Use

$$\frac{\text{Meter Reading at End of Year - Meter Reading at Start of Year}}{27027 \times \text{Irrigated Area}} = \text{Annual Water Use}$$

$$\frac{12{,}116{,}400\ (8)\ \text{US gal} - 100\ (7)\ \text{US gal}}{27027 \times 14\ (1)\ \text{acres}} = 32\ (9)\ \text{inches}$$

Method 2: Pump water use

Pump horsepower from supplier's table		10	hp
Energy consumption for entire year from hydro bill		11	KWh
Pump flow rate from pump curve		12	US gpm

EQUATION: Pump Power

$$\text{Pump Horsepower} \times 0.746\ \text{KW/hp} = \text{Pump Power}$$

$$0\ (10)\ \text{hp} \times 0.746\ \text{KW/hp} = 0.0\ (13)\ \text{KW}$$

EQUATION: Pump Operating Hours

$$\frac{\text{KWh for Entire Year}}{\text{Pump Power}} = \text{Pump Operating Hours}$$

$$\frac{0\ (11)\ \text{KWh}}{0.0\ (13)\ \text{KW}} = 0.0\ (14)\ \text{hr}$$

EQUATION: Annual Water Use

$$\frac{\text{Meter Reading at End of Year - Meter Reading at Start of Year}}{27027 \times \text{Irrigated Area}} = \text{Annual Water Use}$$

$$\frac{(14)\ \text{hr} \times (12)\ \text{US gpm} \times 0.0022}{14\ (1)\ \text{acres}} = 0.0\ (14)\ \text{inches}$$

Method 3: Sprinkler system annual water use

Sprinkler system output flow rate from Box 9 of Worksheet 8)	72.0	16	US gpm days
Number of zones	7	17	
Operating hours per zone per day	2.5	18	hr/zone/day
Number of operating days per year	100	19	day

EQUATION: Annual Water Use

$$\frac{\text{Zone Flow Rate} \times \text{No. of Zone} \times \text{Operating Hours} \times \text{No. of Days} \times 0.0022}{\text{Irrigated Area}} = \text{Annual Water Use}$$

$$\frac{\underset{\text{US gpm}}{2.5\ (16)} \times \underset{\text{zones}}{7\ (17)} \times \underset{\text{hr/zone/day}}{2.5\ (18)} \times \underset{\text{day}}{100\ (19)} \times 0.0022}{14\ (1)} = 19.8\ (20)\ \text{inches}$$

Answer: If there is a Water Licence, 3(a), and as a double check, do step 3(b).
If using groundwater or if water supplied by a purveyor (no licence requirement), do step 3(b) only.

Step 3(a) Check annual water use with Water Licence.
Convert annual water use to acre-feet and compare to the licensed annual volume

EQUATION: Annual Water Use acre-feet

$$\frac{\text{Meter Reading at End of Year - Meter Reading at Start of Year}}{27027 \times \text{Irrigated Area}} = \text{Annual Water Use acre-feet}$$

$$\frac{32\ (9, 15, \text{or } 20)\ \text{inches} \times 14\ (1)\ \text{acres}}{12} = 37\ (19)\ \text{ac-ft}$$

is 37 (19) ac-ft

less than 0 (2) ac-ft

Step 3(b) Calculate percent difference of peak flow rate.
Use the metered water use if available because it is the most accurate method.

EQUATION: Percent Difference

$$\frac{\text{Actual Annual Water Use}}{\text{Calculated Annual Water Requirement}} \times 100\% = \text{Percent Difference}$$

$$\frac{32\ (9, 15, \text{or } 20)}{21\ (6)} \times 100\% = 155\ (21)\ \text{inches}$$

is 155 (21) **% less than 110%**

No Reduce water use or YES Water use does not exceed requirement by more than 10%

Note: Refer to "Irrigation System Assessment Guide" to find ways to reduce water use

DRAINAGE

DRAINAGE ENVIRONMENTAL CONCERNS

Primary environmental concerns related to drainage systems are:

- Disturbances during drain system installation and maintenance that results in impacts to water quality, aquatic life and habitat loss.
- Poor drainage discharge water quality that results in water pollution.
- Drainage discharge water quantity that results in increased watercourse flow and erosion.
- Drainage of wetlands or peat land that accelerate soil carbon losses contributing to climate change.
- Poorly designed or maintained drainage systems that do not prevent soil saturation resulting in nitrous oxide emissions, a powerful greenhouse gas contributing to climate change.

For information on these concerns:

➔ see Water Quality and Quantity Factors, **page 9-1,** and refer to all sections

➔ see Impacts on Biodiversity and Habitat, **page 7-7**, and refer to Farm Activities and Impacts

➔ Climate Change Adaptation, **page 12-15**

DRAINAGE LEGISLATION

The following is a brief outline of the main legislation that applies to drainage.

➔ see **page A-1** for a summary of these and other Acts and Regulations

Drinking Water Protection Act

This Act and Regulations have requirements regarding the protection of drinking water quality and regulate domestic water systems (those serving ***more*** than one single-family residence).

- SECTION 6: requires water suppliers to provide potable water to water users.
- SECTION 23(1): subject to subsection (3), a person must not (a) introduce anything or cause or allow anything to be introduced into a domestic water system, a drinking water source, a well recharge zone or an area adjacent to a drinking water source, or (b) do or cause any other thing to be done or to occur if this will result or is likely to result in a drinking water health hazard in relation to a domestic water system.

Environmental Management Act

The *Code of Practice for Agricultural Environmental Management* requires persons to use environmentally responsible and sustainable agricultural practices when carrying out agricutural operations, for the purpose of minimizing the introduction of waste into the environment and preventing adverse impacts to the environment and human health.

The *Code of Practice for Agricultural Environmental Management* has requirements, described in other sections of this Reference Guide, to prevent contaminated runoff from entering watercourses.

Watercourses are are defined to include:

a) An area of land that perennially or intermittently contains surface water, other than:
   - Puddles.
   - Groundwater and dugout ponds for livestock watering; and
   - Furrows, grassed waterways and other temporary ponded areas that are normally farmed, and

b) Drainage ditches that lead to an area described in paragraph (a).

- SECTION 47: Wood residue must not be used:
  - For the construction of berms;
  - As an envelope for tile drains;
  - As fill or to level a site;
  - To create an access way through a watercourse.

Water Sustainability Act

The *Water Sustainability Act* (WSA) is the principal law for managing the diversion and use of water resources. Non-domestic groundwater users are required to apply for a water licence to maintain their right to use groundwater.

- SECTION 6: Prohibits diverting water without a licence except in limited circumstances for fire suppression, domestic use and mineral prospecting.
- SECTION 11: Requires approvals for making changes in and about streams.
- SECTIONS 16 & 17: May require mitigation measures on (sensitive) streams where a water diversion or use is authorized.
- SECTION 45: No new dams on protected rivers.
- SECTION 128: Regulations respecting sensitive streams.

Under the WSA, no person may divert water from surface water or from an aquifer unless the person holds an authorization or the diversion and use of water is allowed by the Act or under a regulation. An authorization can take the form of a "use approval", which allows for short term use of water for up to 24 months, or a water licence which establishes a long term water right. Authorization holders have some responsibilities including the need to pay water fees and rentals and make beneficial use of the water they are authorized to divert, store and use.

In most cases, any person who diverts water for use or storage must apply to the Province for the right to use the water and pay an annual rental fee for that use. The requirement for groundwater licensing for non-domestic (e.g., farm or business use) came into force on February 29, 2016 and applies to new groundwater users as well as those who began using groundwater prior to February 29, 2016.

Drainage requires a licence for "land improvement purpose". Approval is required for "works in and about a stream" such as open channels that allow water to flow into watercourses.

Apply for a Water Licence

Wildlife Act

The provincial *Wildlife Act* protects wildlife designated under the Act from direct harm, except as allowed by regulation (e.g., hunting or trapping), or under permit. Legal designation as Endangered or Threatened under the Act increases the penalties for harming a species. The Act also enables the protection of habitat in a Critical Wildlife Management Area.

Fisheries Act

Administered by both Fisheries and Oceans Canada and Environment and Climate Change Canada, this Act is established to manage Canada's fisheries resources, including fish habitat. The Act can also be administered provincially by FLNRORD and ENV. The Act applies to all Canadian waters that contain fish, including ditches, channelized streams, creeks, rivers, marshes, lakes, estuaries, coastal waters and marine offshore areas. It also applies to seasonally wetted areas that provide fish habitat such as shorelines, stream banks, floodplains, intermittent tributaries and privately owned land. The Act includes provisions for stiff fines and imprisonment to ensure compliance.

The purpose of this Act is to provide a framework for (a) the proper management and control of fisheries; and (b) the conservation and protection of fish and fish habitat, by preventing pollution.

This Act was updated in 2019 and now empowers the Minister to make regulations for the purposes of the conservation and protection of biodiversity.

The definition of fish habitat is: "water frequented by fish and any other areas on which fish depend directly or indirectly to carry out their life processes, including spawning grounds and nursery, rearing, food supply and migration areas". The quantity, timing and quality of the water flow that are necessary to sustain fish habitat are also deemed to be a fish habitat. Furthermore, serious harm to fish includes the death of fish or any permanent alteration to, or destruction of, fish habitat.

Provisions of the *2019 Fisheries Act* relevant to agricultural operations include:

- Protection for all fish and fish habitats;
- Prohibition against the death of fish or the 'harmful alteration, disruption or destruction of fish habitat';
- A permitting framework and codes of practice to improve management of large and small projects impacting fish and fish habitat;
- Protection of fish and/or fish habitats that are sensitive, highly productive, rare or unique; and
- Consideration for the cumulative effects of development activities on fish and fish habitat.

Specific sections of the Act include:

SECTION 34.2(1) The Minister may establish standards and codes of practice for:

(a) The avoidance of death to fish and harmful alteration, disruption or destruction of fish habitat;

(b) The conservation and protection of fish or fish habitat; and

(c) The prevention of pollution.

SECTION 34.4(1) No person shall carry on any work, undertaking or activity, other than fishing, that results in the death of fish.

SECTION 35 (1) No person shall carry on any work, undertaking or activity that results in the harmful alteration, disruption or destruction of fish habitat.

Every person who contravenes subsection 34.4(1) or 35(1) is guilty of an offence and liable.

Notifying authorities about serious harm to fish or deposit of a deleterious substance:

SECTION 38 (4.1) Every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations of a harmful alteration, disruption or destruction of fish habitat that is not authorized under this Act, or of a serious and imminent danger of such an occurrence, if the person at any material time:

(a) Owns or has the charge, management or control of the work, undertaking or activity that resulted in the occurrence or the danger of the occurrence; or

(b) Causes or contributes to the occurrence or the danger of the occurrence.

SECTION 38 (5) If there occurs a deposit of a deleterious substance in water frequented by fish that is not authorized under this Act, or if there is a serious and imminent danger of such an occurrence, and detriment to fish habitat or fish or to the use by humans of fish results or may reasonably be expected to result from the occurrence, then every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations.

SECTION 38 (7) As soon as feasible after the occurrence or after learning of the danger of the occurrence, the person shall provide an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations with a written report on the occurrence or danger of the occurrence.

Species at Risk Act

This Act has sections that protect listed species, their residence and critical habitat. It applies to federal lands, internal waters (i.e., all watercourses), territorial sea of Canada, and the air space above them.

The provisions of the *Species at Risk Act* (known as the 'safety net') could be invoked on BC crown and private lands using a federal order under the Act if provincial action is not sufficient to protect listed species.

On private land, unless an order is made by the government, the SARA prohibitions apply only to:

- Aquatic species at risk; and
- Migratory birds listed in the *Migratory Birds Convention Act, 1994* and also listed as endangered, threatened or extirpated in Schedule 1 of the Act.

DRAINAGE BENEFICIAL MANAGEMENT PRACTICES

Crops generally require moderately to well-drained soils for proper growth. Adequate drainage increases soil strength, trafficability and nutrient uptake by the crop. In the BC Interior, drainage also serves as an important purpose of controlling soil salinity and alkalinity. In South Coastal BC, most soil and topographic conditions require subsurface drainage to reduce saturation of the crop root zone, to reduce soil compaction, to reduce overland flow and to control erosion. Proper drainage ensures nitrogen in fertilizer and manure additions is not converted into nitrous oxide, a very powerful greenhouse gas.

Generally, improved subsurface drainage reduces overland flow, which in turn can reduce the potential transport of contaminants, including pesticides, fertilizers and soil particles, to surface waters.

Drainage System

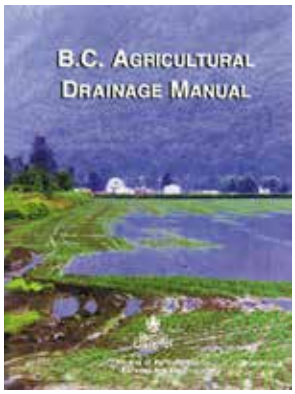
Plants growing in soils with good drainage are more capable to take up nutrients from the soil and water, reducing leaching of nutrients. A drainage system may consist of a combination of land grading improvements, ditches, subsurface drain pipes and pumping systems. A site-specific design produced by a qualified soil and drainage specialist is highly recommended to ensure that subsurface systems are matched to specific soil conditions and plant rooting requirements. A well-designed system will improve the trafficability of soils, reduce the delay time for re-entry to fields after rainfall, and increase the growing season.

Agricultural drainage criteria were developed under the Agricultural and Rural Development Subsidiary Agreement (ARDSA), and are commonly referred to as ARDSA criteria or the Agricultural Drainage Criteria. These criteria describe the level of drainage required to allow for proper on-farm drainage, and help to improve regional drainage in agricultural lands:

- The runoff from a 10-year, 5-day storm must be removed within 5 days in the dormant period (November 1 to February 28).
- The runoff from a 10-year, 2-day storm must be removed within 2 days in the growing period (March 1 to October 31).
- Between storm events and in periods when drainage is required, the base flow in channels must be maintained at 1.2 m below field elevation.
- The conveyance system must be sized appropriately for both base flow and design storm flow.

Implement the following practices:

- Design subsurface drainage systems for the specific soil conditions and plant rooting requirements.
- Avoid the use of wood residue as porous backfill around subsurface drains to prevent any potential of leachate contaminating drainage discharge water.
- Install interceptor drains to reduce concentrated overland flow.
- Grade land to eliminate low areas where water can pond to improve field access and trafficability (done in a manner that prevents soil degradation).
- Grade land to reduce surface ponding (these are not wetlands but rather shallow depressions in a field) which attract unwanted wildlife such as ducks, thus avoiding further soil degradation from puddling by the ducks.
- Install permanent drop structures in channels to allow water to flow gently without causing erosion.
- Where feasible, link drainage system to farm water supply infrastructure. See Linking Drainage and Water Supply, **page 9-13.**



B.C. Agriculture Drainage Manual

Drainage Management Guide

Factsheet 535.100-2 Agricultural Drainage Criteria

BC Agriculture & Food Climate Action Initiative Drainage Resources

Subsurface Drainage System. Maintenance of subsurface drains and outlets is important for the benefits of drainage. A subsurface drainage system is used to improve drainage and reduce surface flow as quickly as possible. Any clogging of drains or obstruction of outlets will increase the potential for surface flow that could cause environmental problems.

Subsurface drainage can also be designed and operated to control the water table level within desired ranges. Some of the environmental benefits of controlled drainage are that:

- The system allows drainage water to be held back when drainage is not required, thus the subsurface drainage acts as subsurface irrigation, reducing water requirements and recycling nutrients that would otherwise leach out into the drain water.
- Drains can be closed if there is a potential for unwanted preferential flow.

➔ see Preferential Flow, **page 9-49**

B.C. Agricultural Drainage Manual: Chapter 10 (Subsurface Drainage Design)

Drainage and Sub-Irrigation as a Climate Change Adaptation Strategy

Factsheet 532.000-2 Special Care in the Installation of Subsurface Drainage on Sloping Land

Surface Drainage System. To maintain drainage ditches in a free-flowing condition, implement the following practices:

- Keep grades shallow to reduce erosion.
- Slope ditch banks shallow enough to prevent slumping and erosion.
  - sandy soils require shallower slopes than clay soils.
- Protect ditch banks, particularly those in sandy soils, against erosion with crushed rock, gravel or effective, permanent cover crops.
  - Grasses provide better cover than broadleaf weeds and reduce spread of weeds.
- Establish buffer strips to filter sediments before they reach the ditch.

➔ see Buffers, **page 11-4**

- If despite implementing the above, sediment and vegetation continue to restrict flow, then clean to remove materials as required to maintain flow.

Drainage Systems Operation and Maintenance

The following drainage information covers basic concerns. For more detailed information, refer to the ***Drainage Management Guide*** publication below.

Drainage Management Guide is a publication that forms part of the Environmental Farm Plan series on Beneficial Management Practices. Its purpose is to ensure drainage systems are operated and maintained in an environmentally correct manner. This publication contains more detailed information and is recommended for use by producers with surface drainage systems such as ditches, or with subsurface systems, that drain into areas with fish and fish habitat

Below is an overview of the general steps required before working in and around a stream. Please check with the agencies for up-to-date approval process.

- Identify the drainage maintenance needs.
- Classify the watercourse.
- Review and determine the agency approval process for the type of work.
- Determine the timing window when the work will be done.
- Follow the required conditions for the watercourse and work to be done.

Factsheet 823.400-1 Agricultural Building Setbacks from Watercourses in Farming Areas

Working Around Water

Agricultural Watercourse Classification. Three watercourse classifications, as shown in **Figure 9.3** below, are used to define agricultural watercourses. They are based on physical and hydrological parameters. The presence or absence of fish must also be determined.

- **constructed ditches:** have no headwaters, carry water from local surface areas or subsurface drains and may be permanently or intermittently wetted; such ditches are primarily constructed for the purpose of removing excess water from farmland in order to improve crop production and farm viability
- **channelized streams:** have headwaters, are permanent or relocated streams, often situated along property boundaries, that have been diverted, dredged, straightened and/or dyked
- **natural streams:** historic watercourses that have not been altered for extended periods of time,

Factsheet 533.500-1 Agricultural Watercourse Classification

Agency Approval. The classification of a watercourse and the type of work to be done in the watercourse determines the agency approval required. Approvals may be needed from Fisheries and Oceans Canada or ENV.

Working Around Water

Timing Window. An instream work 'Timing Window' is a time when fish species are at a stage in their life cycle when they are least sensitive to disturbances should any occur from maintenance work. These windows are set by the type of watercourse, its condition, and its location in BC.

Working Around Water

Channelized Steam

Channelized Steam

Natural Steam

Constructed Ditch

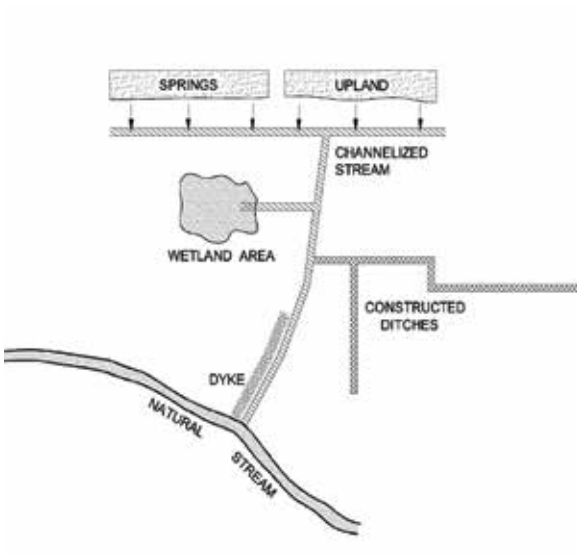


FIGURE 9.3 Watercourse Classification

Drainage Water Quality

There are practices that can reduce the impacts to drainage water in watercourses by surface contaminants reaching the drainage discharge through preferential flow pathways to drain tiles (see Preferential Flow below), or by wood residue leachate used in constructing the drainage system.

Poor-quality drain water can be eliminated or controlled by implementing the following practices:

- Keep contaminants from entering drainage systems.
- Install a controlled drainage system with the capacity of isolating and managing contaminated runoff.

  ➔ see Collecting and Storing Contaminated Water, **page 9-54**

  Controlled Drainage/Subirrigation
- Plant a vegetative strip along the channel to filter contaminants before reaching the drainage system.

  ➔ see Buffers , **page 11-4**

Preferential Flow or Macropore Flow. Preferential flow occurs when holes or cavities created by worms, mice, or moles lead directly from the ground surface to subsurface drainage tiles, as shown in Figure 9.4, next page. In this situation, freshly-spread liquid manure may freely flow through the soil into subsurface drainage tiles and from there to watercourses causing a risk of pollution.

Where there is a risk of macropore flow, implement the following practices:

- Do not spread manure on grass or bare fields when fields are wet and tile drains are running.
- Cultivate bare fields to break up macropores shortly before spreading manure (preferably within 24 hours).
- Reduce one-time manure application rates to 40 m^3/ha or less.
- If contamination still occurs, it may be necessary to block the outflow or contain the contaminated drain water in a collection pond.

Preferential or macropore flow may increase phosphorus levels in drainage water, even if manure is not discharged through the drains. The risk of phosphorus transport through tile drains decreases if soil phosphorus levels are managed at or below levels required for crop production (see **Chapter 6** for beneficial management practices). The risk also decreases if controlled tile drainage is installed, which may be more practical on some sites than others.

➔ see the Subsurface Drainage Systems, **page 6-28**.

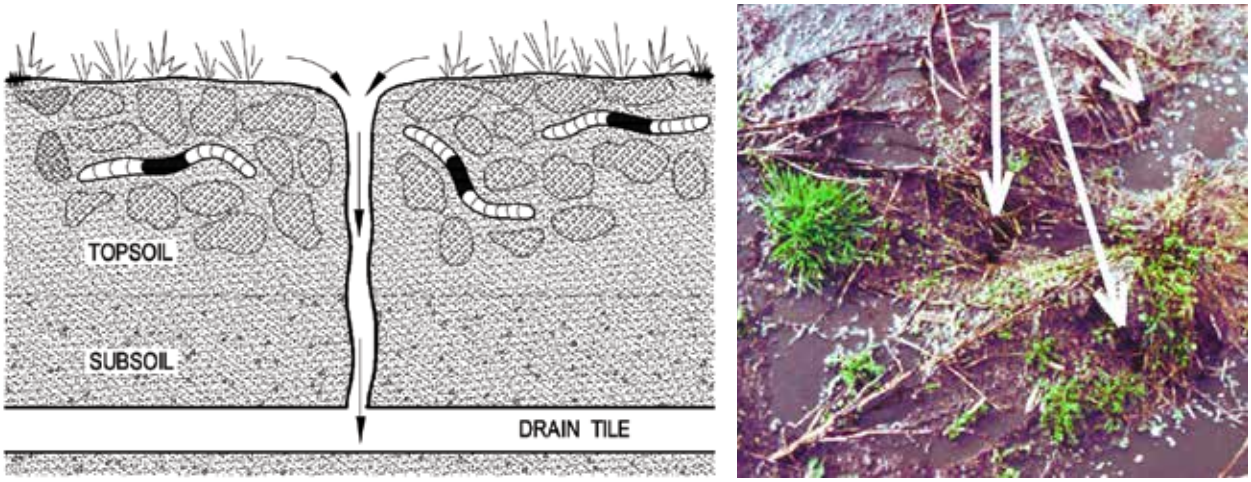


FIGURE 9.4 Preferred Flow or Macropore Flow (Surface Water Flow Directly to Drain Tiles)

Wood Residue. Monitor systems that were constructed in the past using wood residue as backfill during the first few years to determine if wood residue leachate in the drain water poses a pollution risk. Drainage water containing wood residue leachate cannot be released into a watercourse. Wood residue must not be used as fill in new drainage systems.

➔ see Wood Residue, **page 2-37**

Monitoring. Monitor the water quality in drainage system outlets on a regular basis, particularly after a long dry spell and after manure has been applied. Such monitoring should determine if farm practices are contributing contaminants, such as, nutrients and pathogens to watercourses.

RUNOFF

For the purposes of this publication, stormwater originates as rainfall precipitation and is one source of runoff. Runoff (also called overland flow) is that portion of stormwater, snowmelt or irrigation water that moves across the land as surface water flow.

RUNOFF ENVIRONMENTAL CONCERNS

Primary environmental concerns related to runoff are:

- Increased peak stream flow due to on-farm impervious areas that results in flooding downstream, erosion of stream banks, etc.
- Runoff water that becomes contaminated that results in pollution.

For information on these concerns:

➔ see Water Quality and Quantity Factors, **page 9-1,** and refer to all sections

➔ see Impacts on Biodiversity and Habitat, **page 7-7**, and refer to Farm Activities and Impacts

RUNOFF LEGISLATION

The following is a brief outline of the main legislation that applies to runoff.

➔ see **page A-1** for a summary of these and other Acts and Regulations

Local Bylaws

There may be local bylaws concerning stormwater management, such as, lot coverage or retention/detention pond construction details that need to be met.

Drinking Water Protection Act

This Act and Regulations have requirements regarding the protection of drinking water quality and regulate domestic water systems (those serving ***more*** than one single-family residence).

- SECTION 6: requires water suppliers to provide potable water to water users.
- SECTION 23(1): subject to subsection (3), a person must not:
  - (a) Introduce anything or cause or allow anything to be introduced into a domestic water system, a drinking water source, a well recharge zone or an area adjacent to a drinking water source, or
  - (b) Do or cause any other thing to be done or to occur if this will result or is likely to result in a drinking water health hazard in relation to a domestic water system.

Environmental Management Act

The *Code of Practice for Agricultural Environmental Management* (AEM Code) requires persons to use environmentally responsible and sustainable agricultural practices when carrying out agricultural operations, for the purpose of minimizing the introduction of waste into the environment and preventing adverse impacts to the environment and human health.

The Code of Practice for Agricultural Environmental Management under the Act defines "runoff" and "contaminated runoff" as follows:

- Runoff is water that flows along the surface of the ground and it may come from equipment, washing, precipitation, and meltwater.
- Contaminated runoff means "runoff that contains suspended or dissolved nutrients, pathogens or other substances after contact with agricultural by-products, leachate or other organic matter or pesticides".

Various SECTIONS of the *The Code of Practice for Agricultural Environmental Management* require that runoff must be diverted from particular storages, structures or processes:

- SECTION 34: storage of agricultural by-products;
- SECTION 38: on-ground under-pen storages;
- SECTIONS 40 AND 71: agricultural composting;
- SECTION 46: storage of wood residues;
- SECTION 63: feedlots;
- SECTION 74: burial pits for slaughter, mortalities and processing waste.
- In addition, the above sections (except Section 63, Feedlots), and the following sections of the AEM code, have requirements for managing contaminated runoff:
- SECTIONS 49 AND 52: nutrient application;
- SECTIONS 62 AND 64: confined livestock or poultry areas, seasonal feeding, grazing and temporary holding areas (Chapter 3);
- SECTIONS 68 AND 74: slaughter, mortalities and processing waste;
- SECTION 77: agricultural products;
- SECTION 77.1: pesticides.

In most cases, the requirements are to prevent contaminated runoff from entering a watercourse, crossing a property boundary or going below the water table. In some cases, there are specific requirements to collect and contain contaminated runoff.

SECTION 78 has requirements for the treatment of contaminated runoff, including notification requirements for existing and modified or new treatment systems. Before modifying or constructing a treatment system, a qualified professional must prepare the designs and plans and approval from ENV is required.

Fisheries Act

Administered by both Fisheries and Oceans Canada and Environment and Climate Change Canada, this Act is established to manage Canada's fisheries resources, including fish habitat. The Act can also be administered provincially by FLNRORD and ENV. The Act applies to all Canadian waters that contain fish, including ditches, channelized streams, creeks, rivers, marshes, lakes, estuaries, coastal waters and marine offshore areas. It also applies to seasonally wetted areas that provide fish habitat such as shorelines, stream banks, floodplains, intermittent tributaries and privately owned land. The Act includes provisions for stiff fines and imprisonment to ensure compliance.

The purpose of this Act is to provide a framework for (a) the proper management and control of fisheries; and (b) the conservation and protection of fish and fish habitat, including by preventing pollution.

This Act was updated in 2019 and now empowers the Minister to make regulations for the purposes of the conservation and protection of biodiversity.

The definition of fish habitat is: "water frequented by fish and any other areas on which fish depend directly or indirectly to carry out their life processes, including spawning grounds and nursery, rearing, food supply and migration areas". The quantity, timing and quality of the water flow that are necessary to sustain fish habitat are also deemed to be a fish habitat. Furthermore, serious harm to fish includes the death of fish or any permanent alteration to, or destruction of, fish habitat.

Provisions of the *2019 Fisheries Act* relevant to agricultural operations include:

- Protection for all fish and fish habitats;
- Prohibition against the death of fish or the 'harmful alteration, disruption or destruction of fish habitat';
- A permitting framework and codes of practice to improve management of large and small projects impacting fish and fish habitat;
- Protection of fish and/or fish habitats that are sensitive, highly productive, rare or unique; and
- Consideration for the cumulative effects of development activities on fish and fish habitat.

Specific sections of the Act include:

SECTION 34.2(1) The Minister may establish standards and codes of practice for:

(a) The avoidance of death to fish and harmful alteration, disruption or destruction of fish habitat;

(b) The conservation and protection of fish or fish habitat; and

(c) The prevention of pollution.

SECTION 34.4(1) No person shall carry on any work, undertaking or activity, other than fishing, that results in the death of fish.

SECTION 35 (1) No person shall carry on any work, undertaking or activity that results in the harmful alteration, disruption or destruction of fish habitat.

Every person who contravenes subsection 34.4(1) or 35(1) is guilty of an offence and liable.

Notifying authorities about serious harm to fish or deposit of a deleterious substance:

SECTION 38 (4.1) Every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations of a harmful alteration, disruption or destruction of fish habitat that is not authorized under this Act, or of a serious and imminent danger of such an occurrence, if the person at any material time.

(a) Owns or has the charge, management or control of the work, undertaking or activity that resulted in the occurrence or the danger of the occurrence; or

(b) Causes or contributes to the occurrence or the danger of the occurrence.

SECTION 38 (5) If there occurs a deposit of a deleterious substance in water frequented by fish that is not authorized under this Act, or if there is a serious and imminent danger of such an occurrence, and detriment to fish habitat or fish or to the use by humans of fish results or may reasonably be expected to result from the occurrence, then every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations.

SECTION 38 (7) As soon as feasible after the occurrence or after learning of the danger of the occurrence, the person shall provide an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations with a written report on the occurrence or danger of the occurrence.

Migratory Birds Convention Act

This Act has a section of importance to runoff concerns:

- SECTION 35(1): prohibits the deposit of any substance harmful to migratory birds in any waters frequented by migratory birds.

RUNOFF BENEFICIAL MANAGEMENT PRACTICES

Comply with applicable runoff related legislation, including the above, and where appropriate, implement the following beneficial management practices to protect the environment.

Producers must ensure that the quality of surface water leaving or passing by the farm is not polluted by farm operations. The most effective practice in preventing water pollution is to eliminate runoff flows from contacting sources of contamination, such as, manure. This is often done by diversion of runoff away from these sources, such as, upland flow ditched away from yards, or roof water directed away using gutters. Where feasible, link storm water control systems to farm water supply infrastructure.

➔ See Linking Drainage and Water Supply, **page 9-13**

Runoff Flow Factors

The velocity and volume of runoff flows are affected by:

- The length and grade of a slope.
- The aspect or direction a slope faces.
  - South facing slopes can have quick snow melt events.
- The soil surface texture which affects the smoothness of terrain.
- The type of crop or volume of crop residue which also affects the smoothness of terrain.

Runoff Flow Management

Stormwater Peak Flow. Stormwater originates from rainfall events. Where development on a farm has increased the impermeable areas of roofs and hard-surface roads to greater than 10% of the total land area or 2 ha (suggested), manage stormwater to reduce flows to pre-development levels. On-farm detention ponds are most commonly used to reduce such peak flows.

Snowmelt. Snowmelt runoff risk is increased in the presence of fine-textured soils, frozen soils and low crop residue levels. Also, the risk is higher for south-facing slopes and increases as slopes increase in steepness and length. Limit the amount of agricultural waste spread on land in the fall, where the risk of snowmelt runoff is high.

➔ see **Tables 6.9** and **6.10**, Monthly Manure Spreading Practices, pages **6-21** and **6-22**

Preventing Surface Water Contamination. If runoff water becomes polluted, it must be managed as contaminated water. Because the treatment of contaminated water typically entails considerable effort and expense, it is usually preferable to prevent the generation of contaminated water in the first place. Use the following principle:

Keep clean water away from sources of contamination;
Keep sources of contamination away from clean water.

To protect surface water quality, implement the following practices:

- Reduce the volume of contaminated water to be collected by using perimeter diversion ditches to divert clean runoff around outdoor livestock areas, manure, wood residue, pesticide and fertilizer storage areas, wells and springs.
- Construct impermeable berms to prevent water that has become contaminated from entering watercourses.
- Reduce the amount of runoff water by:
  - Planting cover crops to improve the infiltration rate of water.
  - Ensuring that subsurface drainage systems work as designed.
- Establish and maintain adequate vegetative buffers around watercourses to:
  - Keep suspended or dissolved contaminates from causing pollution.
  - Reduce nuisance impacts on neighbours.
  - Intercept quantities of runoff.

➔ see Buffers, **page 11-4**

Contaminated Runoff Collection, Storage and Use

Water may contain farm contaminants, such as, manure, soil, pesticides, petroleum and fertilizer. Contaminated runoff must be handled as a potential pollutant. To determine the impact of such runoff entering watercourses, samples may need to be collected upstream and downstream of the source of the runoff for laboratory analysis. Contact the water-testing laboratory to find out how to collect representative samples. For help to determine if contaminated runoff is negatively affecting stream water quality and polluting, various criteria must be examined.

British Columbia Approved Water Quality Guidelines

Water Quality Evaluation of Agricultural Runoff in the Lower Fraser Valley

British Columbia Water Quality – Human Health and Ecosystem Health website

Collecting Contaminated Runoff. Implement the following practices to collect contaminated water from these three common sources:

- From outdoor areas, use berms or grade the area with a slope of 2 to 4% to direct water to run into a collection basin or manure pit for reuse (take this extra volume into account when sizing manure pits).
- From drainage systems, be able to isolate and close the drainage system to store water.
- From irrigation runoff, divert surface runoff to a reservoir for reuse and improve the irrigation system.

Storing Contaminated Runoff. Contaminated water that cannot be immediately used must be stored in a secure facility until it can be disposed of or used in an environmentally sound manner. For example, it would not be unusual that some winter and spring runoff originating from confined livestock areas would be contaminated. Storage in such cases is essential until the waste can be properly applied to cropland in the spring or summer.

Depending on soil conditions, contaminated water storages may be earth lined in clayey areas, and impervious materials such as plastic or concrete will be required in coarser soils. Siting considerations are similar to those for manure storages:

- Locate storages with the following setback distances:
  - At least 30 m from drinking water source (the *Code of Practice for Agricultural Environmental Management*).
  - At least 15 m from the high water mark of a watercourse, other than a point of diversion used for a drinking water source (the *Code of Practice for Agricultural Environmental Management*).
  - At least 30 m from wells (*Health Hazards Regulation*).

➔ see Manure Storage – Storage Facilities, **page 3-31**

Sizing Contaminated Runoff Storage. Contaminated water must be stored to avoid application on snow or frozen ground. Under most Southern BC conditions, storage is required during the six months of October to March inclusive. In Northern BC, a minimum seven months of storage, October to April inclusive is recommended to accommodate the shorter season available for spreading. **Appendix Table B.1, page B-3,** shows the six and seven month precipitation values for areas of BC. Where appropriate, retain the services of a hydrologist to ensure proper sizing of a storage facility.

The size of a collection basin for contaminated runoff depends on:

- The amount of precipitation that occurs during the storage period.
- The farm area directly influenced by the material of contamination.
- The type of ground cover on the drainage area.
- The amount of offsite runoff entering a contaminated area.

To obtain an initial approximation for design of storage of contaminated runoff from outdoor livestock areas (where no offsite surface water enters the area), use **Worksheet #11, page 9-57**:

- Design storage capacity is based on the most winter precipitation expected in 25 years (recommended).
- The winter storage period (either 6 or 7 months) depends on when the storage can be emptied in the spring.
- During the growing months of May to October, sizing considerations do not come into play as contaminated runoff can be directly applied to cropland.

Using Contaminated Runoff. If contaminated runoff has been collected it must be disposed of so as not to pose a pollution risk to humans, livestock or water quality. The specifics of disposal depend on the types of contaminants in the water. Contact ENV if you are uncertain of appropriate disposal method.

If the contaminant is **manure or fertilizer**, spread the affected water onto cropland as outlined in Nutrient Application, **page 6-10**.

If the contaminant is **wood residue,** spread the affected water as irrigation onto cropland that readily allows infiltration. It is critical that the water be spread to avoid over-irrigation, so that toxicants in the water are in contact with soil surfaces for natural processes to reduce the load of toxicants. See the Irrigation section starting on **page 9-21** for guidance.

If the contaminant is mainly **eroded soil,** settled solids may be applied to land, with the remaining liquid applied as irrigation water.

If the contaminants are **petroleum and pesticides**, test the water for the degree of contamination. If resulting quality standards are not met, treat the water before reuse or release, following legislative requirements as applicable under SECTION 78 of the *Code of Practice for Agricultural Environmental Management*.

- Water Quality Evaluation of Agricultural Runoff in the Lower Fraser Valley
- Canadian Drinking Water Guidelines
- Centre for Disease Control: Agricultural Water Contamination

WORKSHEET #11
Confined Livestock Area
Determining Volume of Contaminated Runoff from Outside Yard

Workbook Question 331

Question: **What volume of contaminated water will need to be stored over the winter?**

Information:

Area of confined livestock site		300	1	m^2
Type of surface:	hard surface, frozen land or roof	hard		
Select site (Table B.1*):	Abbotsford	1.54	2	m

Calculation: **Calculate storage area for type of yard surface**

Method 1. For hard surface, frozen land or roof areas

EQUATION: Volume

1.0	x	Area	x	Total Winter Precipitation	=	Volume
1.0	x	300 (1) m^2	x	1.54 (2) m	=	462 (3)

Method 2. For soil based yards

EQUATION: Volume

0.9	x	Area	x	Total Winter Precipitation	=	Volume
0.9	x	300 (1) m^2	x	1.54 (2) m	=	462 (3) m^3

Method 3. For crop land (not frozen)

EQUATION: Volume

0.6	x	Area	x	Total Winter Precipitation	=	Volume
0.6	x	300 (1) m^2	x	1.54 (2) m	=	277 (3) m^3

Answer:

This farm will require a contaminated water storage facility to hold 462 m^3 of contaminated water expected from the outside yard area.

Note: Refer to Tables in BC Environmental Farm Plan Reference Guide

LEACHATE

Leachate is produced from water moving through a material, such as wood residue or manure, creating a contaminated liquid. Leachate can move over the soil surface to surface water or through the soil to groundwater.

LEACHATE ENVIRONMENTAL CONCERNS

Primary environmental concerns related to leachate are: contamination reaching groundwater or surface water that results in water pollution

For information on these concerns:

➔ see Water Quality and Quantity Factors, **page 9-1**, and refer to all sections

LEACHATE LEGISLATION

The following is a brief outline of the main legislation that applies to leachate.

➔ see **page A-1** for a summary of these and other Acts and Regulations

Drinking Water Protection Act

This Act and Regulations have requirements regarding the protection of drinking water quality and regulate domestic water systems (those serving ***more*** than one single-family residence).

- SECTION 6: requires water suppliers to provide potable water to water users.
- SECTION 23(1): subject to subsection (3), a person must not (a) introduce anything or cause or allow anything to be introduced into a domestic water system, a drinking water source, a well recharge zone or an area adjacent to a drinking water source, or (b) do or cause any other thing to be done or to occur if this will result or is likely to result in a drinking water health hazard in relation to a domestic water system.

Environmental Management Act

The *Code of Practice for Agricultural Environmental Management* under the Act defines leachate as follows:

- Concentrated liquid originating from agricultural by-products, wood residue or other organic matter.

Various SECTIONS of the *Code of Practice for Agricultural Environmental Management* require that leachate does not enter a watercourse or go below the water table:

- SECTION 34: storage of agricultural by-products;
- SECTION 38: on-ground under-pen storages;
- SECTIONS 40 AND 71: agricultural composting;
- SECTION 46: storage of wood residues;
- SECTIONS 49, 51 AND 52: nutrient application;

- SECTIONS 62, 63 AND 64: confined livestock or poultry areas, feedlots, and seasonal feeding, grazing and temporary holding areas;
- SECTIONS 68, 69 AND 74: slaughter, mortalities and processing waste;
- SECTION 77: agricultural products.

SECTION 78 has requirements for the treatment of leachate including notification requirements for existing and modified or new treatment systems. Before modifying or constructing a treatment system, a qualified professional must prepare the designs and plans and approval from ENV is required.

Public Health Act

Part 3, Division 1: Preventing Disease and other Health Hazards.

15: A person must not willingly cause a health hazard, or act in a manner that the person knows, or ought to know, will cause a health hazard.

Health Hazard Regulation regulates the distance of wells from possible source of contamination

- SECTION 8(1): provides separation distance of wells to be at least 30 m from any probable source of contamination.

Fisheries Act

Administered by both Fisheries and Oceans Canada and Environment and Climate Change Canada, this Act is established to manage Canada's fisheries resources, including fish habitat. The Act can also be administered provincially by FLNRORD and ENV. The Act applies to all Canadian waters that contain fish, including ditches, channelized streams, creeks, rivers, marshes, lakes, estuaries, coastal waters and marine offshore areas. It also applies to seasonally wetted areas that provide fish habitat such as shorelines, stream banks, floodplains, intermittent tributaries and privately owned land. The Act includes provisions for stiff fines and imprisonment to ensure compliance.

The purpose of this Act is to provide a framework for (a) the proper management and control of fisheries; and (b) the conservation and protection of fish and fish habitat, including by preventing pollution.

This Act was updated in 2019 and now empowers the Minister to make regulations for the purposes of the conservation and protection of biodiversity.

The definition of fish habitat is: "water frequented by fish and any other areas on which fish depend directly or indirectly to carry out their life processes, including spawning grounds and nursery, rearing, food supply and migration areas". The quantity, timing and quality of the water flow that are necessary to sustain fish habitat are also deemed to be a fish habitat. Furthermore, serious harm to fish includes the death of fish or any permanent alteration to, or destruction of, fish habitat.

Provisions of the *2019 Fisheries Act* relevant to agricultural operations include:

- Protection for all fish and fish habitats;
- Prohibition against the death of fish or the 'harmful alteration, disruption or destruction of fish habitat';
- A permitting framework and codes of practice to improve management of large and small projects impacting fish and fish habitat;
- Protection of fish and/or fish habitats that are sensitive, highly productive, rare or unique; and
- Consideration for the cumulative effects of development activities on fish and fish habitat.

Specific sections of the Act include:

SECTION 34.2(1) The Minister may establish standards and codes of practice for:

(a) The avoidance of death to fish and harmful alteration, disruption or destruction of fish habitat;

(b) The conservation and protection of fish or fish habitat; and

(c) The prevention of pollution.

SECTION 34.4(1) No person shall carry on any work, undertaking or activity, other than fishing, that results in the death of fish.

SECTION 35 (1) No person shall carry on any work, undertaking or activity that results in the harmful alteration, disruption or destruction of fish habitat.

Every person who contravenes subsection 34.4(1) or 35(1) is guilty of an offence and liable.

Notifying authorities about serious harm to fish or deposit of a deleterious substance:

SECTION 38 (4.1) Every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations of a harmful alteration, disruption or destruction of fish habitat that is not authorized under this Act, or of a serious and imminent danger of such an occurrence, if the person at any material time.

(a) Owns or has the charge, management or control of the work, undertaking or activity that resulted in the occurrence or the danger of the occurrence; or

(b) Causes or contributes to the occurrence or the danger of the occurrence.

SECTION 38 (5) If there occurs a deposit of a deleterious substance in water frequented by fish that is not authorized under this Act, or if there is a serious and imminent danger of such an occurrence, and detriment to fish habitat or fish or to the use by humans of fish results or may reasonably be expected to result from the occurrence, then every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations.

SECTION 38 (7) As soon as feasible after the occurrence or after learning of the danger of the occurrence, the person shall provide an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations with a written report on the occurrence or danger of the occurrence.

LEACHATE BENEFICIAL MANAGEMENT PRACTICES

Leachate Sources

Leachate can be generated from water moving through any material that contains soluble components or degrades or decomposes in the presence of water. Materials that can be sources of leachate can be split into two broad classes, those that are mainly organic (e.g., wood residue, silage, manure, and compost), and those that are mainly inorganic (e.g., fertilizer, pesticides and farm waste). In general, the more rapidly a material releases soluble compounds (or nutrients) to water, the greater the risk of an environmental impact. For more information on the sources of material that may produce leachate, see the following sections:

- ➔ see Farm Waste, **page 2-19**
- ➔ see Chemical Fertilizer, **page 2-26**
- ➔ see Wood Residue, **page 2-40**
- ➔ see Compost, **page 2-48**
- ➔ see Manure Handling and Storage, **page 3-25**
- ➔ see Mortality Disposal, **page 3-49**
- ➔ see Forage Crop Storage, **page 4-14**
- ➔ see Greenhouse, Container Nursery and Mushrooms, **pages 4-22** and **4-23**
- ➔ see Pesticides, **page 5-15**
- ➔ see Leachate Formation in Soil, **page 8-15**

Leachate Production Factors

Figure 9.5, next page, illustrates factors that influence the volume and quality of leachate production and its movement to surface water and groundwater:

- Water moving through materials or the soil will produce and move leachate:
  - High precipitation areas are at highest risk, such as the Pacific Coast climatic region (Climatic Information, **page B-1**).
- Structures or farm layout design that:
  - Keep water from coming in contact with materials will reduce the risk of leachate production;
  - Have leachate containment.
- The type and moisture content of materials through which water percolates.
- The pH of water movement in soil.
- The degree of leachate capture via soil adsorption.

➔ see Leachate Movement in Soil, **below**

- The degree of leachate capture in crop uptake.

Reduction of leachate production and methods to address management of materials can be found in **Chapters 2, 3, and 4**.

➔ see Wood Residue, **page 2-40**

➔ see Compost, **page 2-48**

➔ see Manure, **page 3-25**

see Forage Crop Storage, **page 4-14**

➔ see Mushroom, **page 4-23**

Leachate Pollution Risk

The threat leachate poses in its ability to cause pollution depends on several factors:

- Leachate formation or contaminant solubility (how well the chemicals being leached dissolve in water).
- Leachate contaminant capture.
  - Absorption (whether it will bind to soil particles);
  - Crop uptake (whether crop can utilize the dissolved chemicals);
  - Degradation (whether it changes characteristics as it is exposed to the soil).
- Leachate movement to surface or groundwater.
- Leachate quantity.

Leachate Movement in Soil

The degree of movement of leachate in soils is a function of:

- Soil infiltration and permeability, and soil capacity to bind contaminants.

➔ see Contaminant Leaching in Soil, **page 8-14**

- Soil water content.

Water Content. The movement of water through the soil is the primary mechanism which moves leachate through the soil. In order to reduce this movement, implement the following practices:

- Design and manage irrigation systems to avoid over-application of water.
- Avoid the use of soil amendments in fields that generate leachate that will cause pollution if water is moving downward to groundwater.
- Design and manage subsurface drainage systems to capture and treat contaminated water, particularly if macropore flow is estimated to be a risk.

➔ see Drainage Water Quality, **page 9-49**

Leachate Capture in Soil

Nutrients and metals in leachate have the potential to be captured in the soil by adsorption or by uptake into plant roots. Effective use of nutrients can be achieved by collecting leachate in a holding pond for subsequent use as irrigation water on cropland.

Soil Adsorption. If leachate has entered the soil, the possibility for natural "entrapment" or "treatment" by the soil exists. Some leachate will react with the soil and be neutralized, while acidic leachate, for example, has the potential to dissolve and mobilize metals or other substances to create a more hazardous situation. Soil processes such as adsorption, which are dependent on soil pH, organic matter or clay content, can neutralize or capture leached chemicals. Wood residue leachate should be applied to a crop without over-irrigating, so that toxicants in the water are in contact with soil surfaces for natural processes to reduce the load of toxicants. See the Irrigation section starting on **page 9-31** for guidance.

- Buffering. Vegetative Buffers can be used to entrap leachate by being absorbed by root systems limiting the migration into surface water as well as reduces erosion and acts as habitat as seen in FIGURE 9.5.

Vegetative Buffers in BC – resource website

Wetland Ways: Agriculture Buffers to Protect Wetlands in BC

Planning an Installing Vegetative Buffers in BC

Agricultural Vegetative Buffers in BC – Demonstration Sites

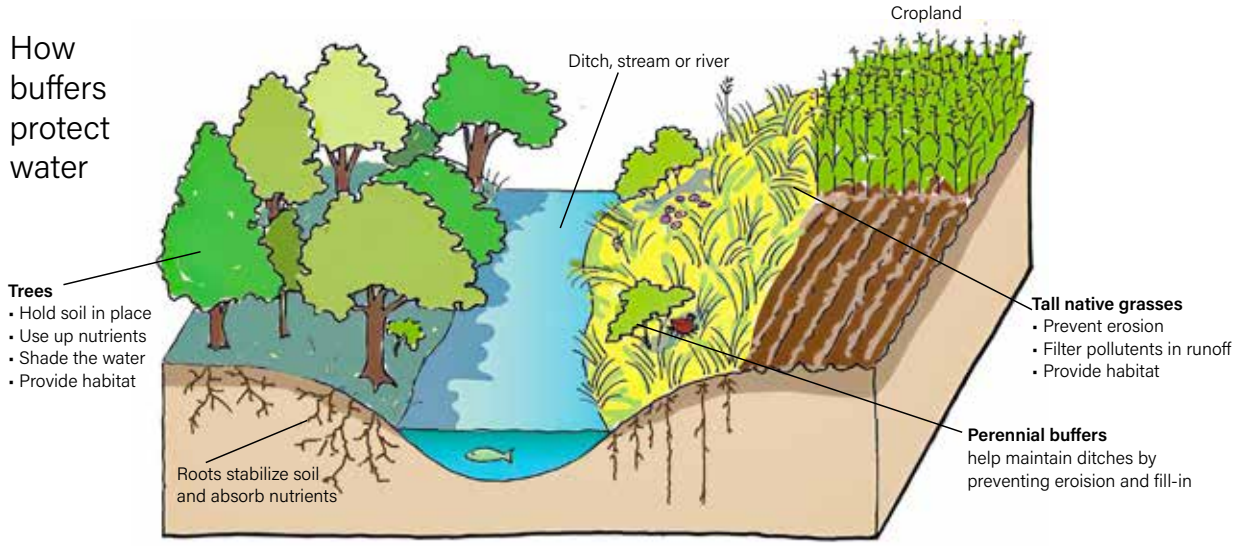


FIGURE 9.5 How Buffers Protect Water

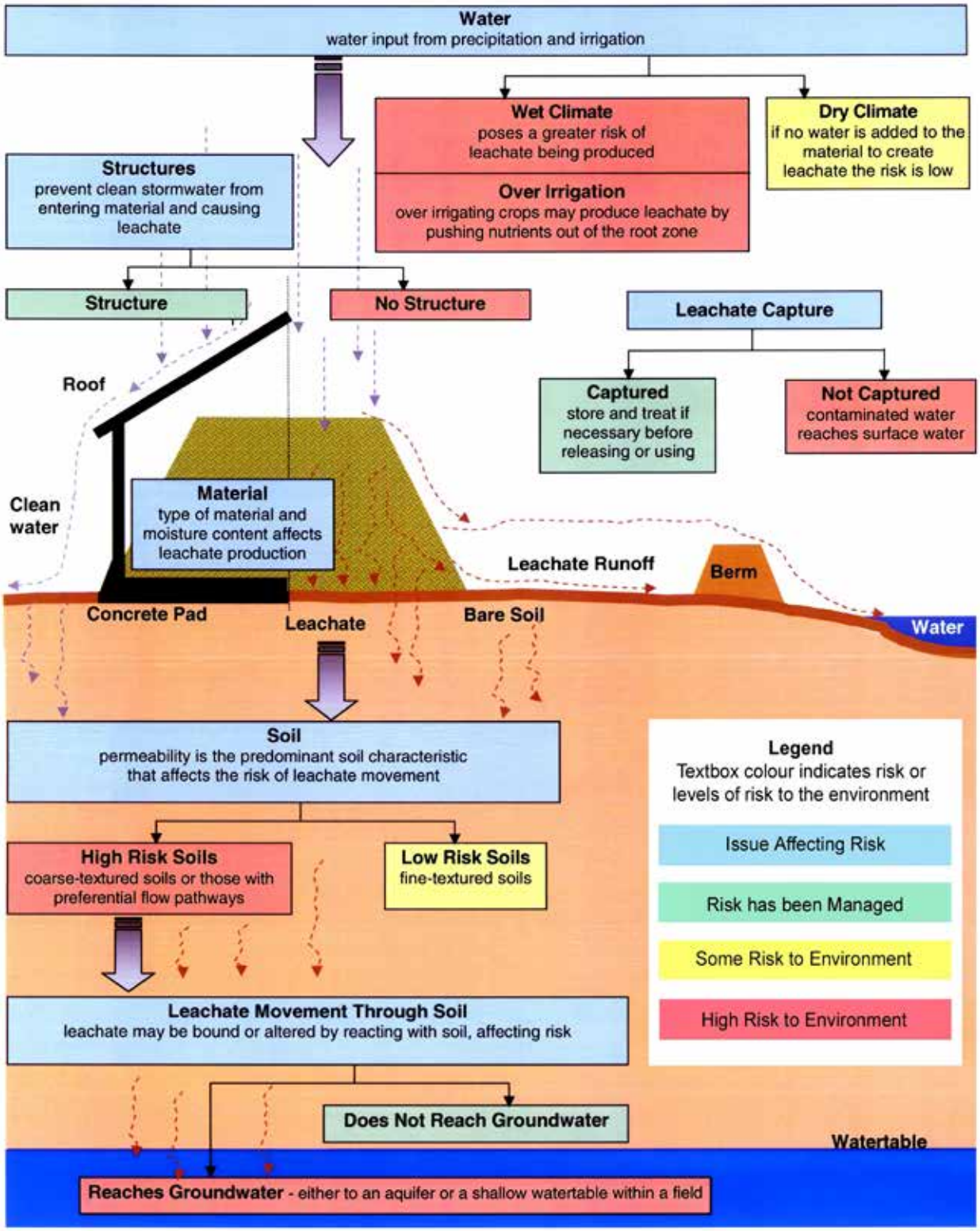


FIGURE 9.6 Leachate Production, Movement and Environmental Risks

Crop Uptake. If leachate reaches the root zone, the possibility for plant utilization of the dissolved nutrients exists. In order to increase the capture of such nutrients, implement the following practices:

- Plant cover crops, such as, annual ryegrass relay crops on corn land to capture nutrients which become available after cash crop uptake ceases.
- Design and manage subsurface drainage systems to increase the size of the crop root zone available for nutrient capture.
- Establish and maintain adequate vegetative buffers to capture leachate moving through the soil to surface or groundwater.

➔ see Buffers, **page 11-4**

Contaminant Degradation. Chemicals introduced into soil by agricultural practices, such as, pesticides or petroleum will naturally degrade to some extent over a variable period of time due to the chemical and biological activity of soil.

Leachate Control

The best alternative to deal with leachate problems is to prevent leachate generation at the onset. Cover leachable materials with tarps or roofs to prevent water from contributing to the formation of leachate.

Leachate Containment. If leachate is generated, containment is the best control method. Implement the following practices:

- Contain leachate near its source by ensuring the existence of an impervious barrier between potential leachate sites and the soil (e.g., a concrete pad under stored material).
- Construct a containment area sized to hold all leachate produced.

Leachate Capture. If leachate cannot be contained, capturing it is the only, often difficult, means to prevent it from reaching surface water or groundwater. Implement the following practices:

- Capture leachate runoff by:
  - Constructing berms and ditches to direct it to storage.
  - Planting buffers to capture contaminants.

➔ see Buffers, **page 11-4**

- Store captured leachate in an impervious storage.

Leachate that has been contained or captured must be handled and disposed of such that the specific contaminants in it do not pose a pollution risk. In some cases, it is entirely appropriate to recycle leachate as, for example, through irrigation systems in greenhouses or nurseries.

➔ see Collecting and Storing Contaminated Water, **page 9-55**

Leachate Use

Leachate Use. Leachate collected from sources, such as, silage, manure or compost can effectively be used as a nutrient source.

➔ see Nutrient Application, **page 6-1**

Leachate Treatment. If leachate cannot be used in an environmentally sound manner, treat it prior to discharge. Treatment options include biological treatment in lagoons or constructed wetlands, activated carbon adsorption (a filtering method), and other chemical technologies. Most treatment technologies, because they are typically costly to implement, should be avoided where possible.

ENV requires that for the treatment of leachate, that there be notification for existing and modified or new treatment systems. Before modifying or constructing a treatment system, a qualified professional must prepare the designs and plans, and approval from ENV is required.

WATER CONFLICTS

This chapter has outlined environmental impacts that may occur **to** water from a farm operation. However, some operations may be affected by impacts **from** water.

WATER CONFLICTS CONCERNS

Three primary water conflicts can pose major impacts to farms:

- Excess water that results in flooding from:
  - Runoff water entering the property;
  - Surface water flooding from streams or lakes;
  - Groundwater flooding from a rise in water tables.
- Shortage of water that results in:
  - Reduced access to surface or groundwater sources;
  - Drought from seasonal or climate changes.
- Water quality that is unfit for domestic, livestock or irrigation uses.

Water conflicts may become more prominent with projected climate change.

➔ see Climate Mitigation and Adaptation discussions, **Chapter 12**.

WATER CONFLICTS LEGISLATION

Water Sustainability Act

The *Water Sustainability Act* (WSA) is the principal law for managing the diversion and use of water resources.

Under the WSA, no person may divert water from a stream or from an aquifer unless the person holds an authorization or the diversion and use of water is allowed by the Act or under a regulation. An authorization can take the form of a "use approval", which allows for short term use of water for up to 24 months, or a water licence which establishes a long term water right. Authorization holders have some responsibilities including the need to pay water fees and rentals and make beneficial use of the water they are authorized to divert, store and use.

In most cases, any person who diverts water for use or storage must apply to the province for the right to use the water and pay an annual rental fee for that use. The requirement for groundwater licensing for non-domestic (e.g., farm or business use) came into force on February 29, 2016 and applies to new groundwater users as well as those who began using groundwater prior to February 29, 2016.

The requirement to obtain a licence for diversion and use of water from streams or aquifers applies regardless of whether the water source is on private or Crown land. However, the WSA and the regulations allow diversion and use of water without an authorization for certain uses:

- Diversion of groundwater or unrecorded surface water for a domestic purpose;
- Diversion of water to extinguish a fire;
- Diversion of water by a well driller to drill a well;
- Diversion and use of water for small scale placer mining and mineral exploration; and

The following SECTIONS of the WSA may be useful to the diversion of water in particular:

- SECTION 6: Prohibits diverting water without a licence except in limited circumstances for fire suppression, domestic use and mineral prospecting.
- SECTION 11: Requires approvals for making changes in and about streams.
- SECTIONS 16 & 17: May require mitigation measures on (sensitive) streams where a water diversion or use is authorized.
- SECTION 45: No new dams on protected rivers.
- SECTION 88: In the case of low or impending low water, for the purposes of protecting the fish population, the minister may make an order regulating the diversion, rate of diversion, time of diversion, storage, time of storage and use of water from the stream by holders of licences or approvals in relation to the stream or aquifer connected hydraulically to the stream.
- SECTION 128: Regulations respecting sensitive streams.

The *British Columbia Dam Safety Regulation*, which was updated in 2016, is to mitigate loss of life and damage to property and the environment from a dam breach by requiring dam owners to: inspect their dams, undertake proper maintenance, report incidents and take remedial action and ensure that the dams meet current engineering standards.

Riparian Areas Protection Act

The *Riparian Areas Protection Act* creates the authority for government to enact Provincial directives to protect areas that border streams, lakes, and wetlands.

With this Act, and through the *Riparian Areas Regulation* (RAR), local governments in certain regions of the Province are able to protect riparian areas during residential, commercial, and industrial development by ensuring that a Qualified Environmental Professional (QEP) conducts a science-based assessment of proposed activities. This includes residential buildings on land zoned for agricultural purposes. Section 12 provides Provincial directives on streamside protection.

The RAR only applies to the residential portion of the farm and only in the southern half of BC. The RAR does not apply to *farm practices* as defined in the *Farm Practices Protection Act*. In some cases, this can lead to the misunderstanding that the RAR does not apply to lands zoned for agriculture, or in the Agricultural Land Reserve (ALR). The RAR does apply to these lands for activities that are not *farm practices*, for example residential construction. It is important to note that local governments have the ability to establish bylaws that apply to agricultural lands, and some have implemented setbacks for agricultural buildings that complement the setbacks designated under RAR.

WATER CONFLICTS RESOLUTIONS

Flooding From Stormwater or Runoff Water

Stormwater or runoff water associated with agricultural conflicts typically originates from surrounding properties and may be contaminated. Neighbouring farm properties should complete and implement an environmental farm plan. Where this is not possible, manage the stormwater to minimize environmental impacts.

Upland urban stormwater management is critical to protect low-lying farmland.

➔ see Farm Building Siting, **page 2-8**

Factsheet 823.400-1 Agricultural Building Setbacks from Watercourses in Farming Areas

Flooding From Watercourses

While dyking is intended to protect land from flooding, it also removes that same land as a floodplain buffer for a given watercourse. This may cause downstream impacts, such as, bank erosion because flows are unable to be reduced by natural spilling onto the floodplain. Flood protection measures for one farm may become bank erosion problems for another farm. Consult the ENV, Fisheries and Oceans Canada, and local community flood plans before measures to redirect floodwaters are undertaken. Where appropriate, flooding from neighbouring properties should be addressed in the neighbouring properties Environmental Farm Plan and by participating in regional water management planning and protection measures.

➔ see Water Conflict Contingency Plan, **page 9-68**

- Freshet Flooding & Fraser Valley Agriculture: Evaluating Impacts and Options for Resilience
- BC Agriculture & Food Climate Initiative Flood Resources

Dam Inspection and Maintenance

Failure of water storage structures, such as, dams used for irrigation or stock watering, can result in negative impacts to water quality, downstream habitat and farmland. Regular inspection and maintenance of dams is important in order to detect weakness in the dam before failure occurs. The responsibility to inspect and maintain privately owned dams falls on the dam owner. For more information on the requirements and recommended monitoring and maintenance, dam owners should follow the dam safety guidelines:

- *Dam Safety Regulation*
- Dam Safety Pocketbook
- Dam Safety Technical Resources
- BC Dam Safety Program
- Dam Safety Management Binder
- BC Agriculture & Food Climate Initiative Water Storage and Dams Resources

Drought

In many cases, reduced irrigation water can be expected if snowpack levels are low causing reduced flows in streams and reservoirs in subsequent growing season. Good water management in such conditions is more important than ever with a changing climate. Plan your water use in the context of water demand and sustainable supply consideration. Use the following to assist your assessment:

- Drought in Agriculture
- Provincial Drought Information
- BC Irrigation Water Use Calculator
- BC Agriculture Water Calculator
- Irrigation System Assessment Guide
- Farm Water Planning Toolkit

ENV has implemented a four stage drought response system that can restrict water use during periods of drought. **Table 9.6** describes the four stages of drought response and the corresponding potential water use restrictions to agricultural producers.

- BC Drought Information Portal
- BC Agriculture & Food Climate Initiative Water Storage and Dams Resources

TABLE 9.6	Drought Response System		
Stage	Goals	Actions Effecting Agriculture	Target
1 Normal	Prevent entrance to Dry Stage	Preparedness – planning	Ongoing reductions in community water use
2 Dry	Prevent and prepare for Very Dry	Voluntary conservation – recommend changes in practices (cropping and water use)	Minimum 10% reduction (up to 20%)
3 Very Dry	Prevent and prepare for Extremely Dry	Voluntary conservation and restrictions – possible reduced availability from supply – Province may limit the number of, and impose restrictions on, new licences, regulate storage, or invoke conditions on existing licences	Minimum additional 20% reduction (up to 40%)
4 Extremely Dry	Prevent and prepare for possible loss of supplies, maximum possible reductions for all sectors	Voluntary conservation, restrictions and regulatory response - Province may restrict use by lower priority licensees or those with conditional clauses, may assist communities seeking alternative sources	Maximum reduction

Implement the following practices in drought conditions:

- Minimize water consumption.
- Develop out-of-channel water storage and collect runoff flows.
- Increase efficiency of water use by:
  - Using soil moisture measurements to schedule irrigation;
  - Checking all water systems for leaks and other avoidable losses;
  - Checking sprinkler nozzles and replacing worn units.
- Make use of industry crop specialists for specific water management recommendations that will make the best use of available irrigation water.

➔ see Irrigation, **page 9-21**

BC Irrigation Water Use Calculator

BC Agriculture Water Calculator

Factsheet 500.310-1 Irrigation Tips to Conserve Water on the Farm

Key Drought Management Tips

Cowichan Valley Drought Communications Plan 2017 Report

BC Agriculture & Food Climate Initiative Drought Resources

Water Quality

If a source of farm water is in danger of being or has been degraded because of off-site impacts, implement the following practices to reduce conflicts:

- If possible, locate the source of contamination and put into place measures to reduce or eliminate the contamination.
- If practical, treat the water before use.
- Contact the ENV to investigate any man-made sources of pollution and have the pollution stopped.
- Change irrigation practices to compensate for poor water quality by, for example, over irrigating to leach out accumulated salts.

Water Conflict Contingency Plan

Develop a contingency plan to provide a timely and effective response to any emergencies involving the farm operation, such as, obtaining approval from agencies prior to making changes in and about a stream to protect farmland during flooding emergencies. ➔ see Changes In and About a Stream, **page 7-17**

Consider regional water conservation strategies and the potential for climate change impacts in your water conflict planning.

Contingency Plan – Template for On-Farm Planning

CHAPER 10 METRIC CONVERSIONS

Metric	Imperial Equivalent
2.5 µm	1/10,000 inch
4 m	13 feet
100 m	330 feet
500 m	1,650 feet
1 km	0.6 mile

Conversions in this table are rounded to a convenient number.
See Appendix E for exact conversion factor.

Values from tables and examples are not included in Metric Conversions

CHAPTER 10 TABLE OF CONTENTS

CHAPTER 10

AIR

INTRODUCTION

This chapter discusses beneficial management practices for protection of air quality. It contains introductory information on the relationship between agriculture and air quality. It also contains information on concerns, legislation and beneficial management practices related to:

- Air emissions;
- Dust and particulate;
- Odours;
- Open burning.

This chapter addresses environmental concerns related to poor air quality, whereas Chapter 12 addresses environmental concerns related to climate change. Poor air quality and climate change are different phenomena, but the emission sources which cause both of these environmental issues may be similar. Taking actions to reduce air emissions from agricultural sources may help improve air quality and address climate change.

For information on these concerns:

➔ see Air Emissions, **page 10-6**

➔ see Impacts of Agriculture's Contribution to Climate Change, **page 12-5**

Air emissions versus air contaminants: what's the difference? In this document, an air emission refers to a substance introduced into the air that may or may not be an air contaminants as defined under the *Environmental Management Act*. All air contaminants are air emissions, but air emissions are not necessarily air contaminants. "Criteria air contaminants" is a term that is used in **Table 10.1** to refer to a group of seven specific substances.

AIR CONTAMINANTS

The key air emissions that affect air quality are gaseous emissions, dust and particulates. These substances can affect human health and the environment as well as contribute to climate change.

- BC State of the Air
- BC Air Quality Website
- Government of Canada Health Effects of Air Pollution Website.

Common Air Emissions

The following air emissions are listed in alphabetical order. While air quality can be influenced by agricultural production, it also may be influenced by many other human activities and natural phenomena.

Ammonia (NH_3). Ammonia easily volatilizes from urine, manure, fertilizer, compost and crop residues. Agriculture is the largest emitter of ammonia to the air both in BC and globally. Ammonia contributes to reduced visibility by reacting with other chemicals in the air to form fine particulate matter (i.e., ammonium sulphate and ammonium nitrate). Elevated levels of fine particulate matter are a concern to human health and reduce visibility in the Fraser Valley and other regions of B.C.

Carbon Monoxide (CO). Carbon monoxide originates mainly from the combustion of fuels used to heat buildings and greenhouses, and from farm equipment (both biomass and fossil fuels). The effects of carbon monoxide tend to be localized; at high concentrations the gas can cause asphyxiation, and at lower levels it produces symptoms of impaired perception and reflexes. Carbon monoxide also contributes to smog formation, but to a much lesser degree than nitrogen oxides or volatile organic compounds.

Nitrogen Oxides (NOx). Nitrogen oxides aid in the production of ground level ozone, a known respiratory irritant and crop growth retardant. Nitrogen oxides also contribute to acid rain production. Nitrogen oxides like carbon monoxide and sulphur oxides originate mainly from the combustion of fuels used to heat buildings and greenhouses, and from farm equipment (both biomass and fossil fuels).

Ozone (O_3). Ozone is unique among the atmospheric gases in that in the upper layers it is beneficial whereas near ground level, it is a indirect pollutant. Ground-level ozone is primarily formed by the reactions of other pollutants such as nitrogen oxides and volatile organic compounds. Both ground-level ozone and particulates contribute to smog formation, which has detrimental effects on the human cardio-respiratory system and on crop productivity. Human caused emissions have tended to deplete ozone in the upper atmosphere while increasing its concentration at ground level.

Sulphur Oxides (SOx). Sulphur oxides originate mainly from the combustion of fuels (both biomass and fossil fuels) used to heat buildings and greenhouses, and from farm equipment. Sulphur dioxide (SO_2) can damage vegetation and can have negative effects on the human cardio-respiratory system. Sulphate (SO_4^{2-}) reacts with other chemicals in the air to form, among other things, ammonium sulphate which contributes to acid rain and is also a major component in the formation of fine particles within the atmosphere.

Volatile Organic Compounds (VOC). Volatile organic compounds are released from various types of manure, petroleum products, and some types of pesticides. They are also emitted by plant production and many natural processes. Many volatile organic compounds and nitrous oxides aid in the production of ground level ozone, a known respiratory irritant and crop growth retardant. Volatile organic compounds can be a source of odours and also contribute to the formation of fine particulate matter, causing health and visibility concerns. Non-Methane Volatile Organic Compounds (NMVOC) are VOC without methane.

Dust and Particulates

The term "dust" is used to describe a range of particles sizes of material which can be transported by air. Dust has strict definition based on particle size, however in many instances when dust particles are transported in the air they are in close association with a wide range of particles including water molecules. At the particle size that is likely to cause pollution, irritation or nuisance, most of these particles (i.e., dust, mist, aerosol, or smoke) cannot be differentiated. The human sensory system can detect some of these particle sizes by sight and others by taste or touch, but it is dusts which obscure visibility and accumulate on surfaces which are considered as a nuisance.

Particulate matter is the tiny solid or liquid particles that float in the air. Some particles are large or dark enough to be seen as smoke, soot or dust. Others are so small that they can only be detected with an electron microscope.

Types of particulate matter:

1. Primary:

- Emitted directly into the atmosphere by wood and fossil fuel burning;
- Includes pollen, spores and road dust;

2. Secondary:

- Formed in the atmosphere through chemical reactions involving nitrogen dioxide, sulphur dioxide, volatile organic compounds and ammonia.

Particulate matter (PM) is measured in microns (one millionth of a metre). PM can make lakes and other sensitive areas more acidic, causing changes to the nutrient balance and harming aquatic life.

PM_{10}

- **Description**: particulate matter less than 10 microns and invisible to the naked eye and small enough to inhaled into our nose and throat.
- **Sources**: road dust, road construction, mixing and applying fertilizers/ pesticides, forest fires.
- **Health impact**: coarse particles irritate the nose and throat, but do not normally penetrate deep into the lungs.
- **Environmental impact**: PM is the main source of haze that reduces visibility. It takes hours to days for PM_{10} to settle out of the air.

$PM_{2.5}$

- **Description**: particulate matter that measures 2.5 microns and less.
- **Sources**: combustion of fossil fuels and wood (motor vehicles, woodstoves and fireplaces), industrial activity, garbage incineration, agricultural burning.
- **Health impact**: fine particles are small enough deep into the lungs. They are associated with all sorts of health problems — from a runny nose and coughing, to bronchitis, asthma, emphysema, pneumonia, heart disease, and even premature death.
- **Environmental impact**: $PM_{2.5}$ is the worst public health problem from air pollution in the Province, and because of its small size, takes significantly longer than PM_{10} to settle out of the air.

Greenhouse Gases (GHG)

When the sun's rays strike, the light energy is converted into heat energy which in turn is radiated back into the atmosphere. Certain gases called 'Greenhouse Gases' (also known as Global Warming Gases) absorb some of this heat energy, resulting in a warming of the earth's atmosphere. This is known as the greenhouse effect. Greenhouse gases such as carbon dioxide, methane, nitrous oxides and other gases are discharged by many human activities, including agriculture. Agriculture can be a net source of greenhouse gases or a net 'sink' by employing beneficial practices that minimize fossil fuel use and sequester carbon in soil and stewardship areas of the farm. When we manage agricultural air emissions we also reduce the release of GHGs.

For information on these concerns:

➔ see Climate Change Mitigation, **page 12-7** and Climate Change Adaptation, **page 12-15**

Trends in Greenhouse Gas Emissions in BC

Carbon Dioxide (CO_2). CO_2 is a greenhouse gas produced by the combustion of fossil fuels and biomass. CO_2 is a major contributor to the greenhouse effect and is therefore associated with climate change. Trees, vegetation and soil organic matter can remove CO_2 from the atmosphere and store as carbon. The use of gas and diesel engines and the burning of vegetation are major sources of on-farm CO_2 emissions.

Methane (CH_4). Methane is a powerful greenhouse gas produced during anaerobic decomposition (decomposition in the absence of oxygen) of organic wastes such as manures. Animals, particularly ruminants, emit methane gas that contributes to the greenhouse effect. Methane has approximately 25 times greater global warming potential than CO_2.

Nitrous Oxide (N_2O). Nitrous oxide is a very powerful greenhouse gas produced in the soil from the biochemical reduction of nitrate to gaseous nitrogen compounds, a process known as denitrification. Nitrous oxide has approximately 300 times greater global warming potential than CO_2.

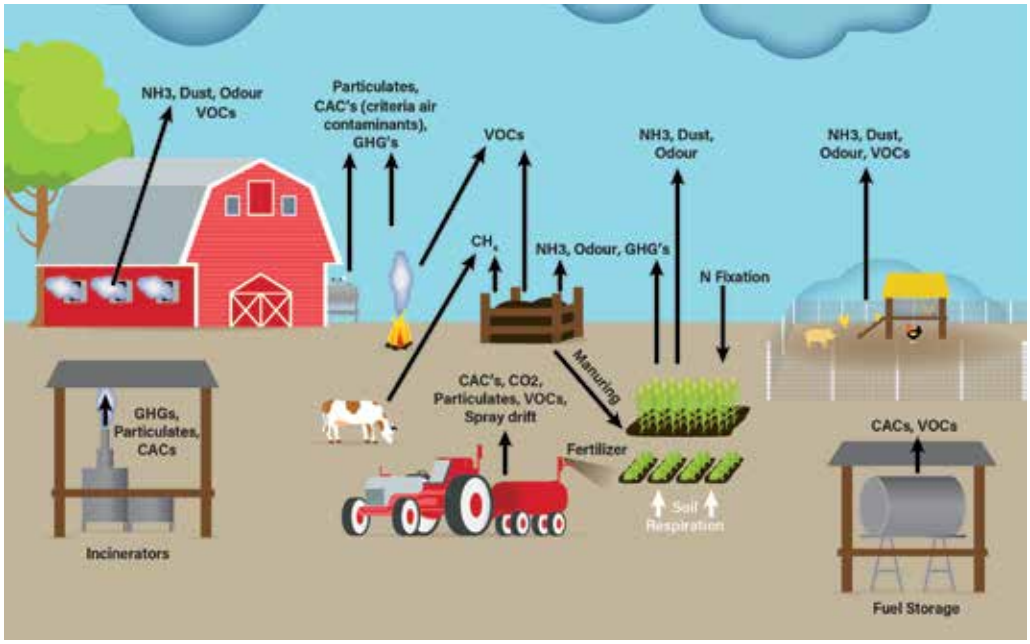


FIGURE 10.1 Farm emissions sources
NMVOC = Non Methane Volatile Organic Compounds

IMPACTS ON AIR QUALITY

Heat Production and Agriculture Boilers

Heat is used in greenhouse production, animal housing and for general space heating. Traditional fuel sources for boilers include natural gas and in some cases, coal. These fuel sources are being replaced by biomass and subsequently new regulations that set standards for air quality have been implemented. Burning biomass in boilers produces particulate matter, CO_2 and other air contaminants. There are several ways to reduce the impact of biomass boilers with emission control technology and beneficial management practices.

➔see Heat Production and Agricultural Boilers, **page 2-61**

Indoor Poultry and Livestock Housing

Indoor poultry and livestock housing contribute to dust, PM, and ammonia (NH_3) emissions, as well as odour that occurs outside of the animal housing area. In animal facilities, ammonia results primarily from the breakdown of manure. Undigested feed protein and wasted feed are additional sources of ammonia in animal production systems. Strategies to reduce ammonia from animal housing focus primarily on preventing ammonia formation and volatilization, or downwind transmission of ammonia after it is volatilized.

➔see Indoor Poultry and Livestock Housing, **page 3-3**

Manure Handling and Storage

The main pollutants associated with the production and handling of manure are methane (CH_4), NH_3 and nitrous oxide (N_2O). Methane is produced under anaerobic conditions during the microbial breakdown of organic compounds in manure. Manure handled as liquid or slurry will emit methane. Manures handled as a solid will have a lesser moisture content and will emit less methane if kept dry. Ammonia is produced in the decomposition of the organic nitrogen compounds in manure. Methane and ammonia are present during both storage and handling of manure. N_2O emissions occur mainly from manure application to soils. N_2O emissions will be significant if the manure is first handled dry and then handled wet. VOCs are also formed from the breakdown of manure both anaerobically and aerobically.

Noise

For the purposes of this publication, noise is considered a nuisance, not an environmental concern. Noise generated by farm activities has the greatest potential for creating nuisance in densely populated areas where farm sites are developed near property boundaries.

Nutrient and Chemical Applications

Pathogens. Many organic wastes, including manures, contain micro-organisms such as bacteria, viruses and parasites. Some of these micro-organisms may be pathogenic (disease causing) to animals of the same or of a different species. Many diseases are transmissible between animals and human beings. Most pathogens die off rapidly when dried or exposed to sunlight. However, there are some that can remain infectious in the air over extended distances and periods of time.

Pesticides. Pesticides include insecticides, herbicides, fungicides and rodenticides. The application of pesticides can result in the formation of spray droplets, mists, or dusts. These airborne particles are prone to drift and can be transported over many kilometres to contaminate other properties. In addition, these pesticide particles may be hazardous to non-target organisms. Applicators and workers may be affected if restricted entry intervals as specified on labels are disregarded.

Active ingredients within some pesticides are volatile and can evaporate from target areas and move with air currents to unwanted locations.

Odours

The handling, storing and composting of wastes; the application of manure and pesticides; and the decomposition of crop wastes can create odours that are offensive to neighbours. Odours, which are generated by farming activities in compliance with the *AEM Code* and with the practices outlined in this publication, should be considered nuisances rather than health hazards.

Open Burning

Open burning produces many harmful air emissions. Smoke from the open burning of vegetation and wood introduces a range of contaminants into the air, including particulate matter, carbon dioxide, carbon monoxide, nitrogen oxides, and hydrocarbon compounds.

In agriculture, ash and dust particulates are introduced into the air mainly by open burning of plant prunings and other similar materials. Fly ash, a term for the larger particulates in burning emissions, can create aesthetic concerns and nuisance complaints. Open burning of plastics and other specific wastes as defined by the *Open Burning Smoke Control Regulation* and *Waste Discharge Regulation* Schedule 1, SECTION 2, is prohibited. Burning prohibited materials produces many harmful air emissions that can cause localized environmental problems and health impacts.

Poor management of open burning and lack of fuel management on the farm or ranch could also result in an uncontrolled wildfire, with the risk of catastrophic impacts on the farm operations and surrounding areas.

AIR EMISSIONS

AIR EMISSION ENVIRONMENTAL CONCERNS

Primary environmental concerns related to air emissions from agriculture are:

- Pollution caused by fossil fuel combustion, wood burning, livestock emissions, waste disposal, soil emissions, and manure handling which results in the following:
  - Release of ammonia (NH_3), sulphur oxides (SO_x), volatile organic compounds and nitrogen oxides (NO_x) which can chemically produce secondary particulate which poses a risk to human health and reduces visibility.
  - Release of volatile organic compounds (VOCs) and nitrogen oxides (NO_x) (i.e., manure, petroleum) that create ground level ozone and lead to the formation of smog which is a concern to human and vegetative health.
  - Release of greenhouse gases, mainly carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), which are linked to global climate change.

ENV has jurisdiction over air emissions via the *Environmental Management Act*. Under the *Environmental Management Act*, Metro Vancouver has been delegated authority to manage air quality within its boundaries.

Learn more about Metro Vancouver's Air Quality Regulatory Program on

- Metro Vancouver Air Quality Website
- Metro Vancouver Ambient Air Quality Objectives

The Province has developed an Air Quality Regulatory Framework which is a series of regulations, codes and acts that set standards for air quality emissions from business and industry in British Columbia.

Air quality objectives are limits on the acceptable presence of particular substances in the atmosphere. These are established by government agencies to protect human health and the environment. Objectives and standards are used to guide air management decisions.

- BC Government Air Quality Objectives and Standards

BC has adopted air quality objectives and standards for a number of substances, including: particulate matter $(PM)_{10}$, $PM_{2.5}$, ozone, sulphur dioxide, nitrogen dioxide and carbon monoxide. They are generally expressed in terms of a concentration (e.g., micrograms per cubic metre, or parts per billion) measured over a specific period of time (e.g., one hour, 24 hours or one year). Objectives are one kind of "criteria." Criteria also include standards, guidelines and planning goals.

They are typically used to:

- Assess current or historical air quality;
- Guide decisions on the permitting of new or modified facilities;
- Guide decisions on episode management, such as air quality advisories;
- Develop long-term air-management strategies and evaluate progress, and
- Aid regulatory development.

AIR EMISSION LEGISLATION

The following is a brief outline of the main legislation that applies to air emissions.

➔ see **page A-1** for a summary of these and other Acts and Regulations

Local Bylaws

Regional and municipal governments can pass bylaws to control emissions such as backyard and open burning, wood stoves and vehicle idling. These governments can also address air pollution through land-use and transportation planning, regional growth strategies and sustainability plans. Local Governments can put in place bylaws that restrict air emissions from industrial and business operations. Farms are not necessarily exempt from these local bylaws, particularly smoke control bylaws, and operators should check with their local or regional government. Local bylaws can be more restrictive than provincial regulations. For instance, a municipality or regional district can have a 'fire' bylaw that covers open burning. Local governments often have a burn ban at certain times of the year for fire safety reasons. Check with the local government office or the fire department to find out about the rules and restrictions. A permit may be required. A permit for burning diseased material may be given during restricted times in extreme circumstances, check with the local fire department about potential exemptions from the local bylaw.

Environmental Management Act

According to this Act, "air contaminant" means a substance that is introduced into the air and that

(a) Injures or is capable of injuring the health or safety of a person,

(b) Injures or is capable of injuring property or any life form,

(c) Interferes with or is capable of interfering with visibility,

(d) Interferes with or is capable of interfering with the normal conduct of business,

(e) Causes or is capable of causing material physical discomfort to a person, or

(f) Damages or is capable of damaging the environment.

The *Code of Practice for Agricultural Environmental Management* (AEM Code of Practice) requires persons to use environmentally responsible and sustainable agricultural practices when carrying out agricutural operations, for the purpose of minimizing the introduction of waste into the environment and preventing adverse impacts to the environment and human health. The Code of Practice includes requirements which address air emissions from agricultural activities.

Requirements for boilers and heaters are outlined in Part 2 and 3 of the AEM Code of Practice. Part 2 SECTIONS 4 and 5 note the requirements and exemptions from registration with ENV. Part 3 includes more specific requirements for the operation of boilers and heaters with respect to air emissions.

- Part 3 includes requirements for the type of fuel for a boiler or a heater (SECTION 9), opacity limits (SECTION 10) and particulate matter limits (SECTION 11).
- If corrective actions are required to address emission opacity or particulate matter, corrective actions are required by SECTION 12.
- Records keeping for biomass fuelled boilers and heaters is specified in SECTION 14.

Part 3 of the AEM Code of Practice contains general requirements in SECTION 6 for ensuring that air contaminants from forced air ventilation systems do not enter a watercourse or cross a property boundary. Similarly, other sections of the AEM code stipulate that certain activities, processes or structures be managed to ensure that air contaminants do not cross a property boundary. These include stored by-products (SECTION 34), composting (SECTION 40), confined livestock or poultry areas (SECTION 62), mortality and processing wastes (SECTION 68).

SECTION 75 of the AEM Code of Practice specifies requirements for incinerators used to dispose of mortalities and solid or semi-solid waste from slaughter. The incinerator must be designed for the disposal of mortalities and meet specific limits for particulate matter emissions and opacity.

Under the *Environmental Management Act*, local governments may be delegated authority to manage air quality within their boundaries. For example, Metro Vancouver has been delegated authority to manage air quality within its boundaries. It administers laws that regulate emissions from industrial, commercial and industrial sources, through permits, compliance promotion and enforcement.

The Act also enables the Province to regulate the emissions from industrial and business operations through the issuance and enforcement of air emission permits.

The *Open Burning Smoke Control Regulation* governs smoke from open burning of vegetative debris from smoke sensitivity zones, agriculture, forestry, land development, and individual property owners. It sets conditions such as setbacks, smoke release periods and venting conditions that must be met. The Regulation enables compliance and enforcement and the ability to issue fines.

The *Waste Discharge Regulation* regulates various industries and their waste discharges into the environment. It prohibits certain materials from being burned and/or incinerated and exempts industries who discharge wastes in accordance with applicable codes of practice from SECTION 6(2) and (3) of the *Environmental Management Act*.

Motor Vehicle Act

The *Motor Vehicle Act* is administered by the Ministry of Transportation and Infrastructure and requires emission control devices on certain heavy diesel vehicles in the Province.

As of October 1, 2010, in accordance with the *Motor Vehicle Act*, heavy diesel vehicle emission control devices must be installed on all BC registered commercial diesel vehicles of model years 1989-1993 with a Licensed Gross Vehicle Weight (LGVW) of more than 8,200 kg. Farm vehicles with a LGVW under 17,300 kg are exempt from these retrofit requirements.

Canadian Environmental Protection Act

The federal government's role in addressing air quality issues is defined through the *Canadian Environmental Protection Act*. Administered by Environment and Climate Change Canada with Health Canada, this Act applies to all lands in Canada and concerns toxic substances, hazardous materials, new substances, export and import of substances, fuels, international air pollution, ocean disposal, etc. Many emission sources that lie beyond provincial authority are subject to federal regulation, standards and guidelines. These include motor vehicles and fuels, marine vessels, railways and off-road engines applicable to agricultural vehicles.

The *Off-Road Compression-Ignition Engine Emission Regulation* introduces emission standards for diesel engines used in off-road applications such as those typically found in construction, mining, farming and forestry. Emissions from engines used in agriculture that are newer than 2006 are subject to the regulation.

➔ see Climate Change Mitigation Legislation, **page 12-7**

➔ see **page A-1** for a summary of these and other Acts and Regulations

AIR EMISSION REDUCTION BENEFICIAL MANAGEMENT PRACTICES

Proper management of manure, crops, nutrients and machinery will greatly assist in reducing pollution causing air emissions from farm operations. Poor air quality and climate change are different phenomena, but their causes are similar. Taking actions to reduce the pollution from agricultural sources will help improve air quality and address climate change.

Comply with applicable air emission related legislation, including the above, and where appropriate, implement the following beneficial management practices to reduce air emissions from agriculture.

Table 10.1 outlines some common farm practices and the resulting air emission(s). The table will help to determine the positive impact that the following beneficial management practices will have on reducing air emissions from agriculture.

TABLE 10.1	Agricultural Air Emission Sources					
Practice	Ammonia	Dust	Particulates	GHG	Odour	Criteria Air Contaminants Particulate matter, Sulphur Oxides, Nitrogen Oxides, Volatile Organic Compounds, Carbon Monoxide
Livestock and poultry housing (exhaust fans)	✓	✓	✓	✓	✓	
Poultry barn clean out		✓	✓		✓	
Manure storage	✓			✓	✓	
Manure spreading	✓	✓	✓		✓	
Manure injection				✓		
Open burning		✓	✓	✓	✓	✓
Dry field tillage		✓	✓	✓		
Diesel use			✓	✓		✓
Fuel use			✓	✓		✓
Using boilers for heat production			✓	✓		✓
Incinerators			✓	✓		✓
Turning of compost windrows	✓		✓	✓		✓
Grazing ruminants				✓		

Air Emissions Reduction

Implement the following practices to reduce air emissions:

- Maximize the use of renewable energy, such as electricity, wind or solar,

  ➔ see Climate Change Mitigation Beneficial Management Practices, **page 12-9,** and refer to On-Farm Energy Production;
- Use energy-efficient equipment and operating practices;
- Use high efficiency motors and pumps;
- Use efficient irrigation equipment to reduce pumping energy requirements;
- Maintain engines in efficient running order;
- Use energy saving practices to reduce fuel usage by farm machinery:
  - Avoid unnecessary idling;
  - Keep tires inflated at optimum tire pressure.
- Graze livestock rather than growing forages that require transport to separate feeding areas or feedlots;
  - Reduce tillage and therefore reduce the use of machinery and the fossil fuel used for equipment.
- Keep internal combustion engines well maintained and include emission control devices if necessary (such as air filters, diesel injectors or catalytic converters).
  - For compliance with the *Motor Vehicle Act* diesel retrofit requirements, emission reduction devices are verified by the following agencies:

  ➔ see Air Emission Legislation, **page 10-7**
- Use appropriately sized and efficiently operated heating plants for greenhouse and other production facilities.
  - Use energy management systems that ensure optimization of temperature and humidity.
  - If used, ensure solid fuels have optimum moisture content (less than 20% moisture, suggested).
  - Implement rigorous maintenance programs for all heating system components, particularly for solid fuel boilers.
  - Ensure that biomass fuelled boilers meet emission testing requirements.

  ➔ see Climate Change Mitigation Beneficial Management Practices, **page 12-9**, and refer to Energy Conservation and Fuel Switching,
- Change livestock feed rations to:
  - Reduce nitrogen content of excretions thus reducing ammonia emissions.
  - Reduce methane emissions.
- Use nutrient application handling practices that minimize emissions and drift:
  - During strong, divergent windy conditions apply nutrients below the soil surface or a crop canopy having a height of at least 8 cm.
  - Make more frequent manure applications at lower application rates using sleighfoot or shallow injection equipment for more efficient use of nitrogen.
  - Use covered manure storages to reduce methane and ammonia emissions.
  - Use solid rather than liquid manure handling systems.

  ➔ see Manure Gas Emissions Reduction, **page 3-42**
- Use drainage or irrigation systems to optimize soil water content.

  Drainage Management Guide

  B.C. Irrigation Management Guide;

- Apply nutrients and manure efficiently to match crop needs.

  Nutrient Management web page;

- Establish and maintain adequate windbreak or shelterbelt buffers around farm buildings and livestock facilities to improve energy efficiency reduce drift and minimize emissions of particulate matter, pesticides and odorous compounds.

  ➔ see Buffers, **page 11-4;**

- Increase carbon within the soil to reduce carbon entering the atmosphere.
  - Increase soil organic matter,
  - Minimize cultivation,
  - Grow perennial crops,
  - Avoid the burning of crop residue, and incorporate residues into soils.
- Follow beneficial management practices for open burning.

  ➔ see Open Burning Beneficial Management Practices, **page 10-26**

Ozone Production Reduction

Ozone is a secondary pollutant formed mainly from VOCs reacting with other substances in the atmosphere. Ground level ozone can have a negative impact on crop production. To reduce ozone production, reduce VOC production and reduce the production of NOx.

Ammonia Emissions Reduction

Agriculture is the largest emitter of ammonia to the air both in BC and globally. Ammonia easily volatilizes from urine, manure, fertilizer, compost and crop residues. It contributes to reduced visibility and reacts with other chemicals in the air to form secondary particulate matter, (i.e., ammonium sulphate and ammonium nitrate). These compounds are a major component of fine particulate matter in the air of the Fraser Valley. Elevated levels of fine particulate can reduce visibility and are a concern to human health.

➔ see Manure, **page 3-42**, and refer to Manure Gas Emission Reduction

➔ see Nutrient Application, **page 6-1**, and refer to Field Spreading Emission Reduction

VOC Emission Reduction from Fuel Evaporation

Fuel evaporation during storage results in VOC emissions and is an environmental concern. Evaporation from aboveground tanks is due to heating of the tank by the sun which causes the fuel to volatilize and vent to the atmosphere. Underground tanks have lower evaporation losses.

➔ see Petroleum Beneficial Management Practices, **page 2-35** and refer to Petroleum Storage

Farm Storage and Handling of Petroleum Products

DUST AND PARTICULATE

DUST & PARTICULATE ENVIRONMENTAL CONCERNS

Dust can result from many farm practices and could be a source of complaint concerning farm activities. The human sensory system can detect some of these particle sizes by sight and others by taste or touch, but it is dusts which obscure visibility and accumulate on surfaces which are considered as a nuisance. There is a fine line in references as to when a dust changes from being a nuisance to being a pollutant.

Particulate matter is the tiny solid or liquid particles that are mush smaller then dust. They result from animal bedding and manures, burning, fuel usage and tillage. Particulate like dust can be considered a nuisance but can also be considered a pollutant when it travels distances or is not controlled through good production practices.

Primary environmental concerns related to dust and particulate are:

- Release of mineral or organic compounds that contribute to particulate or secondary particulate formation that results in:
  - Health risks when inhaling the particulate;
  - Visual impairment such as smog from the particulate in the outdoor (ambient) air.
- Wind erosion causing dust to be transported to other areas and cause damage, such as:
  - Waterways, causing impacts to fish;
  - Farm fields, creating a dust cover on crops; and;
  - Residential areas, creating visibility and breathing concerns.

For information on these concerns:

➔ see Air Emissions, **page 10-12**, and refer to Dust and Particulate

DUST & PARTICULATE LEGISLATION

The following is a brief outline of the main legislation that applies to dust and particulate.

➔ see **page A-1** for a summary of these and other Acts and Regulations

Local Bylaws

Regional and municipal governments can pass bylaws to control emissions from activities such as backyard and open burning, wood stoves and vehicle idling. These governments can also address air pollution through land-use and transportation planning, regional growth strategies and sustainability plans. Permits may be given by local governments that restrict emissions from industry and business operations. Farms are not necessarily exempt from these local bylaws, particularly smoke control bylaws, and operators should check with their local or regional government. Local bylaws can be more restrictive than provincial regulations. For instance, a municipality or regional district can have a 'fire' bylaw that covers open burning. Local governments often have a burn ban at certain times of the year for fire safety reasons. Check with the local government office or the fire department to find out about the rules and restrictions. A permit for burning diseased material may be given during restricted times in extreme circumstances, check with the local fire department about potential exemptions from the local bylaw.

Environmental Management Act

SECTION 6(5) of the *Environmental Management Act*: states that "nothing in this section or in a regulation... prohibits"

- (6)(i): Emission into the air of soil particles or grit in the course of agriculture or horticulture.

The Act is unclear on whether the release of "organic dust" from livestock barns through ventilation systems or from activities associated with grain cleaning and handling requires a discharge permit. However, regardless of permit requirements, pollution must not occur from any emission into the air.

The *Code of Practice for Agricultural Environmental Management* requires persons to use environmentally responsible and sustainable agricultural practices when carrying out agricultural operations, for the purpose of minimizing the introduction of waste into the environment and preventing adverse impacts to the environment and human health. The AEM Code of Practice includes requirements which address air emissions from agricultural activities.

Requirements for boilers and heaters are outlined in Part 2 and 3 of the AEM Code of Practice. Part 2 sections 4 and 5 note the requirements and exemptions from registration with ENV. Part 3 includes more specific requirements for the operation of boilers and heaters with respect to air emissions.

- Part 3 includes requirements for the type of fuel for a boiler or a heater (SECTION 9), opacity limits (SECTION 10) and particulate matter limits (SECTION 11).
- If corrective actions are required to address emission opacity or particulate matter, corrective actions are required by SECTION 12.
- Records keeping for biomass fuelled boilers and heaters is specified in SECTION 14.

SECTION 6 of the AEM Code of Practice has requirements for ensuring that air contaminants from forced air ventilation systems do not enter a watercourse or cross a property boundary. Similarly, other sections of the AEM Code of Practice stipulate that certain activities, processes or structures be managed to ensure that air contaminants do not cross a property boundary. These include stored by-products (SECTION 34), composting (SECTION 40), confined livestock or poultry areas (SECTION 62), mortality and processing wastes (SECTION 68).

SECTION 75 of the AEM Code specifies requirements for incinerators used to dispose of mortalities and solid or semi-solid waste from slaughter. The incinerator must be designed for the disposal of mortalities and meet specific limits for particulate matter emissions and opacity.

Farm Practices Protection (Right to Farm) Act

This Act protects farmers from liability in lawsuits alleging nuisance associated with dust resulting from the farm operation when they meet certain regulatory conditions.

The *Farm Practices Protection (Right to Farm) Act* (FPPA) provides that a farmer is not liable in nuisance to any person for any odour, noise, dust or other disturbance resulting from that farm operation. However, for this protection to apply, the farmer must comply with the *Environmental Management Act* (EMA), among other things. The applicability of a burning bylaw to a farm operation in relation to the (FPPA) depends on the location of the farm and the local authority under which the bylaw was prepared.

DUST & PARTICULATE BENEFICIAL MANAGEMENT PRACTICES

Suppression measures to prevent the release of dust from livestock barns and fields will contribute significantly towards reducing the potential for pollution and complaints. Comply with applicable dust related legislation, including the above, and where appropriate, implement the following beneficial management practices to protect the environment.

Dust Suppression

Dust can result from a variety of farm practices and can be a nuisance to neighbours. Several measures can be taken to reduce the amount of dust generated from farm activities. Implement the following practices for dust suppression:

- Avoid cultivation in situations where the soil will become or is excessively dry.
- Minimize the amount of time soil is left bare in fields.
- Evaluate and modify activities that may create dust such as tillage, harvesting, grain handling, livestock handling, feed processing.
  - Work soils when moisture conditions are least likely to generate dust.
  - Practice minimum tillage.
  - Bale straw instead of chopping.
- Choose manure application methods that apply manure directly to the soil rather than into the air.
- Change bedding in livestock housing on a regular basis to reduce dust accumulation.

➔ see Indoor Poultry and Livestock Housing, **page 3-2**

- Choose cropping, crop residue and cover crop management practices that minimize soil loss by wind erosion.

➔ see Soil Erosion Risk, **page 8-12**

- Design ventilation structures to deliver emissions either to the ground or to the air in a manner that reduces dust drift.
- Chose spray equipment which places spray on the target rather than into the air when there is a risk of drift.

➔ see Pesticide Use, **page 5-25**

Farm Nuisance-Dust

Particulate Suppression

Particulate matter can remain suspended in the air. Implement the following practices for particulate suppression:

- Avoid burning crop residue or land clearing, chop the crop residue instead and apply it to the land

➔ see Open Burning, **page 10-22**

- Maintain general sanitation and housekeeping in livestock housing.

➔ see Indoor Poultry and Livestock Housing, **page 3-2**

- Reduce ammonia production that leads to secondary particulate formation.

➔ see Manure Handling and Storage Beneficial Management Practices, **page 3-30** and refer to Nutrition and Ration Management

Management of Dust in Broiler Operations

Siting and Management of Poultry Operations

Farm Practice Factsheet: Ventilation

Fine Particulates – What They are and How They Affect Us

BC Agriculture Air Management Website

Dust and Particulate Capture

Some sources of particulates can be controlled using emission control devices to catch dust and particulates. This can be used for ventilated animal housing, boilers and internal combustion engines.

- Keep internal combustion engines well maintained and include emission control devices if necessary (e.g., air filters, diesel injectors or catalytic converters).
- Install chemical or wet scrubbers or cartridge filters on building ventilation fans.
- Install dust suppression system, such as an electrostatic precipitators, that will reduce airborne particulates and exhausted particles.
- Install bio-filters on animal housing to reduce dust and odours.
- install vegetative filters to provide capture of dust at exhaust fan outlets.

➔ see Indoor Poultry and Livestock Housing, **page 3-2**, and refer to Protection of Air Quality

- Install emission control devices on biomass burners.
  - Visually assess the opacity of emissions from the boiler or heater at least once each day that it is operating and during any start up and shutdown procedures.
  - Conduct regular testing of emissions of particulate matter from boilers or heaters that are using biomass as fuel.
- Install secondary burners on mortality incinerators.
  - Visually assess the opacity of emissions from the incinerator at every 12 hours that it is operating and during each burn cycle.
- Keep proper records operating a biomass boiler or heater, or mortality incinerator.
- Use greenhouse boilers with low particulate generation.
  - Ensure solid fuels have optimum moisture content (< 20% moisture content, suggested).
  - Implement a rigorous maintenance program for all heating system components, particularly for solid fuel boilers.

➔ see Heat Production and Agricultural Boilers, **page 2-58**

- Develop wind screens, breaks or strategies to reduce dust movement off the property.

Vegetative Buffers

Vegetative buffers around farm buildings and farm activities can be used to catch dust and particulates before they become problems in other areas. Vegetative buffers address some issues better than others. The potential effectiveness of properly designed, healthy vegetative buffers to address various objectives (**Figure 10-2**) is compared in **Table 10.2**.

Dust mitigation: Vegetative buffers act as a filter by collecting dust and changing airflow patterns.

Odour mitigation: Odour plumes often occur at ground level and may be partly mitigated by buffers. Odours are often attached to the dust and particulate coming from livestock barns, so controlling the dust will help to minimize the odours fom livestock operations. Visual screening also reduces the perception of odour, which is an important aspect of odour mitigation.

Pesticide drift mitigation: Spray drift occurs when spray droplets are transported by air currents during pesticide application. Vegetative buffers intercept and capture spray droplets. Research has shown that with a proper design, a vegetative buffer can reduce pesticide drift by 50-90%.

TABLE 10.2	Relative effectiveness of vegetative buffers	
Objective (issue being addressed)		Relative Efficacy
Primary objective	Pesticide drift mitigation Dust mitigation Odour mitigation	High Moderate – high Low – moderate
Secondary objective	Visual screening/aesthetics Energy efficiency Noise and light reduction Biodiversity/riparian enhancement	High Moderate Low Low

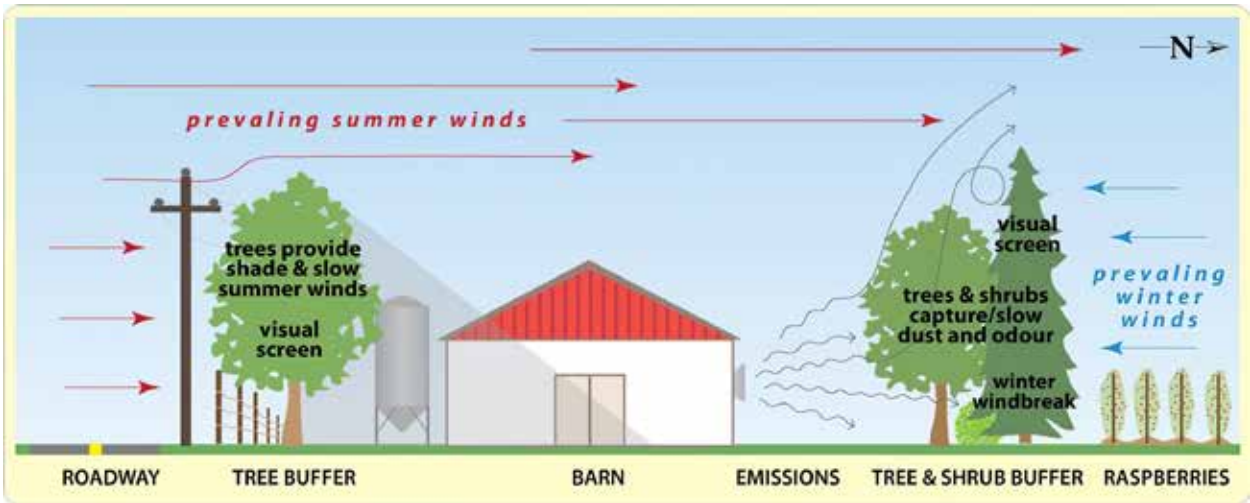


FIGURE 10.2 Example of vegetative buffer objectives.

Vegetative Buffers Intensive Agricultural Operations in BC

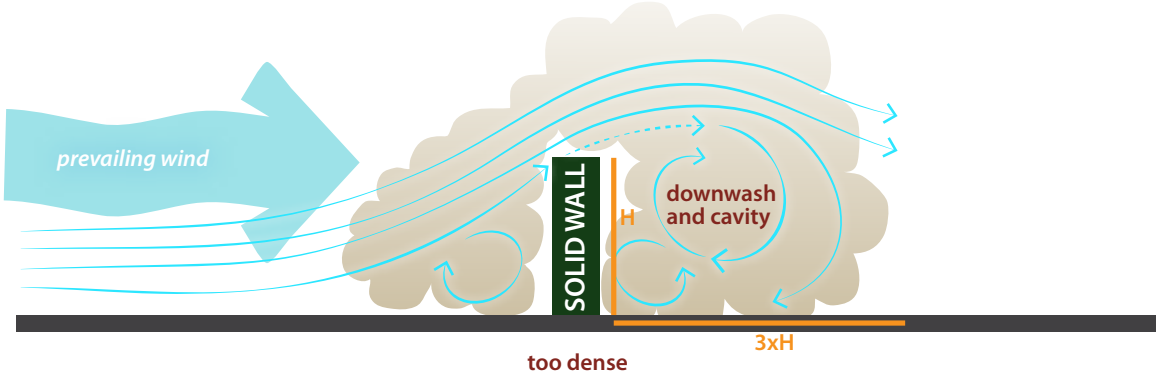


FIGURE 10.3 Effect when buffer vegetation is too dense (low canopy porosity)

ODOURS

ODOUR ENVIRONMENTAL CONCERNS

Vegetative buffers around farm buildings and farm activities can be used to catch dust and particulate and also odor and spray drift before they become problems in other areas. Vegetative buffers are trees or vegetation areas that are designed in interface areas to intercept the airflow to capture the dust/odour or pesticide. Refer to the vegetative buffer guidebook for detailed information on how to plan and design a buffer for an interface area. Primary environmental concerns related to farm odours are:

- Direct odours and particulate carrying odorous compounds that come from animal housing areas, manure handling and storage areas and land where manure is applied, resulting in:
  - High levels of odours that result in air pollution and health impacts to humans;
  - The nuisance they pose to neighbours.

For information on these concerns:

➔ see Odours, **page 10-17,**

ODOUR LEGISLATION

The following is a brief outline of the main legislation that applies to odours.

➔ see **page A-1** for a summary of these and other Acts and Regulations

Farm Practices Protection (Right to Farm) Act

This Act protects farmers from liability in lawsuits alleging nuisance associated with odour resulting from the farm operation when they meet certain regulatory conditions.

The *Farm Practices Protection* (Right to Farm) *Act* (FPPA) provides that a farmer is not liable in nuisance to any person for any odour, noise, dust or other disturbance resulting from that farm operation. However, for this protection to apply, the farmer must comply with the *Environmental Management Act* (EMA), among other things. The applicability of a burning bylaw to a farm in relation to the FPPA depends on the authority under which the bylaw was prepared.

Environmental Management Act

According to the *Environmental Management Act* (EMA), "air contaminant" means a substance that is introduced into the air and that

(a) Injures or is capable of injuring the health or safety of a person,

(b) Injures or is capable of injuring property or any life form,

(c) Interferes with or is capable of interfering with visibility,

(d) Interferes with or is capable of interfering with the normal conduct of business,

(e) Causes or is capable of causing material physical discomfort to a person, or

(f) Damages or is capable of damaging the environment.

The *Code of Practice for Agricultural Environmental Management* requires persons to use environmentally responsible and sustainable agricultural practices when carrying out agricutural operations, for the purpose of minimizing the introduction of waste into the environment and preventing adverse impacts to the environment and human health.

The AEM Code of Practice provides a definition of odour in Section 7 which specifies that an odour does not interfere with the normal conduct of business if:

> a) The odour is produced in carrying out an agricultural operation in accordance with normal agricultural practices; and
>
> b) Ammonia, sulphur, and other harmful compounds associated with the odour do not settle out of the air into a watercourse or across a property boundary at a level that would cause injury, interference, discomfort or damage.

Substances associated with odour might be considered air contaminants if they cause material physical discomfort, whether or not normal agricultural practices are followed. However, the Environmental Appeal Board (EAB) has previously stated that "material physical discomfort to a person' means more than just unpleasantness. It implies a physically measurable effect." How odour is regulated under the *Environmental Management Act* may be evolving, but it is clear that not all substances associated with odours are air contaminants.

Read decisions from the EAB regarding odour and material physical discomfort:

- Appeal No. 96/01(c)
- Decision Nos. 2007-EMA-007(a); 2008-EMA-005(a)

ODOUR BENEFICIAL MANAGEMENT PRACTICES

Comply with applicable odour related legislation, including the above, and where appropriate, implement the following beneficial management practices to protect the environment and minimize nuisance to neighbours.

Odours from Livestock. Odours in livestock production typically originate from indoor livestock housing; from manure handling, storage and composting areas; and from fields during the course of manure spreading. Odours come from many sources, the most common are:

- Ammonia from manure in indoor livestock housing;
- Odorous compounds carried on dust from indoor livestock housing, and from manure spreading;
- Odorous gases from manure storage, either wet or dry;
- Harmful odorous compounds from manure breakdown in the lack of oxygen (anaerobic conditions).

Odours associated with livestock operations are largely the result of gases produced from manure and other decomposing organic matter. Livestock housing can also produce odourous ammonia emissions from dry manure as well as dust that carries odour.

When manure decomposes in the presence of sufficient oxygen, a process known as aerobic decomposition, few odorous gases are produced. On the other hand, the decomposition of manure in the absence of oxygen, known as anaerobic decomposition, results in the release of many odorous and often dangerous gases, including ammonia, hydrogen sulphide, methane, and other toxic organic chemical substances. Manure odours from solid manure can be minimized by keeping the manure sufficiently dry to allow air movement and aerobic conditions through the pile to occur, by applying it as soon as possible, and/or by mixing it with bulking agents for further composting action.

➔ see Manure Gas Emissions Reduction, **page 3-42**

Odours from Crop Residues. Decomposition of post-harvest crop residues or vegetative processing waste can result in significant odour generation if not managed properly. Specifically, residues from cole crops pose a high risk of odour generation that can be a nuisance to neighbours. In order to minimize odours from crop residues, incorporate residues into the soil immediately post-harvest. Dispose of waste from crop processing in a manner that minimizes odour generation.

➔ see On-farm Processing and Sales Beneficial Management Practices, **page 2-66**

Strategies to reduce odours can either be to prevent the gaseous emissions, cover gaseous emissions, or reduce particles carrying odour or prevent drift of particles carrying odour.

Farm Nuisance - Odour

Vegetative Buffers. Through the establishment of adequate buffers, odours can usually be managed to reduce nuisance or pollution. The use of vegetative buffers surrounding exhaust fans and farm boundaries, **Figure 10.3 , 10.4 and 10.5**, can effectively reduce the impact of odours.

- Install vegetative buffers around exhaust fans or farm borders.
- Seek expert guidance when attempting to construct vegetative filters for odour or dust reduction purposes.

➔ see Buffers, **page 11-4**

Demonstration site summaries of vegetative buffers being used for odour management in BC

Vegetative Buffers for Intensive Agricultural Operations in BC

BC Vegetative Buffers Website

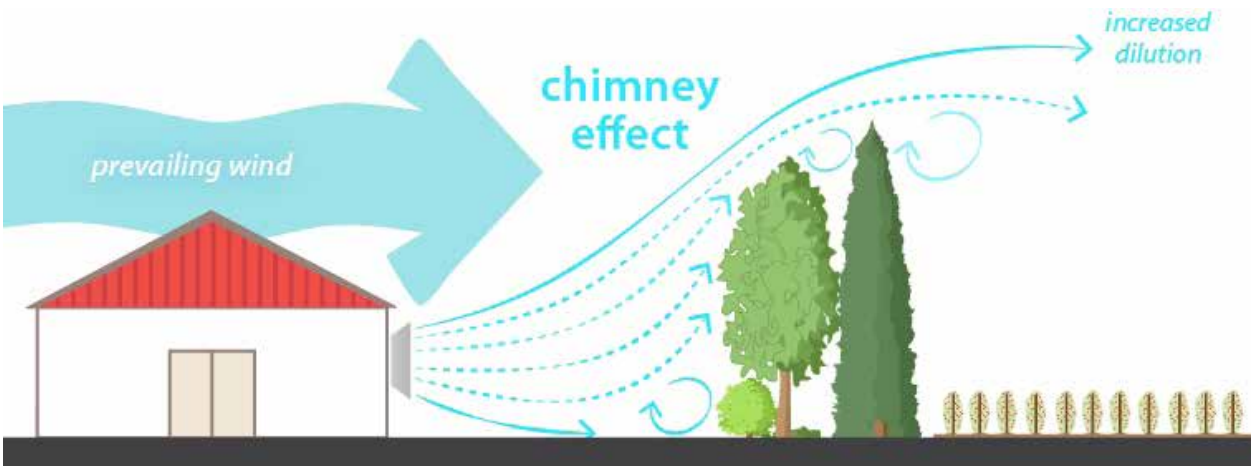


FIGURE 10.4 Vegetative Buffer Around Ventilation Exhaust

FIGURE 10.5 Example of Vegetative Buffer Between Farms

Outdoor Livestock Odour Reduction

Implement the following practices to reduce odours from outdoor livestock areas:

- Handle the manure as a solid and keep it as dry as possible, or mix in bulking agents.
- Minimize the area covered by manure in confined livestock areas.
- Clean pens often and move manure to storage facilities.
- Drain puddles and other standing water.
- Remove livestock mortalities promptly and dispose in an approved manner.

Indoor Barn Odour Reduction

Implement the following practices to reduce odours from barns:

- Handle solid manure in as dry a state as possible.
- Remove wet manure from buildings frequently.
- Remove dead animals promptly and dispose in an approved manner.
- Install vegetative buffers surrounding barn exhaust fans.
- Use mechanical filters on barn exhaust to trap odorous dust particles.

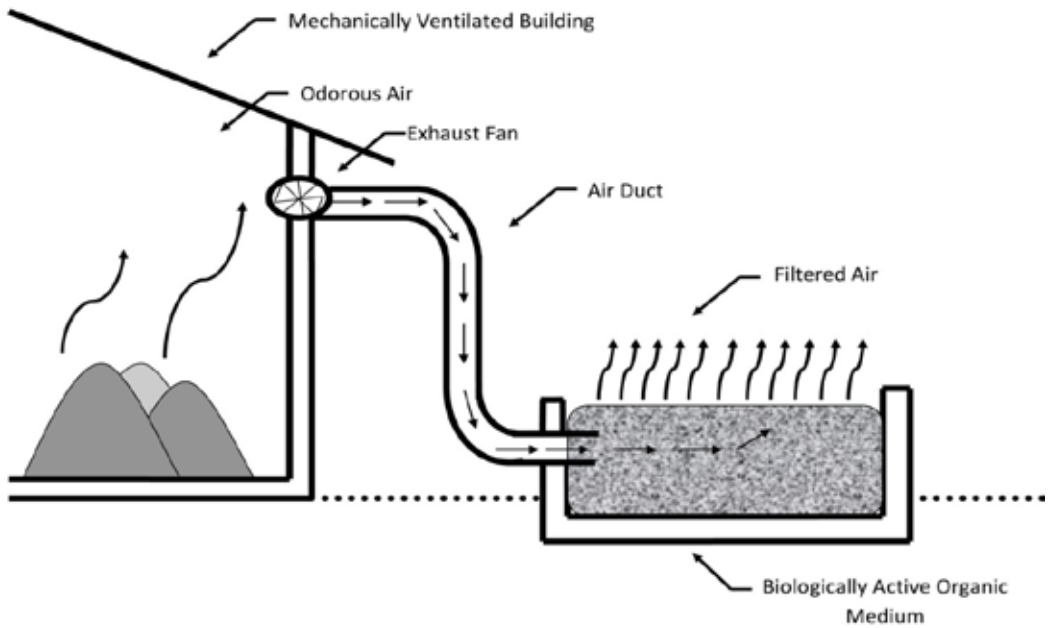
➔ see Indoor Poultry and Livestock Housing, **page 3-2**, and refer to Protection of Air Quality

- Use chemical or biological odour control agents when other management methods are unsuccessful.
  - Several such agents are available commercially, but they have been used in the past with varying degrees of success.
  - Evaluate odour control products on farm before buying large quantities.

Biofilters. Biofilters are used in farm operations to trap and degrade odours within the air before they leave an indoor facility. Biofilters trap particulates that can carry odorous compounds and also reduce ammonia and hydrogen sulphide emissions by providing an environment for biological degradation of the trapped compounds.

- Use biofilters or filters on barn exhaust systems.

➔ see Indoor Poultry and Livestock Housing, **page 3-2**, and refer to Protection of Air Quality



Manure Storage and Handling

Long-term storage of manure is a necessity on many farms. Livestock and poultry producers farming on minimal land areas require storage to facilitate the timely sale or delivery of manure to crop producers. Carefully plan and manage the handling, composting, spreading or storage of all wastes to avoid the creation of odorous conditions. Comply with all manure storage regulations and implement the following beneficial management practices to avoid generation of odours:

- Minimize disturbance of stored manure when putting fresh manure into storage tanks.
- Use covers on manure storage areas.
- Minimize surface area of manure to reduce emissions.

➔ see Manure Gas Emissions Reduction, **page 3-42**

Manure Treatment for Odours

In situations where well-managed manure storages or field spreading practices are not enough to control odours, manure treatment options can be considered. These could include aerobic treatment and carbon reduction for liquid manure systems and composting for solid manure. Where appropriate, implement the following manure treatment options:

- Apply regular frequent aerobic treatments by mixing or turning manure to prevent anaerobic conditions.
- Consider neighbouring proprieties my considering the time of the day or week and wind direction for field application.
- Apply additives to manure piles to reduce the impact of odours when land applying.
- Compost manure following the guidelines outlined in Chapter 2.

➔ see Compost, **page 2-48**, and refer to Compost Beneficial Management Practices

➔ see Manure Gas Emissions Reduction, **page 3-42**

OPEN BURNING

The term "open burning"is defined in the *Open Burning Smoke Control Regulation* means the combustion of vegetative debris using an open fire, other than:

a) For a domestic or agricultural purpose, if all of the vegetative debris is branches or other pieces of vegetative debris, with or without leaves, each branch or piece of which is less than 3 cm in diameter, and includes foliage referred to in section 6 (5) (e) of the *Environmental Management Act*, or

b) A campfire.

An "open fire" meanse the combustion of material without using a stack or chimney to vent the emitted products of combustion to the atmosphere.

OPEN BURNING ENVIRONMENTAL CONCERNS

Primary environmental concerns related to open burning are:

- Release of fine particles into the air that:
  - Results in a health risk from inhaling the particulate;
  - Results in visual impairment from the particulate.
- Escape of the open fire that results in a fire safety risk to the environment.
- Release of greenhouse gases, mainly carbon dioxide (CO_2) and release of other air contaminants that effect local air pollution.
- Release of other contaminants as a result of illegal burning of waste other than agricultural debris (e.g., plastics, coated woods and waste, solvents, wire, etc.).
  - Results in health risks from inhaling the particulate; and
  - Results in health risks and environmental risks from deposition of contaminants in the localized environment.

For information on these concerns:

➔ see Air Emissions, **page 10-7**

OPEN BURNING LEGISLATION

The following is a brief outline of the main legislation that applies to open burning.

➔ see **page A-1** for a summary of these and other Acts and Regulations

Because burning is practiced in a wide range of farm activities, agriculture is given special consideration in legislation. Both municipal and provincial governments regulate open burning. Before carrying out any burning operation, check for:

- Restrictions imposed by local government bylaws.
- Pollution concerns regulated by ENV under the *Environmental Management Act.*
- Fire safety concerns regulated by the Ministry of Forests, Lands and Natural Resource Operations under the *Forests and Range Practices Act.*

Note: the following is only a summary of burning requirements, contact all relative agencies regarding necessary details before igniting any fire.

Local Bylaws

Local fire departments, municipalities, improvement districts or regional districts may have smoke management plans (guidelines), specific bylaws or restrictions on open burning. Farms are not necessarily exempt from these local bylaws, particularly smoke control bylaws, and operators should check with their local or regional government. Local bylaws can be more restrictive than provincial regulations. For instance, a municipality or regional district can have a 'fire' bylaw that covers open burning. Local governments often have a burn ban at certain times of the year for fire safety reasons which may include the prohibition and the quenching of all open burning in the area. Requirements and classification of smoke sensitivity zones for open burning may also be substituted with another for a given time, if deemed necessary. Check with the local government office or the fire department to find out about the rules and restrictions. A permit may be required. A permit for burning diseased material may be given during restricted times in extreme circumstances, check with the local fire department about potential exemptions from the local bylaw.

Where local regulatory requirements are more stringent, they apply over provincial legislation.

Farm Practices Protection (Right to Farm) Act

This Act protects farmers from liability in lawsuits alleging nuisance associated with odour, noise, dust or other disturbance resulting from the farm operation when they meet certain regulatory conditions. The applicability of a burning bylaw to a farm in relation to the *Farm Practices Protection (Right to Farm) Act* (FPPA) depends on the authority under which the bylaw was prepared. The FPPA provides that a farmer is not liable in nuisance to any person for any odour, noise, dust or other disturbance resulting from that farm operation. However, for this protection to apply, the farmer must comply with the *Environmental Management Act* (EMA), among other things.

Environmental Management Act

The *Open Burning Control Regulation* applies to open burning for a domestic or an agricultural purpose as follows:

a) If all of the vegetative debris open burned is branches or other pieces of vegetative debris, with or without leaves, each branch or piece of which is less than 10 cm in diameter but of which at least some of the individual branches or pieces are 3 cm or greater, only Sections 9, 12 and 30 of this regulation apply to the open burning;

b) If all of the vegetative debris is branches or other pieces of vegetative debris, with our without leaves, of which at least some of the individual branches or pieces are 10 cm or greater in diameter, this regulation applies with respect to the open burning:

If the burning of agricultural vegetative debris is branches or other pieces of vegetative debris of which the pieces are less than 3 cm in diameter, then this regulation does not apply. However, local bylaws regarding burning and smoke control will continue to apply.

There are specific standards and exemptions under the *Open Burning Smoke Control Regulation* and *Code of Practice for Agricultural Environmental Management* for various materials burned on the farm. A waste discharge approval or permit for burns is not required under this Act for:

- Agricultural burning of leaves, crops, weeds, foliage or stubble.
- Residential (i.e., backyard) burning of leaves, foliage, weeds, crops or stubble.
- Burns that satisfy all the terms and conditions set out in the *Open Burning Smoke Control Regulation*.
- Burns conducted to comply with the *Weed Control Act*.

Agricultural vegetative debris diameter (cm) Application of OBSCR

- < 3cm Exempt (local bylaws still apply).
- > 3cm to < 10cm Burning must stay within 5 km of original location.
- Prohibited materials must not be included nor used as an accelerant.
- Must adhere to any prohibitions issued by a Director.
- > 10cm No exemptions.

In addition, specific requirements are set forth for the burning of diseased vegetative debris (see Division 3, SECTIONS 24 AND 25).

All other burns (e.g., household, industrial) require a waste discharge approval or permit from ENV.

Under the *Environmental Management Act*, Metro Vancouver has been delegated authority to manage air quality within its boundaries. Open burning in Metro Vancouver will typically require a permit or approval from Metro Vancouver.

Even though permitted, open burning must not pollute the air. SECTION 2, Schedule 1 of the *Waste Discharge Regulation* provides a list of materials that are prohibited from being open burned.

The *OBSCR* sets forth regulations for open burning based on smoke sensitivity zones, which are categorized as High, Medium, and Low. These zones are listed in Schedule 3 of the regulation. The regulations pertaining to duration and venting index vary depending on sensitivity zone. See Part 3 Division 1 of the OBSCR for more information on smoke sensitivity zones. Regardless of smoke sensitivity zone, the OBSCR requires a burn operator to (see Table 10.3 on **page 10-28** for the full list of prohibited materials):

- Explore all possible options to reduce, reuse or recycle as much of the material as possible (i.e., not burn).
- Burn only vegetative debris such as foliage branches, limbs, roots, shrubs, etc.
- Only burn the targeted vegetative debris within 5 km radius of where it originates from.
- Do not burn prohibited materials, or substances that normally emit dense smoke or noxious odours.
- Burn the material more than 500 m from a neighbouring residence or business and more than 1,000 m from a hospital, continuing care facility, or school unless otherwise exempted under SECTION 4. These setbacks may be relaxed to 100 m and 500 m respectively if specific best management practices are undertaken. See Part 2, SECTION 13(2) of the OBSCR.
- Open burning may be prohibited if it poses a hazard to population centres, work camps, or airports by significantly reducing visibility.
- Ensure that the ventilation index is:
  - "Good" on the day the burn is started and forecast to be "good" or "fair" on the second day for burning in high and medium smoke sensitivity zones, and
  - "Good" or "fair" on the day the burn is started and forecast to be "good" or "fair" on the second day for burning in high and medium smoke sensitivity zones (see the regulation for further information and requirements).

  BC Venting Index

- Ensure satisfactory control and feeding of the fire, and make sure adequate equipment and staff are available to ensure the regulatory limits are met.
- Follow all of the burning restrictions that are relevant to the smoke sensitivity zone.
  - These restrictions include a smoke release period and restrictions on the number and frequency of burns per year that is no more than 12 days per calender year and 6 days in each month on a small, private land within a high smoke sensitivity area (see regulation for further information and requirements).
  - Ensure that all reasonable efforts are taken to minimize the amount of smoke emitted by open burning (see Part 2, SECTION 11 in the OBSCR for further information).
  - Ensure that proper records are made and kept if open burning is carried out using one or more category 3 open fires or air curtain incinerators.
  - A list of smoke senstivity zones can be found in Schedule 3 of the OBSCR.

  BC Open Burning Regulation Map

  BC Open Burning Smoke Control Regulation Information Page

  Interactive GIS Map of Venting in BC

Wildfire Act

This Act regulates **open fires within 1 km of forest land or grass land.** It is administered by the Ministry of Forests, Lands and Natural Resource Operations.

- SECTION 2: requires reporting a forest land or grass land fire.
- SECTION 3: prohibits dropping, releasing or mishandling a burning substance, or any other thing that the person reasonably ought to know is likely to cause a fire.
- SECTION 4: states Section 5 & 6 do not apply to the City of Vancouver or a municipality or a local government having an open fire bylaw.
- SECTION 5 & 6: regulates non-industrial and industrial open fires.

Wildfire Regulation. This regulation applies to all **open fires within 1 km of forest land or grass land**.

- SECTIONS 4 – 12: outline fire prevention requirements.
- SECTIONS 13 – 17: outline fire control requirements.
- SECTIONS 18 – 24: outline permissible open fires (category 1, 2, 3 and resource management fires) - a burn registration number is required for category 3 fires – call toll free **1-888-797-1717.**
- SCHEDULE 1: outlines three Danger Regions of BC.
- SCHEDULE 2: defines five different Fire Danger Classes using a matrix of Build-up Index and Fire Weather Index.
- SCHEDULE 3: provides restrictions on High Risk Activities as required in Section 6(3).

Category 1 Open Fire. Camp fires and piles under 1 m in height and diameter

Category 2 Open Fire. For open fires that are:

- No more than 2 piles that are less than 2 m in height and 3 m in width;
- Or burns of stubble or grass over an area not exceeding 0.2 ha.

Category 3 Fires. For open fires that are:

- Burning material in 3 or more piles not exceeding 2 m in height and 3 m in width;
- Or for 1 or more piles exceeding 2 m in height and 3 m in width;
- Or for one or more windrows, or for burning stubble over an area exceeding 0.2 ha.

BC Wildfire Service website for fire information including the Fire Danger Class information for areas of BC

OPEN BURNING BENEFICIAL MANAGEMENT PRACTICES

Comply with applicable open burning related legislation, including the above, and where appropriate, consider the following beneficial management practices to protect the environment.

Open Burning

The risks associated with outdoor fires are the reason for local and provincial regulations.

- Whenever possible, consider alternatives to burning such as:
  - Reducing the size of the materials (such as by chipping) to allow it to be used as mulch or used as a compost material.
  - Recycling as much material as possible before burning.
- Any fire attendee should have equipment and water on hand appropriate to control for the size and type of fire. Follow the information in the *Wildfire Act* and *Regulation.*
- Use the flow chart in **Figure 10.6 on page 10-27** to determine if the *Open Burning Smoke Control Regulation* applies to the open burn.

Alternatives to Open Burning in BC (Directory)

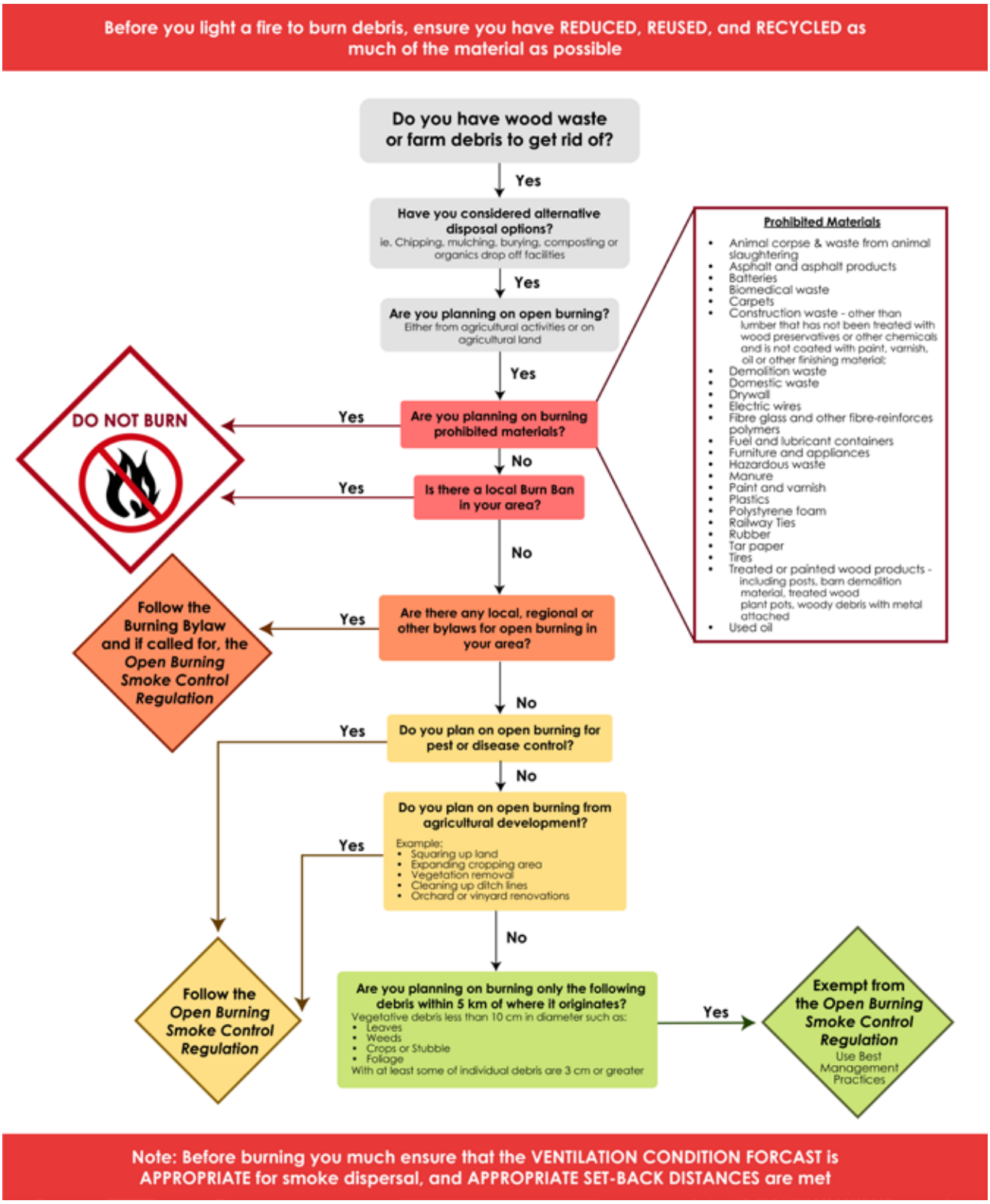


FIGURE 10.6 Burning Practices Flow Chart

Where agricultural burning is necessary (if the option of chopping the vegetative residue and/or applying it to land has already been explored), many smoke-related problems result from poor open burning practices. Emissions containing particulate matter from open burning can limit visibility, release harmful gases, and aggravate respiratory conditions in susceptible individuals. Particulate emissions and pollution can be reduced by implementing the following practices to reduce smoke production:

- Build good piles with clean, dry debris (do not include stumps, rocks, or soil) to reduce smouldering stage.
  - Pile to approximate a haystack shape where the material does not splay out at the sides, and the dimensions approximate a base-to-height ratio of 1:1.
  - Avoid overloading of fires that may restrict combustion, and cause smouldering and increased smoke.
- Minimize the smouldering stage, as this stage can contribute more than half of the total particulate emitted during the burn.
- Control the fuel properties.
  - Avoid compaction of the material.
  - Allow fuel to dry before burning to reduce the moisture content of the pile.
- Use forced air technology (i.e., air curtain incinerators, or other appropriate air-assist technology) as these can reduce emissions by up to 90%.
- Avoid burning during periods of calm stable air or when the venting index is poor, when smoke is unlikely to disperse properly.
- Use wood residue as heating fuel instead of open burning.
- Follow local smoke management plans guidelines on open burning within your municipality.
- Use controlled burning, in conjunction with regional wildfire risk abatement plans, to lower the wildfire hazard risk around farm infrastructure.
- Follow required setback distances from residences, schools, and hospitals, as detailed in the OBSCR SECTION 13.

Note: ensure that there are no contaminants in the fire, such as tires, plastic or other prohibited materials , as listed through the *Waste Discharge Regulation*. SECTION 2, Schedule 1. (see **Table 10.3**)

TABLE 10.3 Materials Prohibited from being burnt under the *Waste Discharge Regulation*

animal carcasses and waste from animal slaughtering	hazardous waste
asphalt and asphalt products	manure
batteries	paint and varnish
biomedical waste	plastics
carpets	polystyrene foam
construction waste other than lumber that has not been treated with wood preservatives or other chemicals and is not coated with paint, varnish, oil, or other finishing material	railway ties
demolition waste	rubber
domestic waste	tar paper
drywall	tires
electrical wire	treated or painted wood products
fibreglass and other fibre-reinforced polymers	used oil
fuel and lubricant containers	

CHAPER 11 METRIC CONVERSIONS

Metric	Imperial Equivalent
5 m	16.5 feet
7 m	23 feet
8 m	26 feet
30 m	100 feet

Conversions in this table are rounded to a convenient number.
See Appendix E for exact conversion factor.

Values from tables and examples are not included in Metric Conversions

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CHAPTER 11

STEWARDSHIP AREAS

INTRODUCTION

This chapter discusses stewardship areas for protection of the environment. It contains introductory information on the relationship between these areas and the environment. It also contains information on environmental concerns, legislation and beneficial management practices related to:

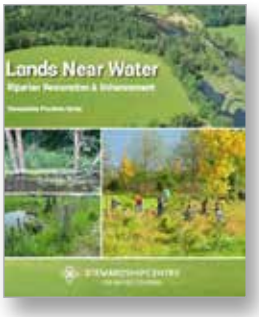
- buffers
- riparian areas

STEWARDSHIP AND SUSTAINABILITY

Stewardship. This term is often used when dealing with issues surrounding the environment. Stewardship can be loosely defined as "taking care of something", but in environmental terms, can mean *"the careful planning and beneficial management of our resources, including the people and wildlife that depend on them".*

Stewardship is not only important to aquatic life and wildlife but to landowners as well. Healthy streams and riparian areas create a positive influence, for example, on the health of adjacent uplands, which are often productive farmland. Similarly, stewardship of native grasslands ensures continued biodiversity and resulting economic returns to the farm by creating long-term livestock forage availability. ➔ see Stewardship Crops, **page 4-13**

- Stewardship Options for Private Landowners in B.C.
- Fringe Benefits: A Landowner's Guide to the Value and Stewardship of Riparian Habitat
- Farm Practices Habitat Management
- Best Management Practices: Farm Forestry and Habitat Mangement
- Land Development Guidelines for Protection of Aquatic Habitat
- Agricultural Building Setbacks from Watercourses in Farming Areas
- Lands Near Water – Riparian Restoration and Enhancement
- Agricultural Waterways – Drainage Management and Restoration



Sustainability. The root of this term is "sustain", and could be defined as "management that meets the needs of the present without compromising the ability of future generations to meet their own needs".

Sustainability is actions and considerations practiced by agricultural producers that use farm resources to ensure the success of the farm in a manner that considers the economic, environmental and social outcomes. When applied to natural resources, sustainability considers all parameters to ensure their long-term viability and success.

BUFFERS, RIPARIAN AREAS, AND THE ENVIRONMENT

Environmental concepts related to buffers and riparian areas are listed in alphabetical order below.

Buffers

Are generally defined as specially managed areas used to separate farm activities from sensitive areas that may be impacted by those activities.

Buffers can function as a barrier to reduce the risk of contamination or as an active or passive "treatment system" to remove contaminants before they reach sensitive areas. Most buffers are either a specially managed area of crops, a combination of crops and trees, or designed landscape plantings, and can include physical barriers such as fences, walls or berms. Buffers may be situated adjacent to farm buildings, manure storages, watercourses, or fields which receive manure or pesticides and are meant to protect watercourses, wells, roads, trails, and recreational or urban areas from adverse impacts. Buffers can provide a multitude of other benefits such as:

- Reducing erosion and runoff;
- Enhancing aquatic and terrestrial habitat;
- Increasing soil productivity;
- Providing aesthetics and visual barriers;
- Reducing noise, odour and dust;
- Providing stable microclimates;
- Providing economic diversification;
- Providing carbon sequestration in vegetative buffers to offset greenhouse gas emissions and helping farm operations adapt to climate change.

Many other terms are used in place of the word 'buffer' depending on their intended use. These include shelterbelt, windbreak, landscaped buffer, trap crop, catch strip, vegetative filter strip, hedgerow, conservation buffer, field margin, living snow fence, or riparian area.

Riparian Areas

Areas bordering watercourses or wetlands are known as riparian areas.

Common to all riparian areas are the following:

- A combined presence and abundance of water, either on or close to the surface.
- Vegetation that responds, requires and survives well with abundant water.
- Soils that are modified by abundant water, stream or wetland processes and lush, productive and diverse vegetation.

The riparian areas along watercourses include the banks, a diverse array of plants and animals and the floodplain. A riparian area can be part of a buffer. See **Figure 11.1**.

Riparian Management Field Workbook

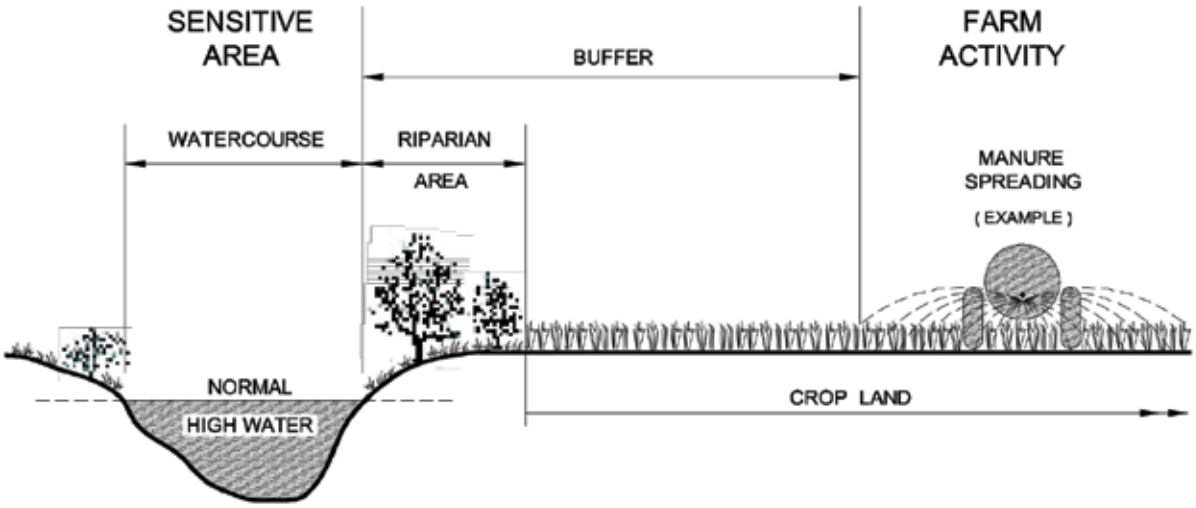


FIGURE 11.1 Relationship between Buffers and Riparian Areas

Stewardship Areas and Climate Change

Multi-functional buffers and riparian areas can serve an important role in both mitigating and adapting to climate change. Buffer and riparian zone vegetation and soils have high capacity to sequester carbon and offset greenhouse gas emissions. Buffers of all types help to moderate extreme weather events and increase farm resilience to climate change.

A setback is a distance separating two things. It is not meant to be a treatment area like buffers. For instance, a setback may be required between a property line and a building.

➔ see Farm Building Siting, **page 2-8**

BUFFERS

BUFFER ENVIRONMENTAL CONCERNS

Primary environmental concerns related to ineffective or non-existent buffers are:

- Contaminated runoff reaching a watercourse.
- Pesticide drift causing air, water, or soil pollution.
- Unreasonable odour, noise, or dust reaching neighbours.
- Uncontrolled temperature management resulting in inefficient heating or cooling of livestock, equipment and buildings.
- Soil erosion by wind or water.
- Weed, insect, or disease pest invasions.
- Unreasonable disturbances of wildlife at crucial times of the year.
- Lost opportunities to sequester carbon and offset greenhouse gas emissions from multi-purpose vegetative buffers.
- Less resilience of agricultural operations to adapt to climate change.

For detailed information on these concerns:

➔ see Impacts on Biodiversity and Habitat, **page 7-7**, and refer to Farm Activities and Impacts

➔ see Water Quality and Quantity Factors, **page 9-1**, refer to Contaminants

➔ see Air Quality Factors, **page 10-1**, refer to Contaminants, to Dust and Particulates

BUFFER LEGISLATION

The following is a brief outline of the main legislation that applies to buffer use.

➔ see **page A-1** for a summary of these and other Acts and Regulations

Local Bylaws

Local governments may regulate aspects such as setbacks to control odour, noise and nuisance issues.

Environmental Management Act

The *Code of Practice for Agricultural Environmental Management* requires persons to use environmentally responsible and sustainable agricultural practices when carrying out agricutural operations, for the purpose of minimizing the introduction of waste into the environment and preventing adverse impacts to the environment and human health.

The *Code of Practice for Agricultural Environmental Management* has requirements for agricultural wastes practices and setbacks:

- PART 4 (SECTIONS 14-19): Setback requirements (from drinking watercourse, water course, and property boundary) for storage of agricultural by-products, agricultural composting processing, wood residue storage and application, nutrient application, confined livestock and poultry areas, on-ground feeding locations or mobile feeding bins, and composting and burial pits.
- PART 6 (SECTIONS 31-60): Collection, storage, and use requirements for agricultural by-products (including compost and wood residue).
- PART 7 (SECTIONS 61-76): Slaughter, mortalities, and processing waste (including land applications of wastewater and agricultural compost).

One way of meeting these AEM Code requirements is to have effective buffers.

Water Sustainability Act

The *Water Sustainability Act* (WSA) is the principal law for managing the diversion and use of water resources, and changes in and about a stream.

The following SECTIONS of the WSA may be useful to agricultural operators in particular:

- SECTION 6: Prohibits diverting water without a licence except in limited circumstances for fire suppression, domestic use and mineral prospecting.
- SECTION 11: Requires approvals for making changes in and about streams.
- SECTIONS 16 & 17: May require mitigation measures on (sensitive) streams where a water diversion or use is authorized.
- SECTION 45: No new dams on protected rivers
- SECTION 88: In the case of low or impending low water, for the purposes of protecting the fish population, the minister may make an order regulating the diversion, rate of diversion, time of diversion, storage, time of storage and use of water from the stream by holders of licences or approvals in relation to the stream or aquifer connected hydraulically to the stream
- SECTION 128: Regulations respecting sensitive streams

The *Water Sustainability Regulation* contains the rules for applications for licensing of surface and groundwater diversions and use, and for "changes in and about a stream".

Riparian Areas Protection Act

The *Riparian Areas Protection Act* creates the authority for government to enact Provincial directives to protect areas that border streams, lakes, and wetlands. The *Riparian Areas Regulation* (RAR) calls on local governments to protect riparian areas during residential, commercial, and industrial development by ensuring that a Qualified Environmental Professional (QEP) conducts a science-based assessment of proposed residential, commercial, and industrial activities in riparian areas.

With this Act, and through the *Riparian Areas Regulation*, local governments in certain regions of the Province are able to protect riparian areas during residential, commercial, and industrial development by ensuring that a Qualified Environmental Professional (QEP) conducts a science-based assessment of proposed activities. This includes residential buildings on land zoned for agricultural purposes. Section 12 provides Provincial directives on streamside protection.

The RAR only applies to the residential portion of the farm and only in the southern half of BC. The RAR does not apply to farm practices as defined in the *Farm Practices Protection Act*. In some cases, this can lead to the misunderstanding that the RAR does not apply to lands zoned for agriculture, or in the Agricultural Land Reserve (ALR). The RAR does apply to these lands for activities that are not *farm practices*, for example residential construction. It is important to note that local governments have the ability to establish bylaws that apply to agricultural lands, and some have implemented setbacks for agricultural buildings that complement the setbacks designated under RAR. Guidelines for **Agricultural Building Setbacks from Watercourses in Farming Areas** have been developed and incorporated into the Guide for Bylaw Development in Farming Areas.

Integrated Pest Management Act

Administered by BC Ministry of Environment and Climate Change Strategy, this Act regulates the sale, containment, transportation, storage, preparation, mixing, application and the disposal of pesticides and their containers.

SECTION 3(1): Without limiting any other provision of this Act, a person must not (a) use a pesticide that causes or is likely to cause, or use, handle, release, transport, store, dispose of or sell a pesticide in a manner that causes or is likely to cause, an unreasonable adverse effect.

It is important for producers to ensure that their pesticide application practices adhere to Section 3(1), as described above, because it may be applied when a drift incident is being investigated in order to determine if the use of the pesticide resulted in an unreasonable adverse effect, or if the action was likely to cause the unreasonable adverse effect.

This Act and the *Integrated Pest Management Regulation* require pesticides to be used according to label directions, such as a specified buffer distance.

Pesticide storage and safe handling practices may be reviewed by a Ministry inspector or a Conservation Officer (also designated as an inspector under the IPM Act) during a farm inspection

Fisheries Act

Administered by both Fisheries and Oceans Canada and Environment and Climate Change Canada, this Act is established to manage Canada's fisheries resources, including fish habitat. The Act can also be administered provincially by FLNRORD and ENV. The Act applies to all Canadian waters that contain fish, including ditches, channelized streams, creeks, rivers, marshes, lakes, estuaries, coastal waters and marine offshore areas. It also applies to seasonally wetted areas that provide fish habitat such as shorelines, stream banks, floodplains, intermittent tributaries and privately owned land. The Act includes provisions for stiff fines and imprisonment to ensure compliance.

The purpose of this Act is to provide a framework for (a) the proper management and control of fisheries; and (b) the conservation and protection of fish and fish habitat, including by preventing pollution.

This Act was updated in 2019 and now empowers the Minister to make regulations for the purposes of the conservation and protection of biodiversity.

The definition of fish habitat is: "water frequented by fish and any other areas on which fish depend directly or indirectly to carry out their life processes, including spawning grounds and nursery, rearing, food supply and migration areas". The quantity, timing and quality of the water flow that are necessary to sustain fish habitat are also deemed to be a fish habitat. Furthermore, serious harm to fish includes the death of fish or any permanent alteration to, or destruction of, fish habitat.

Provisions of the *Fisheries Act* relevant to agricultural operations include:

- Protection for all fish and fish habitats;
- Prohibition against the death of fish or the 'harmful alteration, disruption or destruction of fish habitat';
- A permitting framework and codes of practice to improve management of large and small projects impacting fish and fish habitat.
- Protection of fish and/or fish habitats that are sensitive, highly productive, rare or unique; and
- Consideration for the cumulative effects of development activities on fish and fish habitat.

Specific sections of the Act include:

SECTION 34.2(1) The Minister may establish standards and codes of practice for:

(a) The avoidance of death to fish and harmful alteration, disruption or destruction of fish habitat;

(b) The conservation and protection of fish or fish habitat; and

(c) The prevention of pollution.

SECTION 34.4 (1) No person shall carry on any work, undertaking or activity, other than fishing, that results in the death of fish.

SECTION 35 (1) No person shall carry on any work, undertaking or activity that results in the harmful alteration, disruption or destruction of fish habitat.

Every person who contravenes subsection 34.4(1) or 35(1) is guilty of an offence and liable.

Notifying authorities about serious harm to fish or deposit of a deleterious substance:

SECTION 38 (4.1) Every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations of a harmful alteration, disruption or destruction of fish habitat that is not authorized under this Act, or of a serious and imminent danger of such an occurrence, if the person at any material time

(a) Owns or has the charge, management or control of the work, undertaking or activity that resulted in the occurrence or the danger of the occurrence; or

(b) Causes or contributes to the occurrence or the danger of the occurrence.

SECTION 38 (5) If there occurs a deposit of a deleterious substance in water frequented by fish that is not authorized under this Act, or if there is a serious and imminent danger of such an occurrence, and detriment to fish habitat or fish or to the use by humans of fish results or may reasonably be expected to result from the occurrence, then every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations.

SECTION 38 (7) As soon as feasible after the occurrence or after learning of the danger of the occurrence, the person shall provide an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations with a written report on the occurrence or danger of the occurrence.

Pest Control Products Act

Regulations under this Act require that users of pesticides follow the directions or limitations as shown on the pesticide label which may include the need for buffers.

BUFFER BENEFICIAL MANAGEMENT PRACTICES

Comply with the applicable buffer related legislation, including the above, and where appropriate, use the following beneficial management practices to protect the environment.

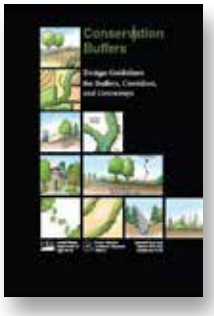
Activities Requiring Use of Buffers

Four specific farm activities may require the establishment of a buffer. **Table 11.1**, lists both the farm areas or activities and the type of buffers that can be used to protect sensitive areas.

TABLE 11.1 Farm Activity and Buffer Type

Farm Activity	Buffer Type	To Protect
Intensive Livestock	Runoff Buffer Mist and Dust Buffer Odour and Noise Buffer	Watercourses, Wells Neighbours, Agricultural Crops Neighbours, Wildlife
Manure Application	Runoff Buffer Mist and Dust Buffer Odour and Noise Buffer	Watercourses, Wells Neighbours Neighbours, Wildlife
Pesticide Application	Runoff Buffer Pesticide Drift Buffer Odour and Noise Buffer	Watercourses, Wells Neighbours, Watercourses, Vegetation, Wildlife Neighbours, Wildlife
Bare or Cultivated Soil	Runoff Buffer Windbreaks and Shelterbelts Mist and Dust Buffer	Watercourses Soil Neighbours

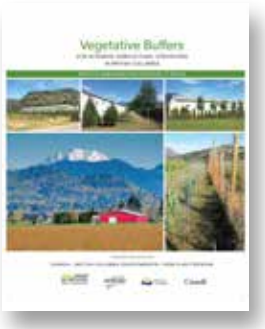
General Buffer Design



Buffers are generally established for a multitude of outcomes and can provide extra insurance against unforeseen environmental problems. However, they should not be intended as the primary means of intercepting sediments and dissolved chemicals generated as a result of poor farming practices or the lack of a nutrient management plan.

Depending on their characteristics (e.g., width, composition, height) and other factors (e.g., weather, emissions, soil type, slope), well-designed and maintained buffers have the capacity to:

- Remove nutrients and pesticides;
- Remove certain pathogens;
- Remove sediment;
- Reduce odour transmission;
- Sequester carbon (equal to 50 percent of the mass of woody vegetation present in a buffer);
- Control erosion and increase water infiltration into soil;
- Protect water quality;
- Reduce dust emissions;
- Stabilize banks and slopes;
- Block wind and snow;
- Provide visual screens;
- Contribute to good neighbour relations.



- Vegetative Buffers for Intensive Agricultural Operations in BC – BMP Guide (2018)
- Conservation Buffers: Design Guidelines for Buffers, Corridors and Greenways (USDA)
- Odor: Can Trees Make a Difference? (USDA)
- BC Vegetative Buffers website
- Buffer Zones website (Alberta Government)
- USDA Conservation Buffers website

Buffer Width. Effective buffer width can vary signficantly depending on its purpose. While there are many resources that provide guidance for specific uses; it may also be useful to experiment with varying widths while monitoring effectiveness. Buffers may be a continuation of a forage field, a separately managed grass area, a planted belt of trees and shrubs, maintenance of a riparian area along a watercourse, or a combination of the above.

Effective buffer widths and composition are a function of:

- Height of buffer vegetation relative to distance to nuisance or pollution source.
- The effectiveness of the vegetation to reduce pollution or nuisance.
- The time of year an activity is occurring.
- The sensitivity of an area to be protected.
- The soil, topographic and climatic conditions associated with a site.
- Habitat values necessary to support biodiversity.

Buffer width can be varied to respond to variability in topography, soil, and other site factors.

- Riparian Buffer Zones: Functions and Recommended Widths

Figure 11.2 shows examples of suggested buffer widths based on a manure spreading activity and its risk of impacting a sensitive area. While this example is for manure spreading equipment, the concept applies to other risk assessment situations as well. Application equipment which places manure accurately and directly on the soil surface will require a narrower buffer than, for example, equipment that distributes manure into the air. In addition, solid manure is less likely to move across a field than liquid manure during application or during subsequent rain events.

An early spring manure application will require a wider buffer than would a summer application. This is due to expected higher rainfalls, greater runoff flow events, and reduced grass nutrient uptake early in the growing season. At the time of application, an assessment of field conditions and forecasted precipitation should be used to evaluate appropriate buffer widths for a specific location,.

- Risk Assessment

When the risk of contaminated runoff flow is high due to conditions such as high rainfall, reduced plant growth, or frozen soil, buffer width and filtering capacity will need to be increased. Vegetative filter strips function best on slopes of less than five percent and are ineffective on slopes greater than fifteen percent. Filter strips are less effective when plants are not actively growing and taking up nutrients.

Buffer Vegetation. Structurally diverse buffers (i.e., buffers with grasses, shrubs, and trees) provide more complexity than buffers with only grass or trees. Select plant species for buffers to:

- Enhance beneficial insects.
- Be non-weedy or non-invasive ➔ see Weeds, **page 5-13.**
- Not be hosts for pests or diseases which could affect adjacent crops.
- Be able to be managed (e.g., by pruning, weed control).
- Have a potential for economic return (e.g., harvest of forage or cuttings).

- Vegetative Buffers for Intensive Operations in BC – BMP Guide (2018)
- A Guide to Agroforestry in BC
- Riparian Management Field Workbook

Monitoring Buffer Effectiveness. Ongoing monitoring is required to ensure that a buffer is accomplishing its intended objectives. Assess the effectiveness and integrity of buffers regularly to ensure that a contaminant or nuisance factor is not reaching sensitive areas. If a buffer is not providing adequate protection of a sensitive area, alter the buffer and/or the farm activity causing the impact.

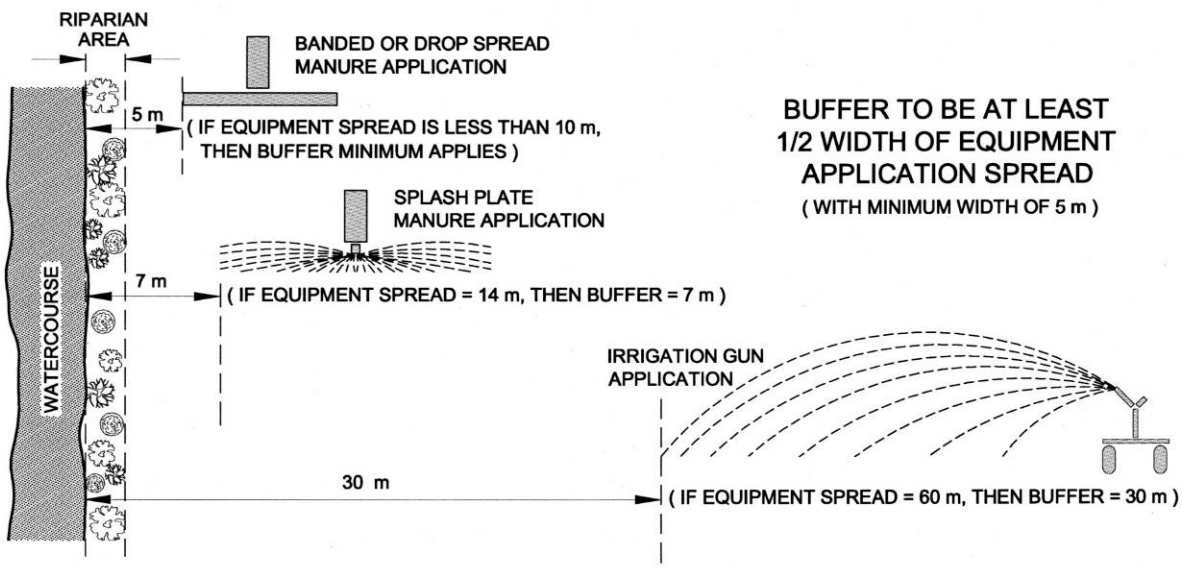


FIGURE 11.2 Suggested Manure Application Buffer Widths Depending Upon Risk of Activity

Runoff Buffers

To establish an effective runoff buffer, it is important to determine and implement the following buffer considerations. Note that buffer areas may need to be recontoured to prevent concentrated overland flow.

- Choose buffer designs (vegetation types, layout and widths) that match the site characteristics and sensitivity of a watercourse in order to:
  - Catch and filter suspended solids such as manure or eroded soil;
  - Allow water carrying dissolved or soluble contaminants, such as nutrients and pesticides, to infiltrate the soil;
  - Minimize bank erosion.
- Choose buffer designs that have a variety of vegetation layers (e.g., grass, shrub, tree) as these are often most effective at reducing sediment and nutrient runoff.
- Considering adding a herbaceous cover (filter strip), with species like creeping fescue, to increase effectiveness.

In combination with good agricultural practices, buffers are used to minimize the impacts of agricultural activities such as:

- Movement of nutrients, sediment and pathogens to watercourses or wells:
  - From intensive livestock operations.
  - During and after soil amendment applications (e.g., manure).
- Movement of pesticide residue to watercourses and wells after application.

Windbreaks and Shelterbelts

Windbreaks and shelterbelts usually consist of multiple linear rows of various tree and shrub species. They are designed for environmental benefits such as protecting farmsteads and livestock areas, saving energy, enhancing wildlife habitat and for the production of marketable crops. Other agroforestry practices, such as timber belts, silvopastures and alley cropping also provide these environmental benefits.

Windbreaks are specialized design structures such as snow fences or rows of vegetation consisting of trees planted in tight spacings to reduce wind speed, as shown in **Figure 11.4**. They generally are planted at right angles to the prevailing winds to protect crops, soil, livestock and buildings.

Shelterbelts are usually designed with multiple linear rows of trees and shrub species and function much like a windbreak. They have multiple purposes such as providing wildlife habitat, improving the aesthetics of an area, or for harvesting of marketable products.

A windbreak, shelterbelt or other agroforestry practice can provide several benefits such as:

- Protecting buildings from excessive heat loss or gain;
- Protecting roads from wind and snow drift;
- Reducing soil erosion, soil moisture loss and crop stress;
- Altering the microenvironment for enhancing plant growth;
- Providing noise and visual screens;
- Improving air quality by reducing and intercepting dust, chemicals and odours;
- Improving irrigation efficiency;
- Improving habitat connectivity;
- Sequestering carbon.

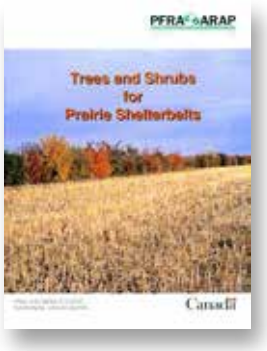
➔ see Other Concepts Related to Climate Change, **page 12-2**

Tree or fence windbreaks may be used to protect buildings, roads, or fields. They have the ability to protect a distance of up to 30 times their height. Tall grass provides soil erosion protection; however, because grasses are more flexible, the protected area will only be 5 to 7 times their height. **Figure 11.5** illustrates the effect of windbreaks on reducing velocity. The optimum density of the windbreak for reduction in wind speed and interception of airborne particulates is 40% to 60%. Density of a planting is defined as the ratio of the solid portion of the planting to the total area planted.

The advantages of windbreaks are especially important in dry years when low crop yields result in insufficient residue cover to protect the crop and soil from the drying effect of wind and temperature. Windbreaks also trap snow, increasing soil moisture for higher crop yields. This yield increase typically offsets yield losses associated with the need to take some land out of crop production for the windbreak planting. Consideration as to species selected for the windbreak must be given, in order to minimize competition for water and unwanted seedling emergence in farm fields.

FIGURE 11.4 Tree Windbreak

- BC Windbreaks, Shelterbelts, Timber Belts, Buffers
- Field Shelterbelts for Soil Conservation (Alberta Government)
- Trees and Shrubs for Prairie Shelterbelts
- Wind and Snow Fences
- BC Fencing Handbook
- Agriculture Canada: Farmyard Shelterbelts



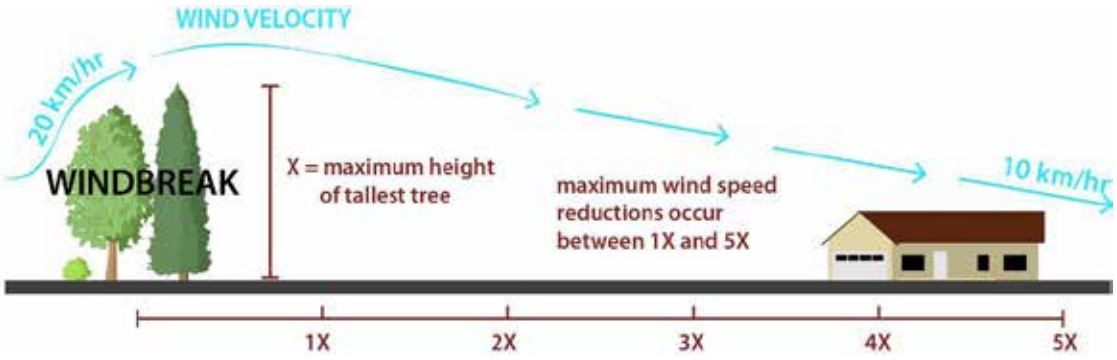


FIGURE 11.5 Approximate Reduction of Wind Velocity by a Single-Row Windbreak

Buffers for Pesticide Drift

Drift refers to the movement of droplets or vapours, by wind or air current, away from target areas. Drift distance is related to the droplet size, with smaller droplets being carried further by air currents. Drift may result from pesticide applications and a buffer area may be helpful in protecting sensitive areas in close proximity or downwind of an application. Buffers, as indicated on pesticide labels, are actually setbacks and are not active or passive treatment systems as described in this chapter. Pesticide buffers (setbacks) are generally intended for watercourses or for non-target terrestrial areas such as shelterbelts, hedges, woodlands, or wildlife habitat. To help reduce the impacts of spray drift it may be necessary to implement the following practices:

- Maintain an untreated buffer between the treated area and downwind sensitive areas;
- Monitor wind direction during spraying to determine when sensitive areas are downwind of the sprayer;
- Follow pesticide labels, in particular check for buffers (setbacks) from watercourses, wells, sensitive vegetation and wildlife habitat;
- Use pesticide beneficial management practices.

➔ see Pesticides, **page 5-15**

➔ see General Buffer Design, **page 11-8**.

Vegetation buffers can be planted to physically intercept drift directly, or to reduce wind speed and therefore drift distance. Note that if vegetation is planted to intercept pesticide drift, then pesticide buffers (setbacks) indicated on the label for sensitive terrestrial areas may have to be followed for the newly planted vegetation.

Buffers for Mist and Dust

Specifications for mist or dust buffers are generally a recommendation of setback distances and species of planting similar to those in windbreaks and shelterbelts. The buffer must be designed to reduce wind velocity in order to allow the particulate matter from agricultural activities to settle out or be trapped on foliar structures like conifer needles. Examples of such activities include fertigation, manure application, dust from field or yard activities, or livestock building ventilation.

Mist Control. Mist refers to the small droplets or vapours generated by farm activities such as manure or pesticide application, (see Buffers for Pesticide Drift above). Mist drift can be reduced by using buffers to trap droplets. To minimize the amount of airborne mist, implement the following practices:

- Use plant density of 40% to 60% to trap mist (the best species for this purpose are conifer tree species such as long needle pines).
- Select plants with dense branching and twig structure.
- Use long lived species requiring low maintenance.
- Use multiple deciduous species with small leaves, and hairy or coarse surfaces.

➔ see General Buffer Design, **page 11-8**

Dust Control. Dust refers to particulate matter or soil carried by wind or air current. Dust can be a substantial irritant or safety concern to workers, neighbours and livestock. To minimize the amount of airborne dust, implement the following practices:

- Ground-level foliage such as grass or shrubs should be planted and maintained to trap dust that exits the barn through exhaust fans.
- Remove dust accumulations from the buffer to ensure that foliage growth remains vigorous and effective.
- Establish vegetative buffers such as shrubs and trees along field margins or roads that generate dust during vehicle movement or field activity.
- Use plant density of 40% to 60% to trap dust (the best species for this purpose are conifer tree species such as long needle pines).
- Select plants with dense branching and twig structure.
- Use long lived species requiring low maintenance.
- Use multiple deciduous species with small leaves, and hairy or coarse surfaces.

➔ see General Buffer Design, **page 11-8**

Buffers for Odour and Noise

Odour Reduction. An odour buffer is characterized by a tightly spaced tree and shrub planting usually planted in close proximity to a livestock facility and perpendicular to the prevailing winds. Most odours generated by livestock facilities travel as particulates suggesting that buffers or shelterbelts can reduce livestock odours by impeding the movements of these particulates. The function of buffers is that the vegetation creates air turbulence causing the odour to either be diluted or trapped within the foliage. For an effective buffer, implement the following practices:

- Establish effective, vegetative buffers between agricultural operations and neighbours.
- Choose tree and shrub species that effectively screen out particulates matter and provide an effective visual screen.
- Consider prevailing winds, screens and terrain when designing odour buffers.
- Monitor odour levels in sensitive areas.

➔ see General Buffer Design, **page 11-8**

Vegetative Buffers for Intensive Agricultural Operations in BC – BMP Guide (2018)

Agricultural Land Commision Landscaped Buffer Specifications

Noise Control. A noise buffer can be a structural barrier such as a noise absorbent or deflective wall, a berm, or a dense vegetative planting consisting of trees and shrubs. Livestock and the operation of equipment can generate significant amounts of noise. Note that vegetation will not stop some sounds such as bird scaring cannons which may need to be deflected by a wall or berm. To reduce noise impacts on humans and sensitive areas, implement the following practices:

- Evaluate the nuisance level of noise created by a specific farm activity.
- Establish a sufficiently large setback from neighbours for structures containing stationary power equipment or livestock.
- Construct a noise barrier or establish an effective vegetative buffer zone by planting a shelterbelt of broadleaf and coniferous trees and shrubs.
- Monitor noise levels in sensitive areas.
- Use the standards established by the Farm Industry Review Board for audible bird scare devices.

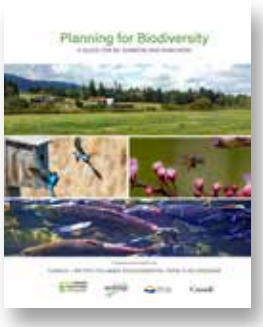
Farm Practice – Wildlife Damage Control – South Coastal BC

Farm Practice – Wildlife Damage Control – Interior BC

➔ see General Buffer Design, **page 11-8**

Buffers for Biodiversity

Shelterbelts, agroforestry practices and buffers can provide benefits to wildlife in several ways, including protection from wind and adverse weather, escape or refuge cover, food and foraging sites, reproductive habitat and travel corridors. Shelterbelts designed for the purpose of wildlife enhancement should be of sufficient size to provide winter food and weather protection appropriate for local climatic conditions. The following buffer practices will help support wildlife:



- Increase the density and diversity of native plant species.
- Establish buffers to minimize auditory and visual intrusion.
  - Length and width will depend on wildlife species and critical life cycle period.
- Maintain buffers to provide connectivity across a landscape.
  - Connectivity is necessary during some critical life cycle periods.

➔ see Planning for Biodiversity, **Chapter 2**

RIPARIAN AREAS

RIPARIAN AREA CONCERNS

Primary environmental concerns related to riparian area protection are:

- Farm buildings located within riparian setback distances resulting in impacts to vegetation and water quality.
- Equipment operation in riparian areas resulting in impacts to vegetation, carbon storage, bank stability and water quality.
- Livestock access to riparian areas resulting in impacts to vegetation, carbon storage, bank stability and water quality.
- Intensive crop production in riparian areas resulting in impacts to vegetation, carbon storage, bank stability and water quality.
- Land clearing and development that results in impacts to vegetation, carbon storage, bank stability and water quality.

For information on these concerns:

➔ see Pest Management, **page 5-3**

➔ see Impacts on Biodiversity and Habitat, **page 7-7**, and refer to Farm Activities and Impacts

RIPARIAN AREA LEGISLATION

The following is an outline of the main legislation that applies to riparian area protection.

➔ see **page A-1** for a summary of these and other Acts and Regulations

Water Sustainability Act

The *Water Sustainability Act* (WSA) is the principal law for managing the diversion and use of water resources, and changes in and about a stream.

The following sections of the WSA may be useful to agricultural operators in particular:

- SECTION 6: Prohibits diverting water without a licence except in limited circumstances for fire suppression, domestic use and mineral prospecting.
- SECTION 11: Requires approvals for making changes in and about streams.
- SECTIONS 16 & 17: May require mitigation measures on (sensitive) streams where a water diversion or use is authorized.
- SECTION 45: No new dams on protected rivers.
- SECTION 88: In the case of low or impending low water, for the purposes of protecting the fish population, the minister may make an order regulating the diversion, rate of diversion, time of diversion, storage, time of storage and use of water from the stream by holders of licences or approvals in relation to the stream or aquifer connected hydraulically to the stream.
- SECTION 128: Regulations respecting sensitive streams.

The *Water Sustainability Regulation* contains the rules for applications for licensing of surface and groundwater diversions and use, and for "changes in and about a stream."

Riparian Areas Protection Act

The *Riparian Areas Protection Act* creates the authority for government to enact Provincial directives to protect areas that border streams, lakes, and wetlands. The *Riparian Areas Regulation* (RAR) calls on local governments to protect riparian areas during residential, commercial, and industrial development by ensuring that a Qualified Environmental Professional (QEP) conducts a science-based assessment of proposed residential, commercial, and industrial activities in riparian areas.

With this Act, and through the *Riparian Areas Regulation*, local governments in certain regions of the province are able to protect riparian areas during residential, commercial, and industrial development by ensuring that a Qualified Environmental Professional (QEP) conducts a science-based assessment of proposed activities. This includes residential buildings on land zoned for agricultural purposes. Section 12 provides Provincial directives on streamside protection.

The RAR only applies to the residential portion of the farm and only in the southern half of BC. The RAR does not apply to farm practices as defined in the *Farm Practices Protection Act*. In some cases, this can lead to the misunderstanding that the RAR does not apply to lands zoned for agriculture, or in the Agricultural Land Reserve (ALR). The RAR does apply to these lands for activities that are not *farm practices*, for example residential construction. It is important to note that local governments have the ability to establish bylaws that apply to agricultural lands, and some have implemented setbacks for agricultural buildings that complement the setbacks designated under RAR. Guidelines for Agricultural Building Setbacks from Watercourses in Farming Areas have been developed and incorporated into the Guide for Bylaw Development in Farming Areas.

Wildlife Act

The provincial *Wildlife Act* protects wildlife designated under the Act from direct harm, except as allowed by regulation (e.g., hunting or trapping), or under permit. Legal designation as Endangered or Threatened under the Act increases the penalties for harming a species. The Act also enables the protection of habitat in a Critical Wildlife Management Area.

Fisheries Act

Administered by both Fisheries and Oceans Canada and Environment and Climate Change Canada, this Act is established to manage Canada's fisheries resources, including fish habitat. The Act can also be administered provincially by FLNRORD and ENV. The Act applies to all Canadian waters that contain fish, including ditches, channelized streams, creeks, rivers, marshes, lakes, estuaries, coastal waters and marine offshore areas. It also applies to seasonally wetted areas that provide fish habitat such as shorelines, stream banks, floodplains, intermittent tributaries and privately owned land. The Act includes provisions for stiff fines and imprisonment to ensure compliance.

The purpose of this Act is to provide a framework for (a) the proper management and control of fisheries; and (b) the conservation and protection of fish and fish habitat, including by preventing pollution.

This Act was updated in 2019 and now empowers the Minister to make regulations for the purposes of the conservation and protection of biodiversity.

The definition of fish habitat is: "water frequented by fish and any other areas on which fish depend directly or indirectly to carry out their life processes, including spawning grounds and nursery, rearing, food supply and migration areas". The quantity, timing and quality of the water flow that are necessary to sustain fish habitat are also deemed to be a fish habitat. Furthermore, serious harm to fish includes the death of fish or any permanent alteration to, or destruction of, fish habitat.

Provisions of the *2019 Fisheries Act* relevant to agricultural operations include:

- Protection for all fish and fish habitats;
- Prohibition against the death of fish or the 'harmful alteration, disruption or destruction of fish habitat';
- A permitting framework and codes of practice to improve management of large and small projects impacting fish and fish habitat;
- Protection of fish and/or fish habitats that are sensitive, highly productive, rare or unique; and
- Consideration for the cumulative effects of development activities on fish and fish habitat.

Specific sections of the Act include:

SECTION 34.2(1) The Minister may establish standards and codes of practice for:

(a) The avoidance of death to fish and harmful alteration, disruption or destruction of fish habitat;

(b) The conservation and protection of fish or fish habitat; and

(c) The prevention of pollution.

SECTION 34.4(1) No person shall carry on any work, undertaking or activity, other than fishing, that results in the death of fish.

SECTION 35 (1) No person shall carry on any work, undertaking or activity that results in the harmful alteration, disruption or destruction of fish habitat.

Every person who contravenes subsection 34.4(1) or 35(1) is guilty of an offence and liable.

Notifying authorities about serious harm to fish or deposit of a deleterious substance:

SECTION 38 (4.1) Every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations of a harmful alteration, disruption or destruction of fish habitat that is not authorized under this Act, or of a serious and imminent danger of such an occurrence, if the person at any material time.

(a) Owns or has the charge, management or control of the work, undertaking or activity that resulted in the occurrence or the danger of the occurrence; or

(b) Causes or contributes to the occurrence or the danger of the occurrence.

SECTION 38 (5) If there occurs a deposit of a deleterious substance in water frequented by fish that is not authorized under this Act, or if there is a serious and imminent danger of such an occurrence, and detriment to fish habitat or fish or to the use by humans of fish results or may reasonably be expected to result from the occurrence, then every person shall without delay notify an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations.

SECTION 38 (7) As soon as feasible after the occurrence or after learning of the danger of the occurrence, the person shall provide an inspector, a fishery officer, a fishery guardian or an authority prescribed by the regulations with a written report on the occurrence or danger of the occurrence.

Species at Risk Act

The purposes of the *Species at Risk Act* (SARA) are to prevent wildlife species from becoming extirpated or extinct, to provide for the recovery of wildlife species that are extirpated, endangered or threatened as a result of human activity and to manage species of special concern to prevent them from becoming endangered or threatened. Once a species is legally listed, the Act requires that recovery strategies be developed for extirpated, endangered and threatened species, and that action plans be developed where recovery is feasible.

- Schedule 1 of the Act sets out the legal list of species at risk (extirpated, endangered, threatened and special concern) in Canada.

Where the Act applies, it makes it illegal to kill, harm, harass, capture or take a species at risk, or to possess, collect, buy, sell or trade any individual or parts of an individual that is at risk. The Act also prohibits the damage or destruction of either the residence (for example, the nest or den) or the critical habitat of any species at risk. Critical habitat is legally identified in a posted recovery strategy or action plan.

While the Act applies to all land and waters in Canada, these prohibitions only apply to areas of federal jurisdiction including migratory birds, all waters (sea and fresh) in Canada, as well as to all federal lands, including Indian Reserves and national parks, and the airspace above them.

On **private land**, unless an emergency order is made by the federal government, the SARA prohibitions apply only to:

- Aquatic species at risk; and
- Migratory birds listed in the *Migratory Birds Convention Act, 1994* and also listed as endangered, threatened or extirpated in Schedule 1 of the Act.

The provisions of the *Species at Risk Act* (known as the 'safety net') could be invoked on BC crown and private lands using a federal order under the Act if provincial action is not sufficient to protect listed species.

While SARA prohibitions do not apply to species of special concern, the Act does require management plans to be developed for these species.

More information about how the Act applies on private land can be found at:

Species at Risk Act public registry

Migratory Birds Convention Act

Under this Act, the federal government is responsible for implementing a Convention between Canada and the U.S. for the protection of migratory birds and nests. The Canadian Wildlife Service of Environment Canada administers the regulations.

- SECTION 5: of the Act states that, no person shall, without lawful excuse:
  - Be in possession of a migratory bird or nest; or
  - Buy, sell, exchange or give a migratory bird or nest or make it the subject of a commercial transaction.
  - Except as authorized by the regulations.

Under the Regulations:

- SECTION 6: no person shall: disturb, destroy or take a nest, egg, nest shelter, eider duck shelter or duck box of a migratory bird without permit.
- SECTION 24(1): any person may, without a permit, use equipment, other than an aircraft or firearms, to scare migratory birds that are causing, or are likely to cause damage to crops or other property (other control measures require a permit).
- SECTION 33: no person shall introduce into Canada for the purpose of sport, acclimatization or release from captivity a species of migratory bird not indigenous to Canada except with the consent in writing of the Director.
- SECTION 35(1): prohibits the deposit of oil, oil wastes or any other substance harmful to migratory birds in any area frequented by migratory birds.

Migratory waterfowl populations create demands on the use of adjacent agricultural lands. Under the Act, it is an offence to harm the habitat of any migratory bird while the bird is resident at the site or to release any substance (including pesticides) harmful to migratory birds into areas frequented by them.

Native birds not protected by this Act (grouse, quail, pheasants, ptarmigan, hawks, owls, eagles, falcons, cormorants, pelicans, crows, jays and kingfishers) are protected by the Provincial *Wildlife Act*. Introduced species are not protected (European starling, house sparrow and crested myna).

RIPARIAN AREA BENEFICIAL MANAGEMENT PRACTICES

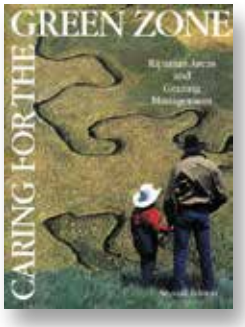
Comply with the applicable riparian area related legislation, including the above, and where appropriate, use the following beneficial management practices to protect the environment.

Riparian Areas

The areas bordering watercourses and wetlands, known as riparian areas, usually have vegetation that is different and more productive than the surrounding upland area due to the presence of water. Stream or wetland health is closely related to the vigour and composition of the border vegetation, which in turn, is an important factor in the condition of the water table and surrounding land. The health of a stream is an indicator of the conditions of the surrounding watershed; a stream, in effect, is an "end product barometer" of a watershed.

In the Interior of BC, riparian areas are easily identified as the green vegetation that is in stark contrast to the brown and yellow vegetation of the drier uplands. In coastal areas of BC, riparian areas may not always have this vegetation contrast. Some of the most endangered plant communities in the Province occur in riparian areas, especially in very dry regions. In these dry areas riparian areas are particularly important to the health of watercourses and the fish and other aquatic life that depend on them. Healthy riparian areas are critical to protecting stream banks and adjacent farmland from erosion.

- BC Riparian Areas website
- Biodiversity and Riparian Areas – Life in the Green Zone
- Caring For the Green Zone: Riparian Areas and Grazing Management
- Riparian Areas – A Users Guide to Health
- Riparian Health Assessment for Streams and Small Rivers – Field Workbook
- Stream Stewardship
- Access Near Aquatic Areas
- Land Development Guidelines for the Protection of Aquatic Habitat
- Riparian Areas: Providing Landscape Habitat Diversity
- Develop with Care – Environmental Guidelines for Urban and Rural Land Development in BC
- Lands Near Water – Riparian Restoration and Enhancement
- Agricultural Waterways – Drainage Management and Restoration



Riparian Functions. A healthy riparian area will demonstrate some of the following key ecological functions:

- Builds and maintains stream banks:
  - Stores floodwater and reduces stream flow energy;
  - Recharges groundwater;
  - Traps sediments;
  - Filters nutrients from water;
  - Increases biodiversity opportunities.
- Shades the stream to reduce solar heat gain.
- Provides overhead cover and protection from raptors.
- Provides important nesting, cover and feeding habitat for breeding and migratory birds and other wildlife.
- Supports insect life for fish.
- Provides large woody debris from riparian areas, which:
  - Provides shelter and resting places for fish;
  - Adds diversity to the in-stream habitat by allowing the formation of pools and spawning areas;
  - Reduces stream flow velocity.
- Sequesters carbon in vegetation and riparian soils, offsetting greenhouse gas emissions.

➔ see Other Concepts Related to Climate Change, **page 12-2**

Riparian Management Field Workbook is a publication that forms a part of the Environmental Farm Plan series on Beneficial Management Practices. Its purpose is to provide an assessment checklist and guidelines for managing farm activities around riparian areas. This information should be used by producers with watercourses on their farms or those who have intensive livestock operations or crop production near riparian areas. **Table 11.2**, below, gives four basic riparian assessment questions found in the Planning Workbook that direct producers to the use of this publication..

TABLE 11.2 Basic Riparian Assessment Questions ★
Are the banks of the watercourse free of damage that results in exposed soil or bank slumping?
Exposed soil or bank slumping can be caused by concentrated overland flow, recreational use, farm equipment or hoof action of livestock. Riparian areas with any exposed soil or bank slumping should be assessed in more detail.
Are all areas of the banks of the watercourse covered with some type of vegetation?
Vegetation protects soil from the impact of storm events that could carry soil from stream banks into the watercourse. Any riparian areas missing some vegetation should be assessed in more detail.
Are shrubs and trees present on all watercourse banks? (not applicable if trees or shrubs are not native in that location or if the watercourse is a constructed ditch)
Shrubs and trees have deeper roots than grass and other herbaceous plants providing a root mass that is more resilient to the impact of flood events and stream scour on stream banks. Any riparian areas that have less than 15% total canopy cover of trees and shrubs (where they should occur naturally) should be assessed in more detail.
Do shrubs along or near the watercourse edge grow without a mushroom or hedged appearance?
Mushroom or hedge shaped riparian shrubs are an indication of over grazing. Riparian areas with shrubs in this condition should be assessed in more detail.

★ Producers with riparian areas lacking these features should refer to the *Riparian Management Field Workbook* publication for detailed assessment and management ideas to improve riparian conditions.

Riparian Functioning Condition. To evaluate the health of a riparian area, the functioning condition of the area is assessed. Functioning condition is a term that refers to the interactions between the soil, water, geography and vegetation of a site. There are three levels of functionality as shown in **Figure 11.7.**

- **Healthy or proper functioning condition:** healthy riparian areas with the most stable, non-eroding lands, the best fish and wildlife habitat and the best agricultural productivity.
- **Healthy but with problems or functional but at risk:** areas that are lacking in some healthy features, and may be experiencing some stream bank erosion, lowering of the water table and fish and/or wildlife habitat may beat risk.
- **Un-healthy or non-functional:** areas that have few if any healthy features, likely to have eroding banks, deepening channels and subsequent lowering of the water table over time, poor fish habitat and poor agricultural productivity.

Riparian Management Field Workbook

Negative impacts on, or loss of, riparian health may also affect the surrounding uplands. Proper functioning condition of riparian areas is the result of good management and benefits all the users within the area, including the landowner.

Some of the key components to management of riparian areas are directly linked to maintaining good soil and water conservation practices across the landscape and preserving, as much as possible, the integrity of the natural riparian zone. Specific land management practices that protect riparian areas include:

- Maintaining a vegetative cover over the soil throughout the year.
- Minimizing animal trampling or vehicle traffic on wet soils.
- Avoiding overuse of fertilizers or manure that may be transported into riparian areas.
- Avoiding applying or disposing of toxic substances on soils.
- Protecting against loss of plant diversity and vitality in riparian areas.
- Protecting against the establishment of exotic or non-water-loving species in riparian areas.
- Avoiding practices that artificially alter streamflow.

Riparian Area Management

In some cases, the condition of the riparian area has diminished to the point that it may require some investment to bring the area up to a healthier or proper functioning condition. Improvement of agricultural riparian areas can occur by implementing the following practices:

- Plant new vegetation.
- Control invasive weeds.
- Encourage a diverse mix of plant species and age that:
  - Are adapted to the climate, soil and water conditions;
  - Fosters a good rooting system for bank stability.
- Protect vegetation from livestock overgrazing or trampling through a grazing management plan by:
  - Considering grazing duration and density in relation to plant growth;
  - Considering stream bank soil moisture content;
  - Consider improving water supply for livestock by providing an off-stream water system or a restricted watercourse access.
- Protect vegetation from harmful pesticide or nutrient management applications.

- Improve stability with erosion control structures by:
  - Contouring terraces with earthworks and seeding;
  - Stabilizing gullies and waterways with erosion control matting, silt fencing, seeding;
  - Stabilizing banks through bank shaping, revetment, gabions, riprap, crib walls, re-vegetation, and blanketing;
  - Utilizing drop inlet and in-channel control structures;
  - Improving infiltration of concentrated water flow with filter trenches, filter wells, diffusing wells, etc.;
  - Installing or upgrading retention ponds and erosion control dams.

Integrated Riparian Management. Agricultural use of riparian areas can occur when the function of the riparian area is maintained. Implement the following practices:

- If livestock are well managed, forages grown in riparian areas can be harvested by grazing such as in riparian pastures.

➔see Outdoor Livestock Areas, **page 3-8** and

➔see Watering Livestock Directly from Watercourses, **page 9-17**

- Traditional crops that are planted, managed and harvested appropriately can be grown in riparian areas, such as hay.

➔see Nutrient Application, **page 6-1**

➔see **Chapter 5,** Pest Management

- Specialty crops that can be harvested by hand can be grown in riparian areas and can include:
  - Floral crops (pussy willow, contorted willow, ferns);
  - Medicinal crops (cascara bark, hawthorn leaves and fruit);
  - Food crops (fiddleheads, berries, nuts) and conifer boughs for the Christmas market.

Healthy or Proper Functioning Condition

- healthy riparian areas with the most stable, non-eroding lands, the best fish habitat and the best agricultural productivity. Other attributes are the ability to: reduce stream energy therefore reducing erosion and improving water quality; filter sediment; capture bedload and aid in floodplain development; improve water retention and groundwater recharge; develop root masses to stabilize banks; develop ponding and channel characteristics to provide fish habitat; support greater biodiversity. This riparian area would probably score as "healthy"

Healthy But With Problems or Functional But At Risk

- areas in a "healthy but with problems condition" are lacking some healthy features indicating that some of their water, soil and vegetation characteristics are at risk, thus leading to some potential stream bank erosion, lowering of the water table or putting fish habitat at risk. This riparian area would probably score as "healthy but with problems"

Non-Functional

- areas that have few if any healthy features, likely to have eroding banks, deepening channels and subsequent lowering of the water table over time, poor fish habitat and poor agricultural productivity. This riparian area would probably score as "unhealthy".

FIGURE 11.7 Examples of Functioning Conditions of Riparian Areas

CHAPER 12 METRIC CONVERSIONS

Metric	Imperial Equivalent
5 °C	41 °F
7 °C	45 °F
0.1 m	0.33 feet
1 m	3.3 feet

Conversions in this table are rounded to a convenient number.
See Appendix E for exact conversion factor.

Values from tables and examples are not included in Metric Conversions

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CHAPTER 12

CLIMATE CHANGE

INTRODUCTION

Agriculture both affects, and is affected by, a changing climate. This chapter discusses farm management practices that provide co-benefits of reducing greenhouse gas emissions that are produced by agriculture and support climate change mitigation and practices, which increase resilience to climate change impacts and support adaptation. Understanding which adaptation measures reduce climate change risks to production is critical to choosing practices that ensure long-term resilience and sustainability of farming and ranching. This chapter also addresses environmental concerns, legislation and beneficial management practices related to:

- Climate change mitigation,
- Climate change adaptation.

Every operation and its location is different, so there is no universal set of climate change adaptation or mitigation practices for agriculture. Options to increase the flexibility and resilience of agriculture under climate change must be evaluated at the farm level and consider changing factors including climate, soils, land use and management patterns, and cost and benefit ratios. In addition to resources listed here, agricultural climate change information is available from the BC Agriculture & Food Climate Action Initiative (CAI), the B.C. Ministry of Agriculture, Food and Fisheries, the B.C. Ministry of Environment and Climate Change Strategy, and other expert sources.

CLIMATE CHANGE FACTORS

Greenhouse Gases (GHGs). When the sun's rays strike the earth, some light energy is converted into heat energy, which can radiate into the atmosphere and be lost. Certain gases block the escape of this heat energy, resulting in a warming of the Earth's atmosphere known as the 'Greenhouse Effect,' which is essential for life on earth. Human activities, including agriculture, are increasing levels of these greenhouse gases (especially carbon dioxide, methane and nitrous oxide) contributing to the *Enhanced Greenhouse Effect* which causes more heat to accumulate.

Carbon Dioxide (CO_2). Carbon dioxide is a greenhouse gas accumulating in the atmosphere from increased sources (i.e., combustion of fossil fuels and biomass, decomposition of organic matter) and reduced sinks (i.e., deforestation, draining wetlands and clearing agricultural land). CO_2 is a relatively weak GHG, with a very long atmospheric life span, so CO_2 emissions increase the greenhouse effect for centuries after their release. CO_2 is the reference gas for the global warming potential (GWP x 1) of all other GHGs, which are sometimes measured by their equivalent as CO_2e.

Methane (CH_4). Methane is a powerful greenhouse gas; one kg of methane has the global warming potential of 25 kg of CO_2e (GWP x 25). Methane is produced during anaerobic (in the absence of oxygen) decomposition of organic matter such as manures. Ruminant livestock produce methane during digestion through the process of enteric fermentation. Methane from livestock is the single largest source of GHG emissions from agriculture in B.C. Methane has a strong greenhouse effect but a short atmospheric life span, meaning management to reduce agricultural methane emissions has a more immediate impact to reduce global warming. .

Nitrous Oxide (N_2O). Nitrous oxide is a very powerful greenhouse gas; one kg of nitrous oxide is the equivalent to 298 kg of CO_{2e} in terms of global warming potential (GWP x 298). Nitrous oxide is produced in the soil from the biochemical reduction of nitrate to gaseous nitrogen compounds, a process known as denitrification. Because of its very high global warming potential and relatively long life in the atmosphere, avoiding N_2O emissions has significant and long-lasting climate benefits..

Other Concepts Related to Climate Change

Adaptation. Adjustment in natural or human systems in response to actual or expected climate impacts, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory, autonomous and planned adaptation:

- *Anticipatory adaptation* – Adaptation that takes place before impacts of climate change are observed. Also referred to as proactive adaptation.
- *Autonomous adaptation* – Adaptation triggered by ecological changes in natural systems and by market or welfare changes in human systems. Also referred to as spontaneous adaptation.
- *Planned adaptation* – Adaptation from a deliberate policy or practice decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain, or achieve a desired state.

Carbon Offsets. A carbon offset system is a financial instrument that establishes tradable credits for GHG reductions and is aimed at encouraging cost-effective reductions or removals of GHGs. In most systems, one carbon credit can offset one metric tonne of carbon dioxide (tCO_2) or its equivalent (tCO_2e) in other GHGs, so the net emissions are zero. If carbon credits are retired rather than sold, they represent reductions rather than being offsets.

Carbon Sequestration. Plants and soil organic matter play an important role in removing carbon dioxide from the air and storing it (sequestering) in carbon sinks. Carbon is the main component in plant material and soil organic matter. Any net uptake of carbon dioxide from the air by plant material or soil will only reduce the amount of carbon dioxide in the atmosphere until decomposition.

Fossil Fuel. Fuels such as oil, gasoline, diesel, propane and natural gas are fossilized hydrocarbon deposits, produced from carbon chains stored underground for millions of years. When extracted and burned, CO_2 and other pollutants are released to the atmosphere. The combination of increased fossil fuel emissions and decreased carbon sequestration from deforestation has lead to a net increase in atmospheric CO_2 concentration.

GHG Reduction. Reduction projects are those that reduce or prevent the release of GHGs into the atmosphere to mitigate global warming.

Global Warming Potential (GWP). Each GHG differs in its ability to trap heat energy in the Earth's lower atmosphere. The combination of the GHGs structural ability to trap heat and lifetime in the atmosphere determines the Global Warming Potential (GWP). GWP is a relative unit measured against the baseline of carbon dioxide (CO_2) over a 100 year time span. For example, methane has a GWP of 25 carbon dioxide equivalency (CO_2e) (i.e., 25 times the warming effect of CO_2 over 100 years). One tonne of CH_4 equates to 25 tonnes of CO_2e and one tonne of N_2O equates to 298 tCO_2e..

Mitigation. Projects, actions and management practices that offset, reduce or prevent GHG emissions from farms and agri-food activities or increase the amount of GHGs being taken out of the atmosphere and sequestered for a specified period of time. This is called climate change mitigation.

What is Anthropogenic Climate Change?

The *Enhanced Greenhouse Effect* has trapped additional heat energy near the Earth's surface which is causing the global climate system to change **(Figure 12.1)**. Anthropogenic or human caused climate change refers to changes in the modern climate as a result of human activities that have increased GHG concentrations in the atmosphere. The scientific community agrees that climate change is caused by human activities, including agriculture, by elevating GHG levels in the atmosphere.

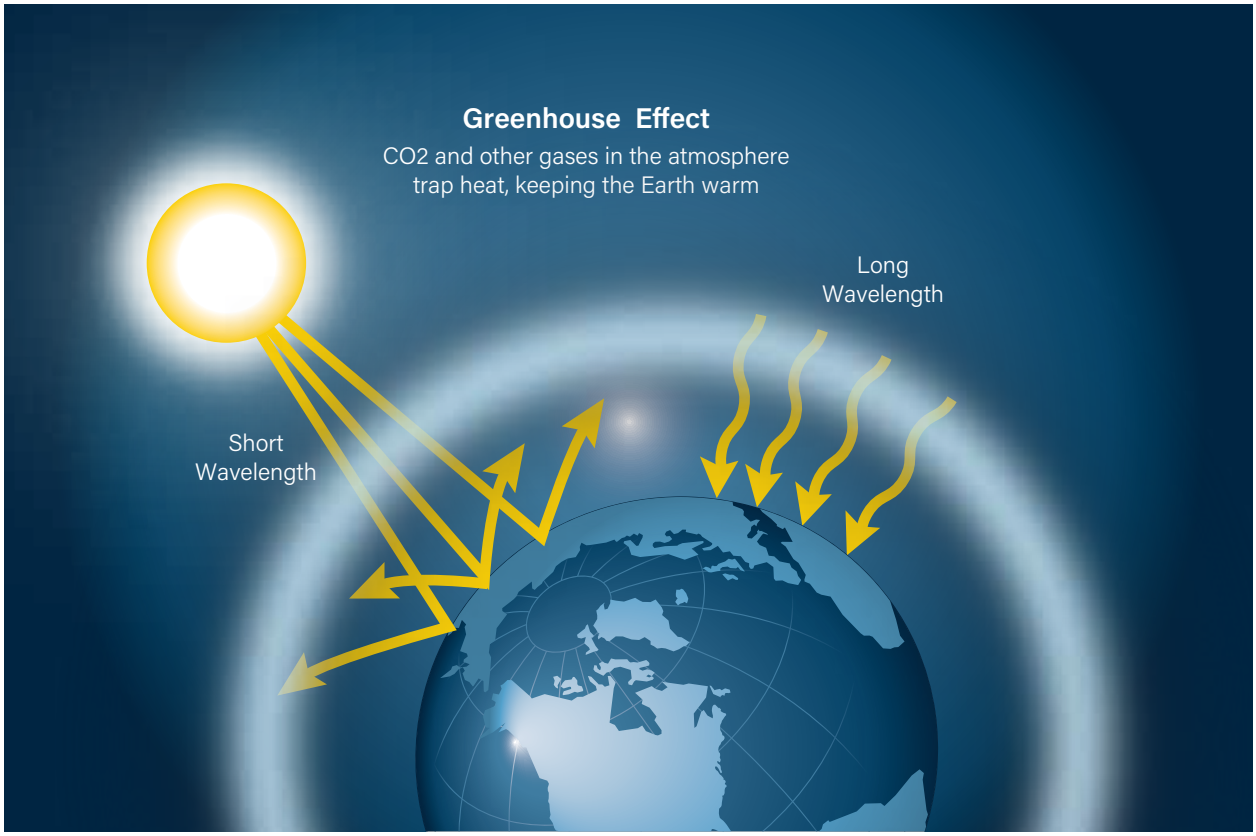


FIGURE 12.1 A simplified representation of the greenhouse effect

Understanding how agriculture contributes to, and is impacted by, climate change, will help the sector to both mitigate the causes of climate change and adapt to the consequences (Figure 12-2).

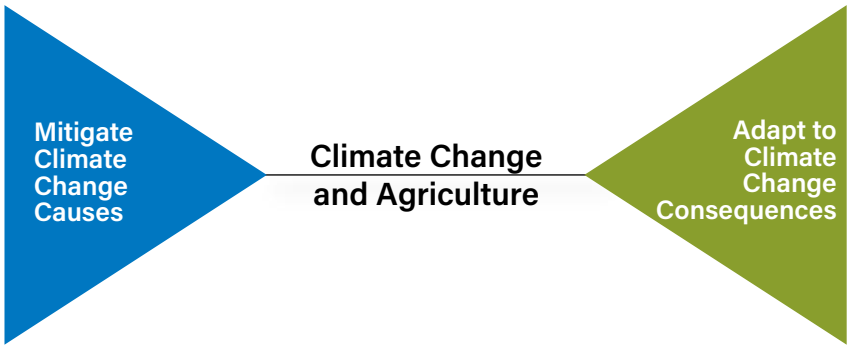


FIGURE 12.2 Schematic relationship between agriculture and climate change adaptation and mitigation.

Many activities from farm operations release GHGs such as CO_2, CH_4 and N_2O, into the atmosphere. While these gases are also naturally exchanged between the atmosphere, the oceans, the soil, and living organisms, additions from human activities are upsetting the natural balance.

Some agricultural practices temporarily store carbon, reducing current levels of carbon dioxide in the atmosphere. Minimizing the release of GHGs while also storing carbon in vegetation and soils can result in farms and ranches having a much lower impact on climate change (Figure 12-3).

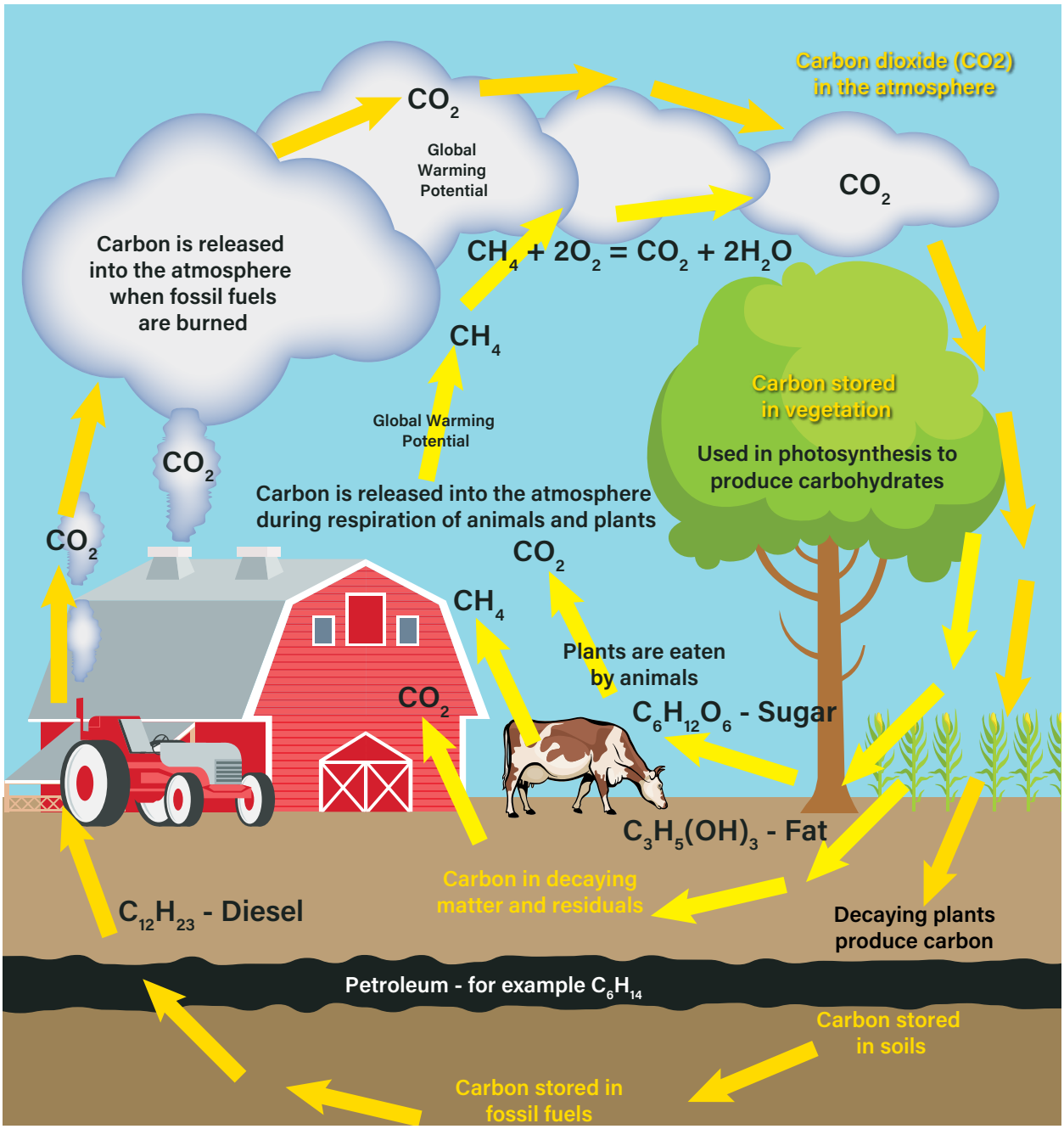


FIGURE 12.3 Example of an agricultural carbon cycle

Climate change has already shifted averages, altered the variability of daily and seasonal temperature and precipitation measurements, and increased the frequency and severity of extreme weather events. While the extent of changes and impacts has varied across the Province, changes have been pronounced in all seasons. In general, B.C. is expected to experience warmer, wetter winters and hotter, drier summers. While averages across seasons tend to minimize what climate extremes are expected, some of the anticipated impacts for B.C. are summarized below. These B.C. average and high range projections are based in the Plan2Adapt tool, and vary considerably across the Province:

According to Canada's Changing Climate report, 2019 there will be:

- Temperature: (avg.) +1.8 to +2.7 (high range) degrees Celsius increase in average annual temperature in B.C. by 2050, and (avg.) +2.7 to + 4.5 (high range) degrees Celsius increase by 2080 (Plan2Adapt, 2018).
- Precipitation: (avg.) +6% to (high range) +12% increase in precipitation by 2050, and (avg.) 9% to (high range) 17% increase by 2080, with the largest changes occurring during the winter (Plan2Adapt, 2018).
- Snowpack: (avg.) -75% to (high range) -95% reduction in the number of glaciers by 2100, decreased snowfall, and earlier snowmelt, leading to reduced snowpack and water shortages and drought during the growing season.
- More frequent and intense extreme weather events and disasters such as flooding, wildfires, drought, and high-intensity precipitation and wind storms.
- Higher intensity rainfall events will lead to increased soil erosion and drainage issues.
- Changes in ecosystems and ecosystem functions resulting in changes in biodiversity and habitats:
  - Greater potential impacts to species at risk and fisheries new pest and disease outbreaks.
  - A 2 to 7 degree Celsius increase in average annual temperature in BC by 2080.
- Increased storm surges in coastal areas and subsequent vulnerability to flooding and erosion (Canada's Changing Climate Report, 2019).
- Sea level: rise of (avg.) 0.74 to (high range) 1.39 m by 2100 (Canada's Changing Climate Report, 2019).

Plan2Adapt

Indicators of Climate Change in BC 2016 Update

BC Government Website: Impacts of Climate Change

Canada`s Changing Climate Report 2019

IMPACTS OF AGRICULTURAL ACTIVITIES ON GREENHOUSE GAS EMISSIONS

Agriculture's Contribution to Climate Change

Overall, B.C. agriculture's contributions to the total GHG emissions in the Province are relatively small and diffuse. Estimating the magnitude of the emissions associated with agriculture is complex because of the range of agricultural practices and other variables such as soil, climate and land cover. The most recent BC Greenhouse Gas Inventory Report 2016 estimates that agriculture was directly responsible for about 3.7% of B.C.'s total GHG emissions. The sources of agricultural emissions identified in the report include:

- Enteric fermentation in ruminant livestock.
- Manure management.
- Soil management and fertilization.

The report attributes 61.1% of B.C.'s total GHG emissions directly produced by agriculture to enteric fermentation, 17.5% from manure management practices and 21.4% from agricultural soil disturbance (e.g., tillage) and applying fertilizer.

Importantly, however, the agricultural sector total does not include emissions related to land use and land use changes (deforestation and grassland conversion to cropland, carbon flux resulting in changes to tillage), or agricultural fossil fuel use associated with farm buildings, equipment operations, and transportion. Therefore, the total GHG contributions of agricultural producers are not fully reflective of the emissions reported for the sector in the inventory report.

Farm Activities and Impacts

Agricultural practices that alter natural ecosystem functions can accelerate or amplify the release of GHGs into the atmosphere. On the other hand, practices that complement or accentuate natural processes can store carbon and decrease GHG emissions.

Other components of the food system that contribute to GHG emissions as sources include:

- Emissions from energy used for food processing.
- Transportation and storage associated with food products.
- Production of chemical fertilizer and petro-chemical based pesticides.

Sources of GHGs attributed to off-farm aspects of the food system will not be discussed in this chapter, as they are largely out of the control of individual farmers. The following are on-farm activities that are known to impact climate change. Activities are listed in alphabetical order.

Clearing Land. Clearing land for crop production releases CO_2 that was previously bound in soil organic matter and biomass such as trees and grasslands. In addition, there are fewer trees to store carbon through their growth so carbon sinks are also reduced. This contributes to a net increase of CO_2 in the atmosphere.

Combustion of Fossil Fuels. The combustion of fossil fuels such as oil, diesel, propane, gasoline and natural gas which are used for heat production, transportation and the powering of farm equipment, increase atmospheric CO_2 concentrations.

Drainage Management. Draining wetlands to create new agricultural production areas increases the decomposition of organic soils and releases CO_2 into the atmosphere. Once in production, incomplete drainage of agricultural soils can create anaerobic conditions (absense of air) that causes additional conversion of nitrogen in fertilizers and manure into CH_4 and N_2O.

Enteric Fermentation. Enteric fermentation is a process that takes place in ruminant livestock which releases CH_4 as part of the natural digestion process of complex carbohydrates. This process contributes to a net increase in atmospheric CH_4 concentrations..

Manure. Anaerobic digestion during storage of livestock manure emits CH_4, contributing to a net increase in atmospheric CH_4 concentrations. Manure also undergoes nitrification and dinitrification, producing N_2O emission during decomposition.

Mineral and Organic Fertilizer Use. In agricultural production, some nitrogen fertilizers may be converted from forms that do not impact GHG emissions to N_2O, increasing atmospheric N_2O concentrations.

Soil Organic Matter Degradation. Soil organic matter degradation is accelerated by various farm practices such as tillage causing less carbon to remain stored in soils. This increases atmospheric CO_2 concentrations..

CLIMATE CHANGE MITIGATION

CLIMATE CHANGE ENVIRONMENTAL CONCERNS

Environmental concerns related to climate change mitigation and GHG emissions from agriculture are:

- Enteric fermentation from cattle and other ruminants resulting in CH_4 emissions.
- Manure production and storage resulting in CH_4 emissions.
- Mineral and organic fertilizer use resulting in N_2O emissions.
- Burning of fossil fuels resulting in CO_2 emissions.
- Uncontrolled open burning or fuel accumulations on the landscape contributing to wildfires that release large quantities of CO_2.
- Clearing land for crop production resulting in CO_2 emissions from carbon that was previously stored.
- Draining wetlands for crop production resulting in CO_2 emissions from carbon previously stored in organic soils.
- Degradation of soil organic matter accelerated by farm activities (e.g. tillage), resulting in CO_2 emissions and reduced carbon storage.

For more information on these concerns:

➔ see Impacts of Agricultural Activities on Greenhouse Gas Emissions, **page 12-5**

CLIMATE CHANGE MITIGATION LEGISLATION

The following is a brief outline of the main legislation that applies to climate change mitigation.

➔ see **page A-1** for a summary of these and other Acts and Regulations

Carbon Tax Act

The *Carbon Tax Act* establishes a carbon tax in BC. The carbon tax is a broad based tax that applies to the purchase or use of fuels, such as gasoline, diesel, natural gas, heating oil, propane, coal, and the use of combustibles, such as peat and tires, when used to produce heat or energy. The carbon tax applies to fuels at different rates depending on their anticipated carbon emissions.

Farmers are not required to pay carbon tax on coloured fuel purchased for farming operations.

Environmental Management Act

The *Code of Practice for Agricultural Environmental Management* requires persons to use environmentally responsible and sustainable agricultural practices when carrying out agricultural operations, for the purpose of minimizing the introduction of waste into the environment and preventing adverse impacts to the environment and human health.

The Act also contains the *Waste Discharge Regulation*, which authorizes the introduction of waste into the environment from certain industries, businesses and operations. Proponents of an on-farm anaerobic digestion project will require a waste discharge authorization. Guidelines for on-farm anaerobic digestion are available from the BC Ministry of Environment and Climate Change Strategy.

On-Farm Anaerobic Digestion Waste Discharge Authorization Guideline

Greenhouse Gas Industrial Reporting and Control Act

The Act enables performance standards to be set for industrial facilities or sectors. Single sites which emit 10,000 tonnes or more of CO_2e per year must report their emissions, and those which emit 25,000 tonnes or more will be regulated. There are currently only three agricultural facilities in B.C. that emit over 10,000 tonnes per year and which are required to report their emissions.

The *Greenhouse Gas Emission Control Regulation* under the Act sets out the requirements for GHG reductions and removals from projects or actions that qualify as emission offsets. There are opportunities to develop agriculture-based projects, such as greenhouse operators switching to biomass boilers.

Climate Change Accountability Act

The Act commits B.C. to reductions of GHG emissions by at least 40% (from 2007 levels) by 2030, at least 60% by 2040, and at least 80% by 2050. Agricultural emission reductions are not regulated, but if they do not occur while reductions occur in other sectors, agriculture will produce a greater share of total GHG emissions than it does currently.

Under the Act, public sector organizations are required to be carbon neutral.

In addition, through the *Climate Action Charter* (separate from the Act), a large number of local governments have agreed to become carbon neutral and developed municipal Climate Plans to mitigate emissions. Through this process, local governments may encourage reduction of agricultural GHG emissions in the municipality.

CLIMATE CHANGE MITIGATION BENEFICIAL MANAGEMENT PRACTICES

Greenhouse gas emissions from agricultural activities can be reduced through three general approaches (**Figure 12-5**):

- **Reduce** energy use and material inputs, making the most efficient use of inputs and minimizing waste, leakage and loss.
- **Replace** fossil fuels with renewable energy sources.
- **Remove** carbon by sequestering it in agroforestry plantings or enhancing soil organics / **Restore** wetlands, forests and grassland areas that are natural stores of carbon.

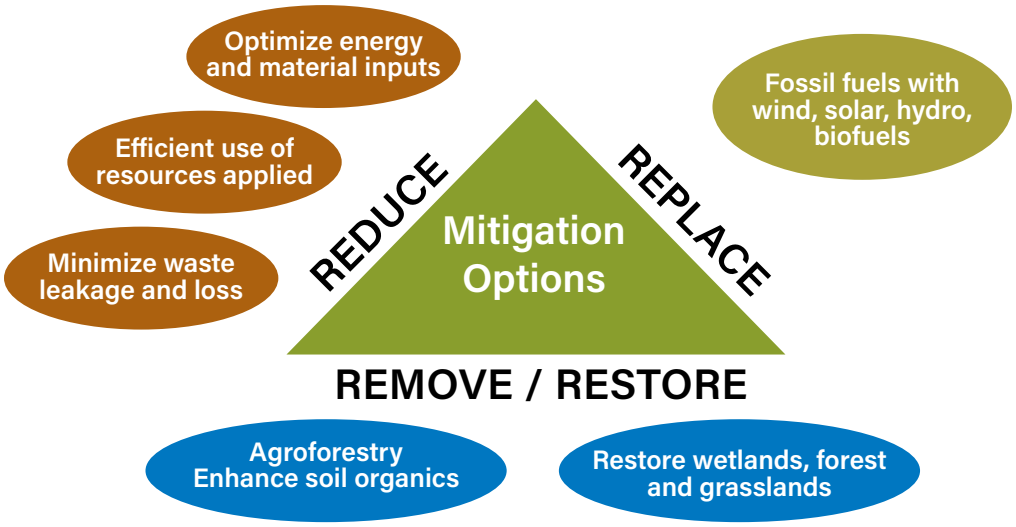


FIGURE 12.4 Mitigation options include reduce, replace, and remove/restore approaches.

Many mitigation actions are linked to improving the overall efficiency and profitability of farming and ranching. The efficient management of the carbon and nitrogen flows within agricultural systems may also help the sector adapt to climate change. Reducing GHG emissions is also an important part of demonstrating responsible environmental stewardship, which helps build the social licence necessary to maintain support for agriculture in society.

There is no universal set of mitigation practices, and the most beneficial option will depend on factors such as regional climate and soils, specific production practices employed, and access to financing and other supports. In prioritizing climate change mitigation actions, consider the warming potentials of the target greenhouse gases. For example, although aiming for an integrated program to enhance on-farm sequestration may have the potential for large reductions in CO_2, investing in modest reductions in N_2O may have a greater immediate impact. This is because of the near 300 fold difference in Global Warming Potential (GWP) between these two gases.

Mitigation planning should also factor in realizing co-benefits. Many of the BMPs for lowering GHGs also benefit water quality, biodiversity or soil conservation. BMP selections should also carefully consider any potential negative trade-offs between adaptation and mitigation actions. For example, vegetative buffers or agroforestry plantings can store considerable amounts of carbon, but may elevate the risks of wildfire impacts around farm structures.

In order to reduce GHG emissions from farm operations, comply with climate change related legislation and, where appropriate, implement the following BMPs.

Note: Most mitigation opportunities use current technologies that can be implemented immediately. Some may require significant capital investments, and innovations can be phased in when replacing existing equipment and infrastructure.

Reduce Energy Use and Inputs

Fuel Switching. The choice of fuel/energy source is important for reducing GHG emissions. For example, using electricity instead of fossil fuels where possible, has a significant positive impact on GHG emissions as outlined in Table 12.1 below..

TABLE 12.1 Greenhouse gas emissions for various fuels and energy types used on farm

Fuel type / Energy type	Type of use	GHG emissions (metric)
Diesel	IC engine *	2.7 kg CO_{2e} / litre
Gasoline	IC engine *	2.3 kg CO_{2e} / litre
Natural Gas	Boiler	49.9 kg CO_{2e} / GJ
Light Oil	Boiler	2.7 kg CO_{2e} / litre
Heavy Oil	Boiler	3.2 kg CO_{2e} / litre
Propane	Boiler	1.5 kg CO_{2e} / litre
Electricity (BC)	Any	2.964 kg CO_{2e} / GJ

* IC engine means Internal Combustion engine, for example a normal diesel tractor engine

Energy Conservation. Minimizing energy use will reduce GHG emissions, particularly when fossil fuel use is reduced. For energy intensive production systems, improved energy efficiency has the potential to yield substantial cost savings. Implement the following practices to improve farm energy conservation:

- Conduct an on-farm energy assessment to highlight opportunities for energy use efficiencies.
- Check for efficiency rebate and incentive programs from your local utility provider.
- Use appropriately sized and efficiently operated heating, cooling and ventilation (HVAC) systems for barns, greenhouses and other production facilities.

➔ see Energy Use in Buildings and Yards, **page 2-56**

  - Use zone controls, timers, sensors or variable speed drives on ventilation, heating, cooling and lighting systems that do not need to operate continuously.
  - Implement thermal energy efficiency improvements that increase insulation.
  - Ensure solid biomass fuels have optimum moisture content.
  - Implement rigorous maintenance programs for all HVAC system components.
  - Use low energy lighting systems where appropriate.
- Replace power take-off (PTO) powered equipment and diesel generators with electrical pumps and engines.
- Ensure that when converting to electrical drive, engines meet the efficiency requirements of *Canada's Energy Efficiency Act.*
- Use energy-efficient equipment and operating practices
  - Use minimum tillage or no-till soil management practices, minimum trimming practices in horticultural operations.
  - Maintain engines in efficient running order and keep tires inflated to the manufacturer's recommended pressure.

➔ see Energy Use in Field Operations, **page 2-57**

  - Use continuous, fuel efficient crop drying and processing systems with automatic controls and moisture sensors.

➔ see Energy Use in Crop Drying and Feed Processing, **page 2-57**

Livestock and Manure Management. Livestock and manure management are important contributors to agricultural GHG emissions. Implement the following practices to mitigate GHG emissions from livestock and manure:

- Select regionally appropriate forages for pastures and grazing land which maximize plant productivity and in turn increases the digestibility of feed resulting in less methane emissions from livestock.
- Implement rotational grazing preventing overgrazing and maximizing digestibility of forage.
- Integrate livestock production and crop production to make efficient use of resources.
- Change feeding practices to reduce CH_4 released from enteric fermentation by using higher quality feed or adding supplements to the diet of ruminants.
- Optimize livestock feeding to minimize waste and maximize feed conversion.

➔ see Nutrition and Ration Management, **page 3-44**

- Use beneficial practices to limit losses and waste from stock water systems.

➔ see Livestock Watering, **page 9-16**

- Manage manure Composting to reduce CH_4 and N_2O emissions:
  - Cover and cool manure storage facilities;
  - Capture CH_4 originating from manure (e.g., by anaerobic digestion) and use it in place of fossil fuels on farm or elsewhere;
  - Separate solids from liquids and use solid rather than liquid manure handling systems (the liquid component will still need to be managed);
  - Apply manure efficiently to match crop needs;
  - Avoid manure or fertilizer application while soil is saturated with water;
  - Make more frequent manure applications at lower application rates using sleighfoot or shallow injection equipment for more efficient use of nitrogen.

Crop and Soil Management. Make the most efficient use of all inputs; minimizing waste, leakage and loss will help ensure the direct and indirect GHG emissions from agriculture are minimized.

- Adopt nutrient management practices that minimize GHG emissions:
  - Improve timing and rates for irrigation and fertilization and improve drainage in fields to minimize water logged conditions;

Drainage Management Guide

  - Use precision farming applications that reduce fertilizer application and overlap;
  - Time input application to minimize losses through runoff and leaching;
  - Reduce the use of excess fertilizer, pesticides and other inputs;
  - Follow a nutrient management plan to optimize nutrient use.

➔ see Nutrient Management Planning, **page 6-30**

  - Implement integrated pest management practices to optimize the use of pest control products.

➔ see Integrated Pest Management, **page 5-7**

  - Use beneficial practices to limit losses and waste from irrigation.

➔ see Irrigation Beneficial Management Practices, **page 9-24**

Replace Fossil Fuels

On-Farm Renewable Energy Production. Renewable energy is produced from naturally occurring sources that are regenerative, including:

- Biomass (e.g., wood residue, manure, food processing waste),
- Flowing water (hydroelectricity),
- Sunlight (solar power),
- Wind power,
- Geothermal power.

Renewable energy sources can displace fossil fuel use, reducing GHG emissions on and off-farm. They can also help decrease reliance on energy sources with volatile prices, and create new economic diversification opportunities for agricultural producers with the opportunity to sell surplus energy back into the 'grid.'

Opportunities for generating or using renewable energy on-farm will depend on the type and scale of operation as well as its location. Some agricultural producers may decide to generate energy or energy feedstock to sell off farm, while others may generate small quantities of energy in the interest of self-sufficiency and reduced energy costs. Renewable energy technologies suitable for on-farm use include:

Anaerobic Digestion. Manure, organic matter and municipal organic wastes are broken down in the absence of oxygen and methane-rich gas is produced and captured for use in a boiler, co-generation facility or upgraded to natural gas for grid injection.

Electricity. Grid electrical power can be generated by utilizing steam produced from fossil fuel combustion, heat released from nuclear reactions, or from other sources such as wind or flowing water (hydroelectric). In B.C., about 88% of the Province's electricity is produced by hydroelectric generation. Hydroelectricity is a renewable energy source which releases negligible amounts of GHGs that contribute to climate change and is therefore a preferred source of power in B.C.

Geothermal Systems. Also known as Geoexchange or Ground Source Heat Pumps, transfer ambient heat to or from the ground. They use the Earth as a heat reservoir in the winter or a heat sink in the summer to provide either baseload heating or cooling.

Gasification. A self-fuelled process where carbon rich feedstocks, such as straw, manure and wood residue, are converted into a gas at high temperatures in an oxygen starved chamber. The produced gas, called syngas, is then burned to produce heat and electricity through co-generation or just heat via final combustion in a thermal oxidizer. The biomass remaining after gasification, referred to as biochar, can be applied as a soil conditioner to enrich soil organic matter.

Wind. Energy from wind is converted to electricity via propeller blades that turn a generator.

Solar. The sun's energy is either captured in heat collectors or other passive systems (e.g., black coil tubing), or is converted to electricity via photovoltaic cells (PV) or captured as heat (Solar Thermal)

Hydroelectric. Energy from running water is converted to electricity via small scale hydro power facilities, such as run-of-river projects.

Pyrolysis. A carbon-rich feed stock, such as manure or wood residue, is converted to oils and high value chemicals at high temperatures (but lower than gasification) in an oxygen starved chamber.

Biofuel. A fuel produced from crops or crop residues resulting in fuels like bio-diesel and ethanol, or from the direct combustion of biomass (wood, purpose grown biofuel crops or crop residues) to fuel biomass boilers. Adhere to all emission standards for biomass boils in use and follow beneficial practices for boil emission reductions.

➔ see Heat Production and Biomass Boiler BMPs, **page 2-58**

On-Farm Energy Production Regulatory Requirements. Some on-farm energy systems may be subject to regulation under the *Code of Practice for Agricultural Environmental Management*, which sets emission standards and testing requirements for boilers and heaters fuelled by biomass.

➔ see Climate Change Legislation, **page 12-7**

Comply with all applicable legislation prior to the initiation of on-farm energy generation facilities. Contact the following agencies, which will evaluate projects on a case-by-case basis for specific regulatory requirements and/or required authorizations:

- **Agricultural Land Commission**, if the proposed facility is within the Agricultural Land Reserve.
- **Local Government**, to enquire if an amendment to the solid/liquid waste management plan is required.
- **Local Government**, to enquire if there are applicable bylaws or if amendment to current agricultural zoning is required.
- **Ministry of Environment and Climate Change Strategy**, Environmental Management Branch, to enquire if an operational certificate or waste discharge authorization is required.
- **Environmental Assessment Office** to enquire if the proposed project is of large scale,

➔ see Climate Change Legislation, **page 12-7**

Remove Carbon/Restore Vegetative Cover

Cropping Practices and Carbon Sequestration. Agricultural ecosystems hold substantial carbon reserves, primarily in soil organic matter. Certain farm practices can facilitate increased carbon storage or reduce the loss of stored carbon. This is known as carbon sequestration. Various cropping, nutrient, and tillage management strategies can increase sequestration. Once sequestered, follow beneficial practices to retain soil organics – soil organic additions are reversible and must be maintained.

Implement the following practices to increase on-farm carbon sequestration:

- Adopt cropping management practices that increase carbon storage
  - Select perennial crops where feasible and species that retain a higher proportion of plant reserves in the roots than the shoots.
  - Implement crop rotations.
  - Decrease summer and bare fallow.
  - Use cover crops.
  - Increase soil organic matter.

➔ see Crops Beneficial Management Practices, **page 4-8,** and refer to Cover Crops and Crop Rotation

➔ see Soil Management Beneficial Management Practices, **page 8-11**, and refer to Soil Organic Matter Content

- Adopt tillage and residue management practices that increase carbon storage and reduce GHG emissions.
- Use reduced or no-till systems, particularly in arid regions.
- Avoid burning of crop residues which releases CO_2 .

➔ see Open Burning, **page 10-23**

  - Leave plant residues on the soil surface to build soil organic matter.

Grazing Management and Carbon Sequestration. Proper grazing strategies can stimulate forage growth and reduce greenhouse gas emissions. Forages can also contribute to the reduction of greenhouse gas emissions – feeding high quality forage grasses reduces methane emissions from animals per unit livestock product. The use of many different grazing areas throughout the year, with varying soil and climatic conditions, can make carbon sequestration strategies on grazing lands complex. Always use grazing systems appropriate to the regional climate and soils, and set conservative stocking rates within rotational grazing patterns to aid in building soil organic inputs.

- Overgrazing is universally recognized as detrimental to soil organic carbon (SOC) reserves.
- Use management intensive grazing on irrigated, high regrowth pastures to increase SOC.
- Use low intensity, rotational grazing on rangeland and pastures with low forage regrowth potential to minimize SOC disturbance.

Grazing Management Guidebook

Agroforestry Practices. All agroforestry systems, by virtue of their tree and shrub components, can increase carbon sequestration on agricultural land in comparison to conventional crop and pasture systems. Agroforestry practices offer many other co-benefits including conserving biodiversity, soil conservation, protecting water quality as well as opportunties for production diversification.

Implementation of the following agroforestry practices will increase carbon sequestration:

- Establish integrated riparian management where areas adjacent to watercourses are planted with planned combinations of trees and plant materials, enhancing habitat and providing select timber and non-timber resources.

➔ see Riparian Area Beneficial Management Practices, **page 11-19**, and refer to Riparian Area Management

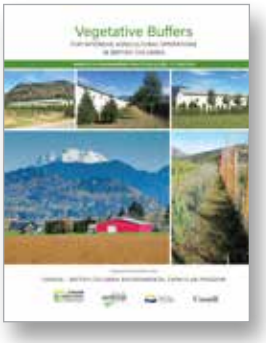
- Establish shelterbelts, timberbelts, hedgerows, or vegetative buffers where managed rows of trees, shrubs and/or grasses are planted adjacent to production areas.

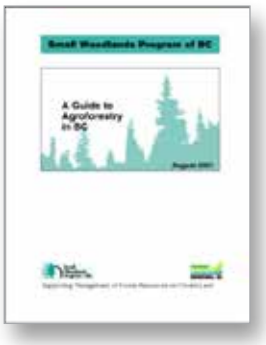
➔ see Buffer Beneficial Management Practices, **page 11-8,** and refer to Windbreaks and Shelterbelts

- Establish silvopastures where managed trees and shrubs are integrated with forage production in pastures.

A Guide to Agroforestry in BC

Vegetative Buffer BMP Guide





Retain or Restore Natural Areas. Retaining or restoring natural areas as part of the agricultural landscape can enhance natural carbon storage potential. Consider incorporating natural areas on farms and ranches as a component of the agricultural landscape:

- Restore marginal pastures or rangeland to native grasslands.
- Convert marginal cropland to forests, shrublands or grasslands.
- Retain or restore wetlands and peatlands. They have very large natural carbon stores in their organic soils and function to help buffer and conserve water flows.

Planning for Biodiversity: A Guide for BC Farmers and Ranchers

CLIMATE CHANGE ADAPTATION

Adapting to climate change is an ongoing process of adjustments in response to actual or expected climate change impacts. Adaptation can be done in anticipation, through proactive adjustments before climate impacts are observed. Adaptation can also be spontaneous or autonomous, sometimes triggered by a natural hazard such as wildfire or flood. Planned adaptation comes from deliberate decisions considering actual or expected changes, and usually aims to return to, maintain, or achieve a novel desired state.

IMPACTS OF CLIMATE CHANGE ON AGRICULTURE CONCERNS

The agriculture sector is one of the sectors most impacted by climate change in B.C., due to its vulnerability to new climate extremes and severe weather events. The timing and extent of climate impacts will very across the Province, but will include:

- Altered length of growing season;
- Extreme weather events altering how farming operations manage risk;
- Increased water management complexity;
- Increased flooding and excess moisture in the shoulder seasons;
- Extended agricultural drought and summer evapotranspiration deficit;
- Changing intensity and distribution of agricultural pests and diseases;
- Increased wildfire events impacting crops, rangeland, livestock, and infrastructure;
- Reduced snowpack, earlier snowmelt, hotter summer temperatures, decreased late summer stream flows, heat stress, and evapotranspiration deficit leading to water shortages for irrigation or livestock;
- Rising sea level combined with larger storm surges altering salinity of coastal floodplains; and
- Increased saltwater intrusion into coastal irrigation water supplies and conveyance systems.

Many of these impacts will lead to serious economic consequences for some producers. However, in some places there will be potential to take adavantage of an extended growing season and wider range of viable crops. B.C. agriculture will continue to succeed by building and reinforcing flexible, resilient production systems and planning for transitions when required.

Strengthening B.C.'s Agriculture Sector in the Face of Climate Change

This chapter addresses planning and beneficial practices on the farm. Other important considerations affecting the ability to adapt not covered here include: participating in multi-stakeholder regional or watershed based planning, accessing credit and financial tools, insurance programs and risk management tools, disaster relief and other support programs, and planning for transformational changes in practices, production or locations.

- Climate & Agriculture Initiative BC
- BC Agriculture Climate Change Adaptation Risk and Opportunity Assessment
- Pacific Institute for Climate Science
- Plan 2 Adapt

Key Concepts Climate Change Adaptation

Adaptive capacity: The combination of strengths, attributes, and resources available to an individual, community, society, or organization that can be used to prepare for and undertake actions to reduce adverse impacts, moderate harm, or exploit beneficial opportunities.

Impacts: Effects on natural and human systems referring here to the effects on natural and human systems of physical events, of disasters, and of climate change.

Maladaptation: Actions, or inaction that may lead to increased risk of adverse climate-related outcomes, increased vulnerability to climate change, or diminished welfare, now or in the future. This includes intervention that could increase the vulnerability of the target group to future climate change or in another location or sector.

Predictability: The extent to which future states of a system may be predicted based on knowledge of current and past states of the system.

Projection: A climate projection is a potential future change, often computed with the aid of a model. Projections are distinguished from predictions to emphasize that projections involve assumptions concerning future socioeconomic and technological developments that may or may not be realized and are therefore subject to substantial uncertainty. Climate projections are usually expressed as a range where considering the 90th percentile values are appropriate when planning critical infrastructure investments.

Resilience: The ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic structures and functions.

Transformation: The altering of fundamental attributes of a system (including value systems; regulatory, legislative, or bureaucratic regimes; financial institutions; and technological or agricultural systems).

Vulnerability: The predisposition to be adversely affected.

On-Farm Adaptation Planning Process

Taking on new practices to respond to climate risks requires careful consideration of what adaptations might be needed, when they should be implemented, and prioritizing which will provide the most benefit for immediate and long term goals. A simple framework to guide adaptation planning for agricultural operations is this five-step adaptive planning and management process (**Figure 12.6**):

1. Define goals and objectives.
2. Assess climate impacts and vulnerabilities.
3. Evaluate objectives considering climate impacts.
4. Identify adaptation approaches and tactics for implementation.
5. Monitor effectiveness of implemented actions.

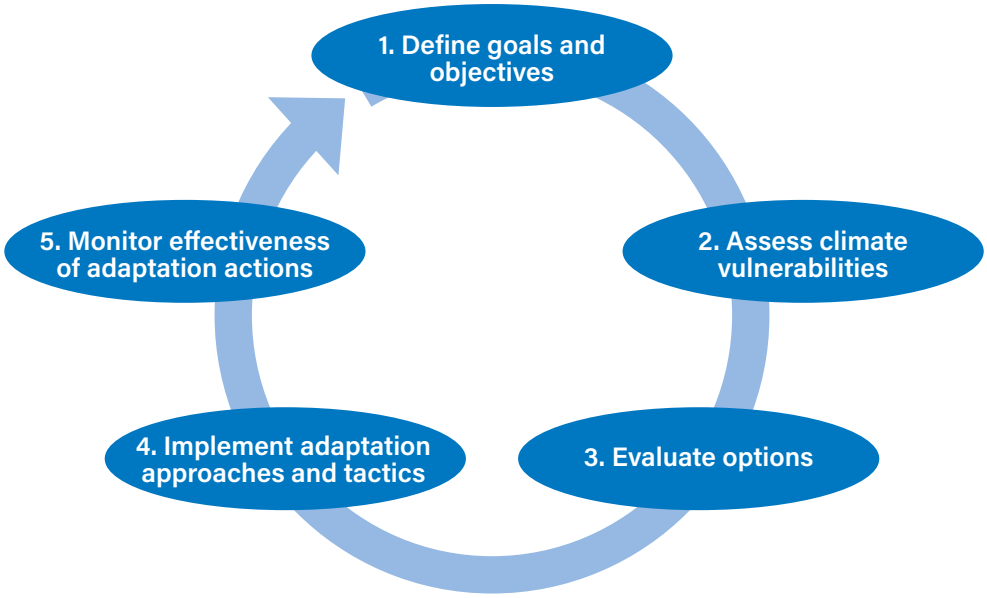


FIGURE 12.5 Five step adaptive planning and management process.
Adaptation Resources for Agriculture. 2016. USDA Technical Bulletin 1944

Following implementation of the prioritized actions, the cycle is repeated to reassess vulnerability in light of the new management practices adopted and changing climate risks. Each of these steps is described in more detail in the sections that follow.

1. Review Options and Set Goals

Define goals and objectives. A good starting point to define current farm management goals and objectives comes from recording fundamental information about the farm. Look at existing management plans or other planning documents and consider discussing this with others to clarify intentions and ensure goals are shared.

Timeframe and Approach. Consider both short-term (0 to 5 years) and long-term goals and approaches to adapt to a changing climate. This may involve decisions regarding how to preserve existing production through changes in practices or additional infrastructure, or over the long term it may be more viable to transition to new commodities, production systems, services produced, or even location.

Emergency and Contingency Plans. Climate variability should factor significantly into risk management strategies. Exposure to new or elevated risks demands robust emergency planning and contingency plans if the worst case occurs. Successful emergency planning will also likely require coordination with regional and provincial emergency plans; consider farm level needs in context of community plans and resources.

Consider completing the following, as appropriate your operation, as part of the adaptation process:

- Contingency Plan – Template for On-Farm Planning
- Emergency Management Planning Workbook for BC Dairy Producers
- Emergency Management Guide for BC Beef Producers
- Emergency Management Guide for BC Pork Producers
- Emergency Management Guide for BC Poultry Farms
- Emergency Management Guide for BC Small Mixed Farms
- Cariboo – Wildfire Preparedness and Mitigation
- Dam Safety Management Binder
- Okanagan Wildfire Preparedness & Mitigation Plan

Management Plans. The resilience of a farm or ranch ultimately rests in selecting from BMPs that will both meet operational goals and provide the greatest flexibility and resilience. Detailed management planning provides options tailored to farm practices and physical conditions and helps identify adaptation approaches and tactics. Management planning that should be considered as part of the adaptation process may include:

- Grazing Management Plan ➔see **page 3-21.**
- Nutrient Management Plan ➔see **page 6-30.**
- Biodiversity Management Plan ➔see **page 7-9.**
- Irrigation Management Plan ➔see **page 9-24.**
- Drainage Management Plan ➔see **page 9-45.**
- Riparian Management Field Workbook ➔see **page 11-21.**

2. Vulnerability Assessment

Assess climate impacts and vulnerabilities. Agricultural production will be affected in may ways by climate change impacts. For this reason, it is critical to think about the general (e.g., regional or provincial) effects and potential impacts of a changing climate, as well as the unique situation for your farm and agricultural production system.

Review Climate Change Projections. B.C. is large and diverse, and there will be regional differences in in the climate change impacts and consequences. Some agricultural operations are already facing climate-related challenges which will shape their short-term adaptation strategy. Long-term goals should also be framed in the context of the regional climate change projections which are usually expressed as a range. For planning, considering the full 10th to 90th percentile values better represents the likely range of changes than simply using an average value. The Pacific Climate Impacts Consortium has published a series of regional climate change projections for B.C.

- Pacific Climate Impacts Consortium Library

Assess Exposure and Sensitivity to Change. Vulnerability is the extent to which an individual agricultural operation and the specific practices employed are susceptible to, or unable to manage, adverse climate change impacts. Climate change vulnerability is influenced by:

- Degree of exposure to the changes - what are the adverse impacts specific to my location: e.g., drought, wind storms, changing pest populations?
- Sensitivity to these changes - what are the impacts to your farm infrastructure, crops, livestock or operating costs when these hazards occur?

Itemize each climate change vulnerability for your operation and rate the sensitivity as either low, moderate, high or extreme. The BC Agriculture & Food Climate Action Initiative has developed a series of regional climate adaptation strategies that include both a summary of projected regional climate change and overviews of the major climate-related vulnerabilities for B.C. agriculture to assist with this planning.

- Regional Adaptation Strategies - Cariboo
- Regional Adaptation Strategies - Cowichan
- Regional Adaptation Strategies - Delta
- Regional Adaptation Strategies – Fraser Valley
- Regional Adaptation Strategies - Okanagan
- Regional Adaptation Strategies - Peace
- Regional Adaptation Strategies – Kootenay & Boundary
- Regional Adaptation Strategies – Vancouver Island

Some of the impacts are complex and may involve multiple-stressors with cumulative impacts. It is therefore important to periodically revisit your exposure and sensitivity assumptions in light of changing information.

3. Evaluate Options

Evaluate objectives considering climate impacts. Based on your management goals and objectives and the likely climate change impacts and vulnerabilities for your area, it is time to identify what climate change related management challenges and opportunities are faced. This is the opportunity to evaluate if objectives are feasible under current management and to alter or refine them to better account for changes in climate.

Review BMP Options based on your goals and detailed management planning. Adaptation can take many forms, and there is no universal set of BMPs applicable to all farming operation.

The EFP process will aid in identifying BMPs appropriate to the specific climate vulnerabilities identified for a given operation.

4. Select and Prioritize Actions

Identify adaptation approaches and tactics for implementation. Addressing climate change impacts and their consequences may require adjusting current practices, trying completely new ones, or starting a whole new system. You can identify and evaluate specific actions that can help prepare for changing conditions given the challenges and opportunities already identified. This will generate adaptation tactics and specific actions that will assist your operation to meet your unique management objectives.

Costs, Benefits and Support Resources. Adaptation can take on many forms, and there is no universal set of BMPs applicable to all farming operations. The ultimate choice of an appropriate adaptation strategy will consider the costs and benefits based on your goals and detailed management planning. It also important, however, to assess the costs and benefits relative to inaction. Consider the following in choosing from your BMP options:

- Adaptations that have mitigation and other co-benefits (water quality, biodiversity).
- BMPs with flexibility to be altered after being implemented.
- Adaptation options that improve price or marketability of production.
- Adaptation options that can utilize and enhance natural assets rather than engineered, constructed assets.
- Not all existing production systems are adaptable; fundamental changes to what and where things are produced may be more resilient.

Regional Planning and Initiatives. Some adaptation approaches are likely only feasible if implemented at a regional or watershed level. Others are far more efficient and effective than when solely focused on individual farms or ranches. Where available, connect to regional planning and management initatives, including:

- Climate monitoring and decision support tools for irrigation or integrated pest management.
- Early warning systems for flood, drought, and fire.
- Plant and livestock breeding programs to create new adapted production choices.
- Broad, pan-agricultural, integrated approaches to pest monitoring.
- Infrastructure for water delivery, drainage or flood prevention.

5. Monitor

Monitor Effectiveness of Implemented Actions. Monitoring is essential to understand what changes are occurring as a result of climate change and whether adaptation actions are positive and effective in meeting management goals and preparing your farm for future conditions. Adaptation efforts with unintended negative consequences are termed maladaptation and must to be corrected as soon as possible. Identify what metrics are realistic to gauge current and future progress when applied to your farm and operations. The aim of this step is a realistic and feasible monitoring scheme that can evaluate management options in the future to account for new information and observations.

Through the Farm Adaptation Innovator Program, producers throughout the Province are evaluating the effectiveness of climate adaptation farm practices. A resource guide has been developed to help producers evaluate and monitor the effectiveness of adaptation practices.

A Guide to On-Farm Demonstration Research

6. Reassess

Reassess. Climate science and adaptation options are continually evolving. Monitor and evaluate the effectiveness of your strategies and tactics; periodically revisit your plans and stay informed and connected to initiatives and support programs. It is recommended that Environmental Farm Plans be updated every 5 years.

BENEFICIAL MANAGEMENT PRACTICES FOR ADAPTATION

Farmstead

- Adopt new building design standards capable of withstanding severe weather (flooding, wildfire, extreme heat).
- Locate buildings and other infrastructure away from flood risk zones or utilize materials and building standards or physical barriers that either seal out (dry flood proof) or withstand flooding (wet flood proof).
- Use 'Fire Smart' practices: prescribed burns, fuel reductions, and create fire breaks around farm and ranch infrastructure.
- Stockpile emergency supplies, keep standby generators with fuel on hand.
- Use vegetative buffers or sheltbelts to protect buildings from wind effects.

➔ see **Chapter 2** Farmstead, for more options and information.

Livestock

- Select livestock species and breeds best adapted to local conditions.
- Locate livestock confinement areas away from flood prone zones.
- Ensure adequate ventilation and install fans, misters, soakers, or evaporative coolers to reduce heat stress in barns.
- Use agroforestry plantings or install shade structures to protect outdoor livestock from wind and sun.
- Adjust herd sizes and timing seasonally to account for forage reductions from flooding, fire, drought or pest impacts.
- Bank forages for deficit periods through deferred grazing systems.
- Improve pasture and range quality to extend the grazing season.
- Integrate livestock into cropping systems to make full use of farm resources.
- Use multi-species grazing to make optimal use of different forage preferences.
- Install fencing and use rotational grazing systems.
- Increase monitoring of livestock health and heat stress.

➔ see **Chapter 3** Livestock, for more options and information

Crops

- Select crop types and varieties that are best adapted to changing local conditions.
- Increase perennial crop use, including trees, shrubs in agroforestry systems, and use multi-species plantings.
- Locate production areas away from flood prone zones or choose crops that are resilient to seasonal flood patterns.
- Select drought tolerant crops/varities.
- Adjust nutrient management plans to match changing climate conditions.
- Diversify and use longer crop rotations, include soil and nutrient building species (e.g., nitrogen fixing legumes).
- Minimize or eliminate fallow land.
- Use cover crops, strip or relay cropping.
- Manage crop residues to minimize bare soil and build soil organic matter.
- Protect feed, harvested crops from spoilage in storage.
- Consider expanded refrigeration/on-farm processing to reduce spoilage of high value fruit and filed vegetables.
- Use nutrient and water recovery systems in greenhouses and container production facilities.
- Adjust the timing or sequencing of cropping operations to match seasonal variations in climate
- Consider using minimum or zero till practices, particularly in arid regions.
- Use low displacement equipment for seeding and applying fertilizer.
- Use precision nutrient and pesticide application systems.
- Install windbreaks, hedgerows, and vegetative buffers; use alley cropping or other multipurpose agroforestry plantings.
- Use protective covers or shift production to controlled environments to protect high value horticultural crops.

➔ see **Chapter 4** Crops, for more options and information

Pest Management

- Increase monitoring for all pests and diseases; share data through regional networks, where available.
- Stay informed of new and emerging pest problems and learn how to identify them.
- Develop rapid response plans for targeted control of new pests.
- Consider shifts in insect vectors of pathogens in pest planning.
- Install a farm climate monitoring station and link it to regional or provincial networks.
- Promote habitat for natural pest controls.
- Manage non-crop pest hosts and control invasive species in non-crop areas.

➔ see **Chapter 5** Pest Management, for more options and information

Soil Amendments

- Avoid excess nitrogen applications.
- Consider the full range of soils biological, chemical, and physical properties for appropriate amendment levels.

➔ see **Chapter 6** Nutrient Application, for more options and information

Biodiversity

- Create and maintain haitat for pollinators or other beneficial organisms.
- Manage farms and fields as part of the larger landscape.
- Use temporary set-asides, or restore cropland to native vegetation where erosion risks are elevated.
- Use appropriate strategies to minimize agriculture-wildlife conflicts where fire, drought or flooding change wildlife distributions.
- Avoid altering or removing natural areas (forest, wetlands) that buffer production areas against extreme weather.

➔ see **Chapter 7** Biodiversity, for more options and information

Soil

- Consider using minimum or zero till practices, particularly in arid regions.
- Minimize bare soil at all times; maintain year-round ground cover.
- In certain circumstances, the use of mulch may conserve soil moisture and may reduce soil temperatures. However, caution must be used as the increase moisture may lead to pathogens.
- Deploy appropriate erosion control measures to prevent small disturbances from becoming problematic.
- Maintain riparian vegetation for erosion control.
- Restore degraded crop, pasture and rangeland or remove it from production.
- Build up organic soil matter for improved soil properties (inflitration and water storage) and soil health.

➔ see **Chapter 8** Soil, for more options and information.

Water

- Assess the whole farm water demand: primary / supplemental irrigation; stock water; fire suppression; pesticide mixing; processing needs.
- Participate in regional climate related monitoring programs.
- Assess irrigation system to find options for improvement or expansion if soils have adequate infiltration rates and evaporation rates are minimized.
- Upgrade irrigation equipment to increase the application efficiency.
- Assess expansion of water storage to alivate water supply challenges.
- Consider if deficit irrigation is appropriate for commodities being grown.
- Complete agricultural flood preparedness and mitigation planning.
- Increase soil organic matter to improve water-holding capacity, structure, and water infiltration.
- Participate in regional water management planning with other users, where available.
- Capture and use rainfall, runoff or waste water for use elsewhere in the operation.
- Minimize the surface area of water developments to cut evaporation losses.
- Avoid loss of access to water during low water levels, high water damage, or salt water wedge.
- Drain fields to minimize surface ponding, soil saturation, nitrification.
- Use laser land levelling to prevent ponding.
- Manage sediment mobilized by intense precipitation.
- Use wetlands, swales, and other landscape features to buffer heavy precipitation runoff.

➔ see **Chapter 9** Water, for more options and information.

Climate & Agriculture Initiative BC – Irrigation Resources

Climate & Agriculture Initiative BC - Water Storage Resources

Air

- Avoid burning crop residues.
- Suppress uncontrolled range and pasture fires to conserve soil organic carbon.

➔ see **Chapter 10** Air, for more options and information

Stewardship Areas

- Complete riparian management plans for all aquatic interfaces.
- Use integrated riparian management.
- Use agroforestry practices to both adapt to, and mitigate climate change.

➔ see **Chapter 11** Stewardship Areas, for more options and information

APPENDIX A TABLE OF CONTENTS

APPENDIX A

LEGISLATION & ENFORCEMENT

INTRODUCTION

This appendix gives a summary of legislation and enforcement related to environmental issues, including:

- Local Government Bylaws,
- Provincial Government Legislation,
- Federal Government Legislation,
- Enforcement by Regulatory Agencies,
- What Should a Landowner Do?
- *Agricultural Waste Control Regulation* Code.

Farm operations may be affected by environmental legislation from federal, provincial governments or by bylaws of municipal governments, regional districts or the Islands Trust. Each level of government has its own set of rules for environmental concerns. Compliance with the requirements of one level of government does not automatically ensure compliance with other levels.

The following is an alphabetical listing of legislation with the agency(s) that administer each Act listed. Please note that though a significant number of Acts are listed, not all producers are affected by them and most Acts are very specific and not wide ranging. There may also be Acts not listed here that apply to farm operations.

It is recommended that the actual legislation be consulted for the complete, precise wording.
Visit www.bclaws.ca **for online versions of the legislation.**
This list is not intended to be a legal interpretation of these Acts.
Please refer to a lawyer or legal authority for specific advice.

A.1 Local Government

Under the *Local Government Act*, regional districts, municipalities and other local governments may make bylaws dealing with a number of matters. Farm bylaws and, where a regulation under Section 918 of the *Local Government Act* has initiated the requirement, those rural land use or zoning bylaws applied to the *Agricultural Land Reserve* which prohibit or restrict agriculture, require approval by the Minister of Agriculture. Once a Section 918 regulation is in place for a particular area, it may authorize local government to enact farm bylaws, and/or require review of the rural land use or zoning bylaws. This review is to determine to what extent the bylaws are inconsistent with the standards established by the minister (under Section 916 of the *Local Government Act*).

The *Local Government Act* gives local governments a wide range of opportunities to apply land use policy and regulation through official community plans (OCP) and bylaws. Because there is a necessity for local bylaws, including official community plans, to be consistent with the *Agricultural Land Commission Act*, local governments can apply planning policy and bylaw regulation to land in the Agricultural Land Reserve.

Local governments may use a variety of tools to reduce conflicts between agricultural and residential land uses. These tools include policy documents such as official community plans that establish long-term goals to guide development within the jurisdictional boundaries. The guiding principles are enforced by a variety of different bylaws including noise and nuisance, subdivision control, zoning, rural land use and miscellaneous bylaws. Other tools include the designation of development permit areas in official community plans, water drainage plans, and a variety of other planning and policy documents such as park and recreation plans, transportation plans and neighbourhood plans. Many local governments have conducted agriculture plans that aim to address the needs of the agriculture industry within the local government's jurisdiction.

The number of bylaws affecting agriculture varies with each local government. Bylaws may regulate:

- Areas within a region or municipality where farming operations are permitted.
- Setback distances from property lines for buildings and production areas, lot coverage, and minimum lot sizes upon subdivision.
- Setback distances of buildings from watercourses.
- Setback distances from watercourses to minimize negative impacts of runoff, to preserve water quality and protect fish and wildlife habitat.
- Storm water management on agricultural lands.
- Landscaping requirements, burning, plant removal in development permit areas or tree cutting.
- Building requirements in flood plains.
- Nuisances, such as excessive noise from farm operations, including scare devices to control birds (if operated outside normal farm practices).
- Discharge of firearms.
- Emissions of air contaminants from machinery or equipment.
- Well water test requirements, to access adequacy of water supply and draw-down rates on adjacent properties.
- Construction materials, height and location of fences.
- Occurrences of harmful insects and weeds.
- Temporary farm worker housing.

Existing operations, not in compliance with a zoning or rural land use bylaw, may be considered "legally nonconforming." For instance, despite the fact that the use or siting of a building may not conform to current bylaws, the use may continue as a nonconforming use, provided the use is not discontinued for a continuous 6-month period. Note that for agricultural uses this time does not apply if due to seasonal, market or production cycles, the control of disease or pest or for other reasons in Section 911(2) of the *Local Government Act*.

Farm Bylaws. The Corporation of Delta, City of Abbotsford, Township of Langley, and City of Kelowna have farm bylaws approved by the Minister of Agriculture to regulate farm use within the municipality's ALR. Both the City of Abbotsford and Township of Langley regulate mushroom composting operations, and some other composting operations as well, through Farm Bylaws. These bylaws require farms to have an enclosed building with all air emissions biofiltered. They also require a storm water management plan and a waste water management plan. Composting must occur on the same parcel as mushroom growing barns are located. Up to 80% of the compost can be sold off-farm.

- The *National Farm Building Code*

  The *National Farm Building Code* (1995) is enforced only where proclaimed by local governments and outlines standards for:

  - Farm buildings; and
  - Pesticide storage.

The BC Building Code. The most recent Code was published in 2012. It can be purchased online here:

Local Air Quality Bylaws. Regional and municipal governments can pass bylaws to control emissions such as backyard and open burning, wood stoves and vehicle idling. These governments can also address air pollution through land-use and transportation planning, regional growth strategies and sustainability plans. Local Governments can put in place bylaws that restrict air emissions from industrial and business operations. Farms are not necessarily exempt from these local bylaws, particularly smoke control bylaws, and operators should check with their local or regional government. Local bylaws can be more restrictive than provincial regulations. For instance, a municipality or regional district can have a 'fire' bylaw that covers open burning. Local governments often have a burn ban at certain times of the year for fire safety reasons. Check with the local government office or the fire department to find out about the rules and restrictions. A permit may be required. A permit for burning diseased material may be given during restricted times in extreme circumstances, check with the local fire department about potential exemptions from the local government.

A.2 Provincial Government

Several government ministries administer Acts that regulate farm practices in BC. The following legislation dealing directly with regulation of some aspect of the agricultural environment is listed alphabetically.

Producers wishing more information about government policies, programs, etc. can obtain them electronically from the individual Ministry Internet web sites. ➔ see C.2 Web Sites, **page C-6**

Provincial Acts and Regulations are on the BC Laws site. ➔ www.bclaws.ca

Agricultural Land Commission Act

The Agricultural Land Commission (ALC) Act S.B.C. 2002, c. 36, and *Agricultural Land Reserve (ALR) Regulations* are the legislative framework for the establishment, administration, and procedures of BC's agricultural land preservation program. The ALC Act takes precedence over, but does not replace other legislation and bylaws that may apply to the land. Local and regional governments, as well as other provincial agencies, are expected to plan in accordance with the provincial policy of preserving agricultural land.

The ALR General Regulation, B.C. Reg. 171/2002, identifies the procedures for submitting applications and notices of intent.

The ALR Use Regulation, B.C. Reg. 30/2019 specifies land uses permitted in the ALR.

The policies of the Commission provide interpretation and clarification of the regulations; outline guidelines, strategies, rules or positions on various issues and provides clarification and courses of action consistently taken or adopted, formally or informally.

ALC Policies and Bylaws

Animal Health Act

This Act provides the authority for the *Game Farm Regulation*, which lists the farming of bison, fallow deer, and reindeer as a regulated activity. Farm operators working with bison and deer therefore require licensing. The Act requires producers to take preventive measures to reduce the risk of introducing and spreading disease; ensure employees are trained to prevent and respond to disease; maintain records of animal origin; abide by inspector's orders and report any incidents of disease or unusual illness.

Building Act

This act was introduced in 2015 and replaced the *BC Building Regulation*. The act oversees residential building and plumbing through codes. The Codes are largely based on the National Codes of Canada, with a small proportion of variations that are specific to B.C.

The act establishes the Province as the sole authority to set building requirements (that is, technical requirements for the construction, alteration, repair, and demolition of buildings) - the objective is to create more consistent building requirements across B.C., while still providing local governments with flexibility to meet their needs. It establishes qualification requirements for building officials to improve consistency in how the BC Building Code is interpreted, applied, and enforced and supports local governments and other local authorities through the implementation of a provincial review process to evaluate innovative building proposals

It applies in all parts of the Province except the City of Vancouver and federal lands and reserves.

For more information consult the BC Building Act Guide.

Carbon Tax Act

The *Carbon Tax Act* establishes a carbon tax in BC. Carbon tax is a broad based tax that applies to the purchase or use of fuels, such as gasoline, diesel, natural gas, heating oil, propane and coal, and the use of combustibles, such as peat and tires, when used to produce heat or energy. Carbon tax applies to fuels at different rates depending on their anticipated carbon emissions, and the tax rates. Farmers are required to pay carbon tax on fuel purchased or used for farming operations; however, some exemptions (e.g., coloured fuel purchased by a farmer that is delivered to their farm land) may apply.

Drainage, Ditch and Dyke Act

Administered by ENV, this Act establishes a system for the regulation and authorization of ditches, watercourses, drainages, and dykes in BC.

Drinking Water Protection Act

This Act and Regulations have requirements regarding the protection of drinking water quality and regulate domestic water systems (those serving **more** than one single-family residence).

- SECTION 6: requires water suppliers to provide potable water to water users
- SECTION 23(1): subject to subsection (3), a person must not (a) introduce anything or cause or allow anything to be introduced into a domestic water system, a drinking water source, a well recharge zone or an area adjacent to a drinking water source, or (b) do or cause any other thing to be done or to occur if this will result or is likely to result in a drinking water health hazard in relation to a domestic water system

The *Drinking Water Protection Regulation* defines potable water as "water from a domestic water system" as:

Water that meets the standards prescribed by the regulation and that is safe to drink and fit for domestic services without further treatment.

- No detectable fecal coliform bacteria or *Escherichia coli* per 100 ml
- No detectable total coliform bacteria per 100 ml for a sample in 30 days
- at least 90% of samples have no detectable total coliform bacteria per 100 ml and no sample has more than 10 total coliform bacteria per 100 ml for more than one sample in 30 days
- limits on chemical and physical parameters (such as nitrates and heavy metals)

Guidelines for Canadian Drinking Water Quality

Environment and Land Use Act

Administered by ENV, this Act establishes the Environment and Land Use Committee which recommends programs to increase environmental awareness, ensures that the natural environment is considered in land-use and resource development decisions, etc. The Minister of Environment and Climate Change traditionally chairs the committee. Orders may be made respecting the environment or land use that may override other Acts and regulations.

Environmental Management Act

This Act empowers ENV to control pollution within BC. Waste is defined to include "air contaminants, litter, effluent, refuse, biomedical waste, hazardous wastes" and any other substance designated by Lieutenant in Council or Minister of Environment. Pollution is defined in the Act as "the presence in the environment of substances or contaminants that substantially alter or impair the usefulness of the environment."

SECTION 6 of the Act has statements of particular interest to agricultural producers:

- SECTION 6(2): states that "...a person must not, introduce or cause or allow **waste to be introduced** into the environment in the course of conducting an industry, trade or business".
- SECTION 6(3): states that "...a person must not introduce or cause or allow to be introduced into the environment, **waste** produced by a prescribed activity or operation".
- SECTION 6(4): states that "a person must not introduce waste into the environment in such a manner or quantity as to cause pollution.
  - 'Agricultural operations' are **not** exempt from this requirement.
- SECTION 6(5): states that "nothing in this section or in a regulation...prohibits"
  - (6)(e): The burning of leaves, foliage, weeds, crops or stubble for domestic or agricultural purposes or in compliance with the *Weed Control Act.*
  - (6)(i): Emission **into the air** of soil particles or grit in the course of agriculture or horticulture.
- SECTIONS 39 TO 64: outline definitions and general principles of responsibilities, procedures, roles and administrative powers for the identification, determination and remediation of contaminated sites and the relocation of contaminated soils. *The Contaminated Site Regulation* is based on those sections of the Environmental Management Act and further specifies protocols, liabilities, fees and soil, sediment and water standards.

On-farm processing, handling and sale of agricultural produce may be defined as "agricultural operations" and, if they generate wastes (such as waste water, cull vegetables etc.), may require a Approval, Permit or Operational Certificate from ENV.

Agricultural activities are subject to several Regulations under this Act:

1. **Code of Practice for Agricultural Environmental Management.** The *Code of Practice for Agricultural Environmental Management (AEM code)* requires persons to use environmentally responsible and sustainable agricultural practices when carrying out agricultural operations, for the purpose of minimizing the introduction of waste into the environment and preventing adverse impacts to the environment and human health. The *AEM Code* includes requirements for building setbacks from water sources and property boundaries in Part 4 of the *AEM Code*.
2. **Antisapstain Chemical Waste Control Regulation.** This Regulation prohibits the use of wood residue contaminated by substances, such as antisapstain chemicals, preservatives etc. from being used as mulch or for burning in residential fireplaces or stoves or for fuel for wood-fired boilers, etc.

3. **Code of Practice for Soil Amendments.** This Code of Practice regulates the use of industrial wastes or by-products such as lime, ash and biosolids as soil amendments. The code provides requirements for maximum concentrations of heavy metals and other contaminants. A land application plan is required if more than 5 m^3 of soil amendments, regulated under the Code of Practice, are to be applied to a site in a year. If soil amendments are to be applied to land within the Agricultural Land Reserve, notice must be given to the Provincial Agricultural Land Commission 30 days prior to discharge.
4. **Contaminated Site Regulation.** *The Contaminated Site Regulation (CSR)* outlines the identification, investigation, and remediation of contaminated sites. Contaminated sites are areas where hazardous waste or organic and inorganic substances are in soil or groundwater at levels potentially toxic to humans, animals and the environment. Contaminated sites are typically the result of past industrial and commercial uses. They are unlikely to be found in areas located in the natural environment or where land uses, and the use of adjacent land, has exclusively been farming or forestry.

   The CSR may also be relevant when landowners import soil onto their property as they may be liable for the remediation of the land if the soil that has been deposited turns out to be contaminated.
5. **Hazardous Waste Regulation.** This Regulation (renamed from *Special Waste*) applies to the management of waste oil, waste pesticides, waste pesticide containers and contaminated soils. Pesticide containers that are rinsed according to the *Hazardous Waste Regulation* are not considered hazardous wastes. This regulation does not apply to a quantity of hazardous waste which is less than 5 kilograms or 5 litres and which is accumulated or produced in a period of less than 30 days.
6. **Municipal Sewage Regulation.** This Regulation spells out the rules for treating municipal sewage, reusing highly treated sewage effluent and disposing of effluent that cannot be reused. Codes of practice for reclaimed water use in agriculture are outlined.
7. **Mushroom Composting Pollution Prevention Regulation.** This Regulation requires that air contaminants from a mushroom composting facility must not be discharged in a manner that causes pollution. Conditions must be met regarding pollution prevention planning, facility design and operation, and reporting.
8. **Open Burning Smoke Control Regulation and Code of Practice.** This regulation applies to open burning for a domestic or an agricultural purpose as follows:

   a) If all of the vegetative debris open burned is branches or other pieces of vegetative debris, with or without leaves, each branch or piece of which is less than 10 cm in diameter but of which at least some of the individual branches or pieces are 3 cm or greater, only sections 7, 9, 12, and 30 of this regulation apply to the open burning;

   b) If all of the vegetative debris is branches or other pieces of vegetative debris, with our without leaves, of which at least some of the individual branches or pieces are 10 cm or greater in diameter, this regulation applies with respect to the open burning.

   There are specific standards and exemptions under the OBSCR and Code of Practice for various materials burned on the farm. A waste discharge approval or permit for burns is **not** required under this Act for:

   - Burns that satisfy all the terms and conditions set out in the OBSCR and the *Open Burning Smoke Control Code of Practice.*
   - Burns conducted to comply with the *Weed Control Act.*

   If the burning of agricultural vegetative debris is branches or other pieces of vegetative debris of which the pieces are less than 3 cm in diameter, then this regulation does not apply. However, local bylaws regarding burning and smoke control will continue to apply.

   Agricultural vegetative debris diameter (cm) Application of OBSCR

   < 3cm Exempt (local bylaws still apply)

   > 3cm to < 10cm Burning must stay within 5 km of original location

   Prohibited materials must not be included nor used as an accelerant

   Must adhere to any prohibitions issued by a Director

   > 10cm No exemptions

In addition, specific requirements are set forth for the burning of diseased vegetative debris (see Division 3, sections 24 and 25).

All other burns (e.g., household, industrial) require a waste discharge approval or permit from ENV. **Note: Metro Vancouver is the agency that gives approvals within its boundaries.** Even though permitted, open burning must not pollute the air. SECTION 2, Schedule 1 of the *Waste Discharge Regulation* provides a list of materials that are prohibited from being open burned.

The OBSCR sets forth regulations for open burning based on smoke sensitivity zones, which are categorized as High, Medium, and Low. These zones are listed in Schedule 3 of the regulation.

Regardless of smoke sensitivity zone, the OBSCR requires a burn operator to:

- Explore all possible options to reduce, reuse or recycle as much of the material as possible (i.e. not to burn).
- Burn only vegetative matter such as tree branches, limbs, roots, shrubs, etc.
- Only burn the targeted vegetative debris within 5 km radius of where it originates from.
- Do not burn prohibited materials, or substances that normally emit dense smoke or noxious odours.
- Burn the material more than 500 m from a neighbouring residence or business and more than 1000 m from a hospital, continuing care facility, or school unless otherwise exempted under Section 4, or if all conditions are met under section 13(2) in the regulation.
- Ensure that smoke from open burning must not be initiated if the local air flow will cause the smoke to:
  - Negatively impact a population centre or work camp, or
  - Pose a hazard at airports or highways by significantly reducing visibility.
- Ensure that the ventilation index is:
  - "Good" on the day the burn is started and forecast to be "good" or "fair" on the following day for burning in high and medium smoke sensitivity zones, and
  - "Good" or "fair" on the day the burn is started and forecast to be "good" or "fair" on the second day for burning in low smoke sensitivity zones (see the regulation for further information and requirements).

    Environment Canada Weather Forecast for BC

    Daily Smoke Control Forecast for BC
- Ensure satisfactory control and feeding of the fire, and make sure adequate equipment and staff are available to ensure the regulatory limits are met.
- Follow all of the burning restrictions that are relevant to the smoke sensitivity zone.
- These restrictions include a smoke release period, and restrictions on the number and frequency of burns per year that is no more than:
  - 12 days per calender year and,
  - 6 days in each month on a small, private land within a high smoke sensitivity area (see the regulation for further information and requirements).
- Ensure that all reasonable efforts are taken to minimize the amount of smoke emitted by open burning (see SECTION 11 in the regulation for further information).
- Ensure that proper records are made and kept if open burning is carried out using one or more category 3 open fires or air curtain incinerators.

  Wildfire Bans and Restrictions in BC

  Interactive venting index map for BC

9. **Organic Matter Recycling Regulation.** This Regulation (also under the *Public Health Act*) deals with the production of compost and subsequent land application of recyclable organic matter derived from many non-agricultural (municipal) sources (i.e., sewage biosolids, yard waste and food waste). It is intended to encourage composting and beneficial use of selected organic matter. The regulation contains quality criteria for metals, pathogens and vector attraction reduction. It also covers aspects of land application plans for managed organic matter. It does not apply to agricultural waste composting operations that operate in accordance with the *Code of Practice for Agricultural Environmental Management.*

   Class A and Class B Compost: Section 12 of the Regulation specifies the requirements for Class A compost. Compost that is produced solely from yard waste or untreated and unprocessed wood residuals must meet pathogen reduction process and vector attraction reduction requirements and quality criteria (trace elements). Compost that contains any of the other permitted organic materials (Schedule 12) must additionally meet pathogen reduction limits and must meet sampling and record keeping requirements as outlined in Schedules 5 and 6 of the OMRR. If the compost meets these requirements, it is considered Class A compost and it can be distributed freely without volume restriction.

   To be designated as Class A compost, fecal coliforms must be measured at less than 1,000 MPN per gram of total solids (dry weight basis). If compost is made from yard waste alone, determination of fecal coliform levels is not required. Class A compost must also meet the quality criteria as outlined in Schedule 4, column 1.

10. **Ozone Depleting Substances and Other Halocarbons Regulation.** This Regulation regulates the servicing of refrigeration equipment and disposal of refrigerant gases.

11. **Spill Reporting Regulation.** This Regulation requires reporting of spills:

   - SECTION 2(1): A person who had possession, charge or control of a substance immediately before its spill shall **immediately report** the spill to the Provincial Emergency Program (PEP) by telephoning 1-800-663-3456 as provided in section 12(5) of the Act or, where it is not practical to report to PEP within a reasonable time, to the local police or nearest detachment of the Royal Canadian Mounted Police.
   - SECTION 2(2): Where it appears to a person observing a spill that a report under subsection (1) has not been made, he or she **shall make the report** referred to in this section.
   - SECTION 2(3): A report under this section **shall include,** to the extent practical,
     - (a) The reporting person's name and telephone number,
     - (b) The name and telephone number of the person who caused the spill,
     - (c) The location and time of the spill,
     - (d) The type and quantity of the substance spilled,
     - (e) The cause and effect of the spill,
     - (f) Details of action taken or proposed to comply with Section 3,
     - (g) A description of the spill location and of the area surrounding the spill,
     - (h) The details of further action contemplated or required,
     - (i) The names of agencies on the scene, and
     - (j) The names of other persons or agencies advised concerning the spill.
   - SECTION 3: Where a spill occurs, the person who immediately before the spill had possession, charge or control of the spilled substance shall **take all reasonable and practical action**, having due regard for the safety of the public and of himself or herself, to stop, contain and minimize the effects of the spill.

   The Regulation requires reporting any spill of pesticide greater than five kilograms or five litres, fertilizer (including manure) greater than 50 kilograms or 50 litres and petroleum products greater than 100 litres, and any polluting substance greater than 200 kilograms (such as manure or mortalities). Check the regulation for other specific substances and reportable quantities.

12. **Waste Discharge Regulation.** This Regulation regulates various industries and their waste discharges into the environment. It exempts industries who discharge wastes in accordance with applicable codes of practice from Section 6(2) and (3) of the Environmental Management Act (as the *Agricultural Environmental Management Regulation* does for agriculture with the *Code of Practice for Agricultural Environmental Management*).

Farm Practices Protection (Right to Farm) Act

Administered by MAFF, this Act provides that farmers on agricultural land are not liable to legal actions resulting from nuisance complaints regarding farming activities when they meet certain conditions. The Act defines a normal farm practice as an activity "that is conducted by a farm business in a manner consistent with proper and accepted customs and standards as established and followed by similar farm businesses under similar circumstances":

- SECTION 2: **protects a farmer from liability** in lawsuits alleging nuisance for odour, noise, dust or other disturbance resulting from a farm operation if:
  - The farmer uses normal farm practices.
  - The operation is conducted in the ALR, land zoned for farm use, or, aquaculture that is defined as a "farm operation" or Crown land designation as a farming area.
  - There is no contravention of other listed legislation, such as the *Environmental Management Act, the Agricultural Environmental Regulation and Code of Agricultural Environmental Management* and land use regulations (e.g., a zoning bylaw).

In addition, the Act establishes a Farm Industry Review Board to receive complaints regarding odour, noise, dust or other disturbances resulting from farm operations. The Farm Practices Board will hear complaints and determine whether the complaint issue results from a normal farm practice.

http://www.agf.gov.bc.ca/resmgmt/fppa/refguide/intro.htm

Food Safety Act

The *Food Safety Act* encompasses the entire spectrum of British Columbia's food industry, from production and processing to retail and food service establishments. The Act is an important part of the legislative framework for food safety in B.C.. It clarifies the legal responsibility of food establishment operators with respect to the safety of their products; grants inspection and enforcement powers to inspectors; and specifies offences and penalties for infractions.

The *Food Safety Act* also gives the Lieutenant Governor in Council the authority to establish regulations governing food production, food sale and the operation of food establishments. However, at present time, the only regulation in place is the *Meat Inspection Regulation*.

- The definition of "food establishment" is broad. The Ministry of Health administers the *Food Safety Act* except as it relates to food establishments where animals are slaughtered for food purposes, whereby the Ministry of Agriculture, Food and Fisheries administers it.
- The *Meat Inspection Regulation* is made under the authority of the *Food Safety Act*. This regulation deals with animal slaughter.

Slaughter establishments in B.C. are either federally registered by the Canadian Food Inspection Agency or are provincially licensed. Slaughter establishments that are provincially licensed through Class A, Class B, Class D, or Class E licences are only permitted to sell their product within B.C. Federally registered establishments are permitted to export their product outside the Province.

The *Meat Inspection Regulation* ensures that:

- Animals are humanely handled and slaughtered,
- Carcasses are processed in a clean environment, and
- Meat is packaged and stored in ways that reduce contamination risks.

The *Food Safety Act* also aligns with the following acts and regulations:

- *Public Health Act,*
- *Food Premises Regulation,*
- *Milk Industry Standards Regulation,*
- *Fish and Seafood Act.*

Fisheries Act

The *Fisheries Act* provides for licensing and regulatory control of activities associated with commercial fisheries and aquaculture operations, this Act deals with licensing of fisheries, processors and safe fish passage:

- SECTION 28: requires **fish protection devices** for any dam or other hydraulic work
  - This may include fish ways, screens, etc.

These requirements are also provisions of the Federal *Fisheries Act* and the Provincial *Fish Protection Act* and are most likely to be enforced by the agencies responsible for those Acts.

Forest and Range Practices Act

This Act regulates all forest practices (which include grazing on Crown lands). To replace the *Forest Practices Code of British Columbia Act*.

Game Farm Act

Administered by MAFF, this Act licences and regulates game farms.

- Section 6: states Section 76 of the Wildlife Act does not apply to game that escapes from a farm being operated by a person who holds a valid licence (but the *Game Farm Regulation* limits this by requiring capture within 30 days and other conditions, such as genetic integrity of wildlife)

Greenhouse Gas Industrial Reporting and Control Act

This Act replaced the *Greenhouse Gas Reduction (Cap and Trade) Act* in 2014. The Act enables performance standards to be set for industrial facilities or sectors by listing them within a Schedule to the Act. The Act streamlines several aspects of existing GHG legislation and regulation into a single legislative and regulatory system, including the emission reporting framework established under the *Greenhouse Gas Reduction (Cap and Trade) Act*. The Act provides authority for the *Greenhouse Gas Emission Reporting Regulation, the Greenhouse Gas Emission Control Regulation*, and the *Greenhouse Gas Emission Administrative Penalties and Appeals Regulation*.

The *Greenhouse Gas Emission Reporting Regulation* requires that industrial operations that emit over 10,000 carbon dioxide equivalent tonnes per year (tCO_2e) report their GHG pollution each year. Operations emitting over 25,000 tCO_2e are required to have their emission reports independently verified.

The *Greenhouse Gas Emission Control Regulation* establishes the infrastructure and requirements for issuing emission offset units and funded units. These are the foundational elements that enable compliance with the performance standards listed within a Schedule to the Act. The Regulation also establishes the BC Carbon Registry, which enables the electronic issuance, transfer and retirement of compliance units (emission offset units, funded units and earned credits).

Greenhouse Gas Reduction Targets Act

The *Greenhouse Gas Reduction Targets Act* sets aggressive legislated targets for reducing greenhouse gases. Under the *Act*, B.C.'s GHG emissions are to be reduced by at least 40% below 2007 levels by 2030, 60% by 2040 and 80% by 2050. A further emission reduction target of 80% below 2007 levels is set for 2050. The Act provided authority for the *Greenhouse Gas Emission Control Regulation* and the *Carbon Neutral Government Regulation* (enacted in December 2008).

Emission Offsets Regulation. The Regulation sets out the requirements for greenhouse gas reductions and removals from projects or actions that qualify as emission offsets for the purpose of fulfilling the provincial government's commitments to be carbon neutral by 2010.

Heritage Conservation Act

No permits or approvals, other than *Heritage Conservation Act* permits issued by the Archaeology Branch, are required to carry out the site alterations, heritage inspections or heritage investigations described in permit applications. However, licensees and property owners or developers may also require other approvals such as forestry cutting permits and municipal development permits unrelated to the archaeological work.

There are no fees for obtaining a *Heritage Conservation Act* permit. The only costs to property owners or developers with respect to archaeological work are the fees charged by the consulting archaeologists they have hired.

www2.gov.bc.ca/gov/content/industry/natural-resource-use/archaeology/permits

www.for.gov.bc.ca/ftp/archaeology/external/!publish/web/Property%20Owner%20Brochure.pdf

Integrated Pest Management Act

Administered by BC Ministry of Environment Climate Change Strategy, this Act regulates the sale, containment, transportation, storage, preparation, mixing, application and the disposal of pesticides and their containers.

SECTION 3(1): Without limiting any other provision of this Act, a person must not (a) use a pesticide that causes or is likely to cause, or use, handle, release, transport, store, dispose of or sell a pesticide in a manner that causes or is likely to cause, an unreasonable adverse effect.

It is important for producers to ensure that their pesticide application practices adhere to Section 3(1), as described above, because it may be applied when a drift incident is being investigated in order to determine if the use of the pesticide resulted in an unreasonable adverse effect, or if the action was likely to cause the unreasonable adverse effect.

Administered by BC Ministry of Environment Climate Change Strategy, this Act regulates the sale, containment, transportation, storage, preparation, mixing, application and the disposal of pesticides and their containers.

Integrated Pest Management Regulation.

- SECTION 18(1): Permit-restricted pesticides are considered to be prescribed for the purpose of the Act
- SECTION 18(2): Except as provided in subsection (4), the following uses of a pesticide are prescribed for the purpose of the Act
  - Aerial application of a pesticide.
  - Use of a pesticide, other than an excluded pesticide, in or on a body of water, unless a licence is required for the use or a confirmation is required for the use.
  - Aerial applications to private land used primarily for agriculture do not require a Pesticide Use Permit.
- SECTION 18(4): A use described in subsection (2) is not prescribed if
  - The use is aerial application to private land used primarily for agricultural production, the use is aerial application of a Scheduled Pesticide, in accordance with a licence or a confirmation, and to land that is neither in an urban area nor used for residential purposes.
- SECTION 33(1): A person who stores a pesticide must store it in a manner that
  - Minimizes hazards to human health and the environment, and
  - Is in accordance with the standards prescribed in Sections 65 [pesticide container and labeling standards], 66 [pesticide storage] and 67 [pesticide storage — licencee], as applicable.
- SECTION 33(2): A person who transports or causes or allows the transport of a pesticide must ensure that the pesticide is secured and transported in accordance with the applicable standards prescribed in Division 7 [Standards for Use, Containment, Transport, Storage or Sale of Pesticide] of Part 2 and in a manner that prevents
  - The escape, discharge or unauthorized removal of the pesticide from the transport vehicle,

    and
  - The contamination of food or drink intended for animal or human consumption, bedding or similar items that are transported with the pesticide.
- SECTION 33(3): A person who uses a pesticide must use it in a manner that
  - Minimizes hazards to human health and the environment, and
  - Is in accordance with the applicable standards prescribed in Division 7 [Standards for Use, Containment, Transport, Storage or Sale of Pesticide] of Part 2 in relation to the handling, mixing, applying or disposing of pesticides, and the handling and disposal of containers used for pesticide.
- SECTION 65(1): Pesticide must be kept, handled, stored or transported
  - In the container in which it was originally packaged and with the label originally affixed by the manufacturer, or
  - In a container designed for containing the pesticide and labeled in accordance with subsection (2).
- SECTION 65(2): For the purposes of subsection (1)(b), a label must display
  - The trade name of the pesticide,
  - The name and the concentration of the active ingredient in the pesticide, and
  - The pesticide's registration number under the federal Act.
- SECTION 65(3): Subsections (1) and (2) do not apply to tanks being used for mixing pesticides for or holding pesticides during use
- SECTION 66(1): Pesticide, other than excluded pesticides and domestic pesticides, must be stored
  - Separately from food intended for human or animal consumption, and
  - In a storage facility that is ventilated so that pesticide vapours are vented to the outside, not used for the storage of food intended for human or animal consumption, locked when unattended, and accessible only to persons authorized by the person storing the pesticide.

- SECTION 66(2): Each door providing access to a facility described in subsection (1) must bear a sign that
  - Has the words "warning: chemical storage — authorized persons only" written in block letters, and
  - Is clearly visible to a person approaching the door.
- SECTION 66(3): Fumigants and other pesticides that
  - Release vapours, and
  - Bear a "poison" symbol on the label and must be stored in a storage facility that is not attached to or within a building used for living accommodation.
- SECTION 70(1): A container used to prepare, mix or apply a pesticide must not be washed or submerged in a body of water.
- SECTION 70(2): If equipment is used to draw water from a body of water or an irrigation system into a container used to contain, prepare, mix or apply a pesticide, a gap must be maintained between the pesticide and the equipment so that pesticide is prevented from entering the body of water or irrigation system.

A summary of the *Integrated Pest Management Act* and *Regulation* can be found at

http://www.env.gov.bc.ca/epd/ipmp/regs/index.htm

Land Act

This Act administers and regulates Crown land disposition, grants and trespass.

- SECTION 67(1) states a person must not throw, deposit, dump or in any way cause to be **placed on Crown land** any glass, metal, garbage, soil or other substance without the authority of the minister.

Local Government Act

Administered by the Ministry of Municipal Affairs, this Act provides the legislative framework for the establishment, function and operation of local governments. It provides for the authority for local government to establish rules and regulations and for the provision of services to the local community. Several SECTIONS may apply to the environment:

- SECTIONS 471 TO 478: relate to official community plans - these may restrict the use of land that is environmentally sensitive to development and provide for the designation of development permit areas in plans (see also section 920) for various purposes including the protection of the natural environment and the protection of farming.
- SECTIONS 479 TO 483: relate to zoning bylaws that may be adopted.
- SECTION 523: allows bylaws to control runoff related to the construction of a roofed area or paved area and to establish the maximum percentage of the area of land that can be covered by impermeable material.
- SECTIONS 551 TO 555: outline the use of land for agricultural operations; Section 551: allows for bylaw standards; Section 552: provides for farm bylaws.
- SECTION 488: provides the authority to issue development permits relating to the protection of the natural environment and the protection of farming.

*Note that under SECTION 553 AND 481(2) zoning bylaws and SECTION 552 farm bylaws do not apply until the Lieutenant Governor in Council, by regulation, declares that they apply. These provisions require that, for land in an Agricultural Land Reserve (ALR), a rural land use bylaw or zoning bylaw which prohibits or restricts the use of land for a farm business, or a farm bylaw, must be approved by the Minister of Agriculture and Lands

Stewardship Options for Private Landowners in BC

Guide for Bylaw Development in Farming Areas (this provides information on the Minister's standards, the review of zoning and rural land use bylaws and the development of farm bylaws)

Motor Vehicle Act

Administered by Ministry of Transportation and Infrastructure, this Act makes deposition or dumping of "noisome, nauseous or offensive matter" (e.g., the carcass of a dead animal, offal, ashes, refuse) on a highway or right-of-way an offence.

As of October 1, 2010, in accordance with the *Motor Vehicle Act*, heavy diesel vehicle emission control devices must be installed on all BC registered commercial diesel vehicles of model years 1989-1993 with a Licensed Gross Vehicle Weight (LGVW) of more than 8,200 kg. Farm vehicles with a LGVW under 17,300 kg are exempt from these retrofit requirements.

Plant Protection Act

Administered by MAFF, this Act is the provincial counterpart to the federal *Plant Protection Act* that focuses on plant protection issues affecting Canada. It provides for the prevention of the spread of pests destructive to plants in BC. Inspectors have powers to enforce the provisions of the Act, including the authority to establish quarantine areas. To assist in the enforcement of the Act, the BC Plant Protection Advisory Council advises and co-ordinates the actions of provincial and federal officials to deal with potential hazards to BC agriculture and forestry from insects, plant diseases, weeds or other biotic agents. The Council's power comes from the mandates of the agencies whose members sit on committees struck to deal with plant protection issues in specific commodity sectors.

The purpose of this Act is to prevent the deleterious spreading of insects, pests, or diseases that are destructive to plants. Under this Act, inspectors may enter premises at any reasonable time for an inspection of the premises, plans, root mediums, or containers. They can order the treatment, confiscation, or destruction of plants. Regulations under this Act include:

- *Bacterial Ring Rot Regulation,*
- *Balsam Woolly Adelgid Regulation,*
- *Blueberry Maggot Control Regulation,*
- *Domestic Bacterial Ring Rot Regulation,*
- *Golden Nematode Regulation,*
- *Little Cherry Control Regulation,*
- *Northern American Gypsy Moth Eradication.*

Private Managed Forest Land Act

This Act allows the Private Managed Forest Land Council to be responsible for private managed forest land other than land that is in a tree farm licence area, a woodlot licence area or a community forest agreement area with respect to inclusion, exclusion, subdivision and non-forestry uses. In addition, the Council is responsible for ensuring that forest management practices, including agroforestry, on private land within the FLR complies with prescribed environmental standards of forest practice for the protection of fish habitat, water quality, soil conservation and critical wildlife habitat.

Public Health Act

Administered by the Ministry of Health, this Act includes regulations of farm practices that may result in a health hazard. A health hazard may occur when nutrients, contaminants or pathogens are discharged to land, water or air which pose a public health problem. Spills of potentially harmful substances must be reported to the Local Health Authority. Under this Act, the Local Health Authority must investigate any health hazard and has authority to order the hazard to be eliminated.

Food Premises Regulation. This Regulation applies to any place where food intended for public consumption is sold, offered for sale, handled, prepared, packaged, processed, stored, etc. Food premises must be connected

to a source of potable water and be connected to a waste disposal system, among other requirements.

- SECTION 4: contains food premises requirements.
- SECTION 7: every operator of food premises must immediately notify a health officer of any circumstance that exists in the food premises that may cause a health hazard.
- SECTION 14: contains food processing requirements.
- SECTIONS 23 AND 24: contain food safety management requirements.

Health Hazards Regulation. This regulates health hazards and the distance of wells from possible sources of contamination

SECTION 8 (1) A person who installs a well, or who controls a well installed on or after July 20, 1917, must ensure that the well is located at least:

(a) 30 m from any probable source of contamination,

(b) 6 m from any private dwelling, and

(c) Unless contamination of the well would be impossible because of the physical conformation, 120 m from any cemetery or dumping ground.

(2) A person who controls a well installed before July 20, 1917, must

(a) Remove any source of contamination within the distances set out in subsection (1), or

(b) Subject to subsection (3), close the well in accordance with the *Groundwater Protection Regulation*, B.C. Reg. 39/2016.

(3) Subsection (2) (b) does not apply to a well located within 6 m of a private dwelling unless it can be shown that the well should be abandoned for a reason other than proximity to a private dwelling.

(4) A well that does not meet the requirements of this section is prescribed as a health hazard.

Sewerage System Regulation. This Regulation applies to domestic sewage disposal systems.

- SECTION 2: states Regulation applies to a holding tank, single family residence or duplex, with a daily flow of less than 22,700 litres.
- SECTION 3: requires domestic sewage be discharged into a public sewer, a holding tank or a sewerage system so as not to cause, or contribute to, a health hazard.
- SECTION 3.1 requires separations distances from wells (as outlined in the 🕮 Sewerage System Standard Practice Manual) to be at least:
  - 15 m from a holding tank.
  - 30 m from a sewerage system.
  - This distance can be varied before construction if a professional competent in the area of hydrogeology provides written advice that it would not likely cause a health hazard.
- SECTIONS 4 AND 5: regulate holding tanks.
- SECTIONS 6 TO 10: regulate sewerage systems.
  - Only an **authorized person** can construct and maintain systems (having taken training).
  - Applies to **new systems**, or **existing ones** under going significant alteration or repair.
  - The **owner is responsible** to have maintenance done and to keep records.
  - The installation of a septic system must be conducted by a Registered Onsite Waterwater Practioner with the Applied Science Technologists and Technicians of BC or a Professional Engineer with Engineers and Geoscientists BC.

Riparian Areas Protection Act

The *Riparian Areas Protection Act* creates the authority for government to enact Provincial directives to protect areas that border streams, lakes, and wetlands. *The Riparian Areas Regulation* (RAR) calls on local governments to protect riparian areas during residential, commercial, and industrial development by ensuring that a Qualified Environmental Professional (QEP) conducts a science-based assessment of proposed residential, commercial, and industrial activities in riparian areas.

With this Act, and through the *Riparian Areas Regulation*, local governments in certain regions of the Province are able to protect riparian areas during residential, commercial, and industrial development by ensuring that a Qualified Environmental Professional (QEP) conducts a science-based assessment of proposed activities. This includes residential buildings on land zoned for agricultural purposes. Section 12 provides Provincial directives on streamside protection.

The RAR only applies to the residential portion of the farm and only in the southern half of BC. The RAR does not apply to farm practices as defined in the *Farm Practices Protection Act*. In some cases, this can lead to the misunderstanding that the RAR does not apply to lands zoned for agriculture, or in the Agricultural Land Reserve (ALR). The RAR does apply to these lands for activities that are not *farm practices*, for example residential construction. It is important to note that local governments have the ability to establish bylaws that apply to agricultural lands, and some have implemented setbacks for agricultural buildings that complement the setbacks designated under RAR.

Transportation of Dangerous Goods Act

Administered by Ministry of Attorney General, this Act establishes requirements to provide for the safe transport of goods deemed to be dangerous. Regulations specify substances and establish classes of dangerous goods.

Water Sustainability Act

Water Sustainability Act (WSA) is the principal law for managing the diversion and use of water in British Columbia. The WSA establishes that all water in *streams* and *groundwater* in British Columbia is owned by the Crown on behalf of the residents of the Province.

A stream is very broadly defined as being any above ground natural water body or watercourse, including springs, glaciers, lakes, ponds, rivers, creeks, and wetlands. Groundwater is defined as any water that is found naturally beneath the surface of the earth.

Under the WSA no person may divert water from a stream or from groundwater unless the person holds an authorization or the diversion and use of water is allowed by the Act or under a regulation. An authorization can take the form of a "use approval", which allows for short term use of water for up to 24 months, or a water licence which establishes a long term water right. Authorization holders have some responsibilities including the need to pay water fees and rentals and make beneficial use of the water they are authorized to divert, store and use.

In most cases any person who diverts water for use or storage must apply to the province for the right to use the water and pay an annual rental fee for that use. The requirement for groundwater licensing for non-domestic (e.g., farm or business use) came into force on February 29, 2016 and applies to new groundwater users as well as those who began using groundwater prior to February 29, 2016.

The requirement to obtain a licence for diversion and use of water from streams or groundwater applies regardless of whether the water source is on private or Crown land. However, the WSA and the regulations allow diversion and use of water without an authorization for certain uses:

- Diversion of groundwater or unrecorded stream water for a domestic purpose;
- Diversion of water to extinguish a fire;
- Diversion of water by a well driller to drill a well;
- Diversion and use of water for small scale placer mining and mineral exploration; and
- Diversion of water for a flow test or to test water quality or quantity.

Other key aspects of the WSA include:

- **Managing water during scarcity**, which involves the regulation of diversion of water use to manage periods when there is insufficient water to meet licensed demand or if a fish population is threatened. Regulation can take the form of a Temporary Protection Order, or a Fish Population Protection Order. The difference between these is that a Fish Population Protection Order can override the WSA First in Time, First in Right (FITFIR) system.
- **Changes in and about streams:** There are two processes that allow a change to be made in and about a stream. A "Change Approval" is a written authorization to make changes in and about a stream and normally involve a more significant or larger change. A "Notification" is for low risk changes that have minimal impact on the environment or third parties

The following sections of the WSA may be useful to agricultural operators in particular:

- SECTION 6: Prohibits diverting water without a licence except in limited circumstances for fire suppression, domestic use and mineral prospecting.
- SECTION 11: Requires approvals for making changes in and about streams.
- SECTIONS 16 AND 17: May require mitigation measures on (sensitive) streams where a water diversion or use is authorized.
- SECTION 45: No new dams on protected rivers.
- SECTION 88: In the case of low or impending low water, for the purposes of protecting the fish population, the minister may make an order regulating the diversion, rate of diversion, time of diversion, storage, time of storage and use of water from the stream by holders of licences or approvals in relation to the stream or aquifer connected hydraulically to the stream.
- SECTION 128: Regulations respecting sensitive streams.

The following is a summary of WSA regulations:

Water Sustainability Regulation. There are a number of purposes for this regulation, which include:

- Establishing application requirements for WSA authorizations, including licences and use approvals for stream water and groundwater;
- Defining processes for making changes in and about streams, and in particular delineating changes that can be made by notification to government and those that must be made after making application for and being granted a Change Approval;
- Defines "sensitive streams" in British Columbia;
- Establishes procedures for licence holders to expropriate land reasonably required for the construction, maintenance, improvement or operation of works authorized or necessarily required under the licence; and
- Defines certain water uses that may occur under the regulation rather than under a licence or use approval, such as short term use of water for well drilling purposes and use of deep saline groundwater in north east BC.

British Columbia Dam Safety Regulation. The objective of this Regulation is to mitigate loss of life and damage to property and the environment from a dam breach by requiring dam owners to: inspect their dams, undertake proper maintenance, report incidents and take remedial action and ensure that the dams meet current engineering standards.

Ground Water Protection Regulation. This Regulation applies to all well pump installers and well drillers in BC. It regulates their registration and qualification and provides for groundwater protection regarding well sealing, identification, deactivation, capping, flood proofing of wells with the "*Code of Practice for Construction, Testing, Maintenance, Alteration and Closure of Wells in BC*". .

Water Sustainability Fees, Rentals and Charges Tariff Regulation. This regulation specifies the water-related fees for all water uses, including water power.

The right to divert and use surface water or groundwater is authorized by a licence or approval. Licences and approvals are granted in accordance with the statutory requirements of the *Water Sustainability Act*. If you use surface water or groundwater for any non-domestic purpose, you require a water licence under the *Water Sustainability Act*.

Apply for a water licence at FrontCounter BC. Approval is also required for any work in or about a stream. Links provided for the following documents:

- Understanding a Water Licence
- Water Rights in British Columbia
- Water Licence Holders Rights and Obligations
- A Users Guide to Working In and Around Water (Changes in and About Streams)
- Standards and Best Practices for Instream Works (Changes in and About Streams)

Water Sustainability Fees, Rentals and Charges Tariff Regulation. This regulation specifies the water-related fees for all water uses, including water power.

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Water Protection Act

Administered by ENV, this Act will not affect most producers. It:

- Confirms the ownership of surface water and groundwater in the Province.
- Maintains existing bulk water removal rights.
- Prohibits large-scale diversion of water between the major watersheds of BC.

Weed Control Act

Administered by MAFF, this Act places the responsibility for the control of noxious weeds on the occupiers of the land. It provides for the appointment of inspectors to ensure compliance and, failing that, for a method by which they can control weeds and recover the costs from the occupier. Weed Control Committees may be established by municipal councils to administer the Act within a municipality. Committees report to the municipal council and the Minister.

Wildfire Act

As of March 31, 2005, this Act regulates **open fires within 1 km of forest land or grass land.** It is administered by the Ministry of Forests, Lands, Natural Resource Operations and Rural Development.

- SECTION 2: requires reporting a forest land or grass land fire.
- SECTION 3: prohibits dropping, releasing or mishandling a burning substance, or any other thing that the person reasonably ought to know is likely to cause a fire.
- SECTION 4: states Section 5 & 6 do not apply to the City of Vancouver or a municipality or a local government having an open fire bylaw.
- SECTION 5 & 6: regulates non-industrial and industrial open fires.

Wildfire Regulation. This Regulation applies to all **open fires within 1 km of forest land or grass land**.

- SECTIONS 4 – 12: outline fire prevention requirements.
- SECTIONS 13 – 17: outline fire control requirements.
- SECTIONS 18 – 24: outline permissible open fires (category 1, 2, 3 and resource management fires).
- A burn registration number is required for category 3 fires – call toll free **1-888-797-1717.**
- SCHEDULE 1: outlines three Danger Regions of BC.
- SCHEDULE 2: defines five different Fire Danger Classes using a matrix of Buildup Index and Fire Weather Index.
- SCHEDULE 3: provides restrictions on High Risk Activities as required in Section 6(3).

Category 1 Open Fire. Camp fires and piles under 1 m in height and diameter

Category 2 Open Fire. For open fires that are:

- No more than 2 piles that are less than 2 m in height and 3 m in width.
- Or burns of stubble or grass over an area not exceeding 0.2 ha.

Category 3 Fires. For open fires that are:

- Burning material in 3 or more piles not exceeding 2 m in height and 3 m in width.
- Or for 1 or more piles exceeding 2 m in height and 3 m in width.
- Or for one or more windrows, or for burning stubble over an area exceeding 0.2 ha.

www.bcwildfire.ca for fire information including the Fire Danger Class information for areas of BC

Wildlife Act

Administered by ENV, this Act protects wildlife designated under the Act from direct harm, except as allowed by regulation (e.g., hunting or trapping), or under permit. Legal designation as Endangered or Threatened under the Act increases the penalties for harming a species. The Act also enables the protection of habitat in a Critical Wildlife Management Area.

- SECTION 4: allows designation of **wildlife management areas.**
- SECTION 7: makes it an offence to alter, destroy or damage **wildlife habitat** within a wildlife management area.
- SECTION 9: makes it an **offence to disturb**, molest or destroy a muskrat or beaver house, den or dam unless you are a licensed trapper or have lawful authority to protect property or maintain irrigation or drainage facilities.
- SECTION 33.1: makes it an **offence to feed** dangerous wildlife (bear, cougar, coyote or wolf) unless as approved hunting or trapping.
- SECTION 34: makes it an **offence to possess**, take injure, molest or destroy the nest of an eagle, peregrine falcon, osprey, heron or burrowing owl or the **nest of any bird** not mentioned above when the nest is occupied by the bird or its egg.
- SECTION 39: makes it an offence to **hunt or trap on cultivated land** or on a Crown land grazing lease while occupied by livestock without the lessee or owners consent.
- SECTION 89: gives an officer **powers of entry** on proof of identification

This Act has been amended by the *Fish Protection Act* to have wildlife include aquatic plants. Aquatic invertebrates or plants can be considered as endangered or threatened..

Workers Compensation Act

This Act has conditions under the *Occupational Health and Safety Regulation* that pertain to pesticide management:

- SECTION 6.77(1): requires that a worker who mixes, loads, cleans equipment, or applies moderately or very toxic pesticides hold a valid applicators certificate.
- SECTION 6.93(1): requires that an employer take all reasonable precautions to prevent the drift or spread of a pesticide.
- SECTION 6.101: requires that a number of factors be considered when designing pesticide storage; pesticide compatibility, quantity, and containment of spills.

A.3 Federal Government

Federal acts are available on the Internet at laws-lois.justice.gc.ca

Canada Agricultural Products Act

This Act has conditions under the *Fresh Fruit and Vegetable Regulation* requiring that no stagnant or polluted water is used in the washing or fluming of the produce, and only potable water is used in the final rinsing of the produce to remove any surface contaminant before packing

Canadian Environmental Assessment Act

Administered by the Canadian Environmental Assessment Agency (an independent agency reporting to the Minister of Environment), this Act applies only to federal lands, works (such as federally-funded projects) and undertakings, lands subject to the Indian Act, as well as lands in respect of which Indians have interests.

Many emission sources that lie beyond provincial authority are subject to federal regulation, standards and guidelines. These include motor vehicles and fuels, marine vessels, railways and off-road engines applicable to agricultural vehicles.

The *Off-Road Compression-Ignition Engine Emission Regulation* introduces emission standards for diesel engines used in off-road applications such as those typically found in construction, mining, farming and forestry. Emissions from engines used in agriculture that are newer than 2006 are subject to the regulation.

Canadian Environmental Protection Act

Administered by Environment Canada with Health Canada, this Act applies to all lands in Canada and concerns toxic substances, hazardous materials, new substances, export and import of substances, fuels, international air pollution, ocean disposal, etc.

Feeds Act

Administered by Agriculture and Agri-Food Canada, this Act controls and regulates the sale of animal feeds. The manufacture, sale or importation into Canada of any feed must be registered, packaged and labeled to prescribed standards.

Fertilizers Act

Administered by Agriculture and Agri-Food Canada, this Act covers agricultural fertilizers. Fertilizers or supplements may only be sold in or imported into Canada if they have been registered, packaged and labeled to prescribed standards.

Fisheries Act

Administered by both Fisheries and Oceans Canada and Environment Canada (also can be administered provincially by ENV), this Act is established to conserve and protect Canada's fisheries resources, including fish habitat. It applies to all Canadian fisheries waters, including ditches, channelized streams, creeks, rivers, marshes, lakes, estuaries, coastal waters and marine offshore areas. It also applies to seasonally wetted fish habitat such as shorelines, stream banks, floodplains, intermittent tributaries and privately owned land.

The Act includes provisions for stiff fines and imprisonment to ensure compliance.

The purpose of this Act is to provide a framework for (a) the proper management and control of fisheries; and (b) the conservation and protection of fish and fish habitat, including by preventing pollution.

This Act was updated in 2019 and now empowers the Minister to make regulations for the purposes of the conservation and protection of biodiversity.

The definition of *fish habitat* is:

"water frequented by fish and any other areas on which fish depend directly or indirectly to carry out their life processes, including spawning grounds and nursery, rearing, food supply and migration areas". The quantity, timing and quality of the water flow that are necessary to sustain fish habitat are also deemed to be a fish habitat. Furthermore, serious harm to fish includes the death of fish or any permanent alteration to, or destruction of, fish habitat.

Provisions of the *Fisheries Act* relevant to agricultural operations include:

- Protection for all fish and fish habitats;
- Prohibition against the death of fish or the 'harmful alteration, disruption or destruction of fish habitat';
- A permitting framework and codes of practice to improve management of large and small projects impacting fish and fish habitat ;
- Protection of fish and/or fish habitats that are sensitive, highly productive, rare or unique; and
- Consideration for the cumulative effects of development activities on fish and fish habitat.

Food and Drugs Act

The Food Directorate of the Health Products & Food Branch, Health Canada, decides the type and form of food products that can be sold in Canada. It is also responsible for determining the safety of potential residues of agricultural chemicals in food and assessing dietary exposure of the public to agricultural chemicals.

Under the authority of the Act, regulations set maximum residue limits of agricultural chemical residues permissible in both domestic and imported food when it first enters commerce. Food with levels of agricultural chemicals exceeding established maximum residue limits is considered adulterated and the crop may be seized and removed from sale.

Health of Animals Act

The Health of Animals Act enables regulatory control over Specified Risk Material (SRM), so that it does not enter the animal feed system. Regulations under this Act (enhanced feed ban) require that producers do not feed any animal products containing SRM to livestock and that abattoirs properly identify SRM to ensure that it is removed from the feed system. A permit from the Canadian Food Inspection Agency (CFIA) is required to handle, transport or dispose of cattle carcasses and certain cattle tissues. Composting processes do not destroy SRM, therefore composted mortalities must be handled in accordance with CFIA regulations as the compost is still considered to contain SRM.

Migratory Birds Convention Act, 1994

Under this Act, the federal government is responsible for implementing a Convention between Canada and the U.S. for the protection of migratory birds and nests. The Canadian Wildlife Service of Environment Canada administers the regulations.

- SECTION 5: of the Act states that , no person shall, without lawful excuse,
  - Be in possession of a migratory bird or nest; or
  - Buy, sell, exchange or give a migratory bird or nest or make it the subject of a commercial transaction.
  - **Except** as authorized by the regulations.

Under the Regulations:

- SECTION 6: no person shall: disturb, destroy or take a nest, egg, nest shelter, eider duck shelter or duck box of a migratory bird without permit.
- SECTION 24(1): any person may, without a permit, use equipment, other than an aircraft or firearms, to scare migratory birds that are causing, or are likely to cause damage to crops or other property (other control measures require a permit).
- SECTION 33: no person shall introduce into Canada for the purpose of sport, acclimatization or release from captivity a species of migratory bird not indigenous to Canada except with the consent in writing of the Director.
- SECTION 35(1): prohibits the deposit of oil, oil wastes or any other substance harmful to migratory birds in any area frequented by migratory birds.

Migratory waterfowl populations create demands on the use of adjacent agricultural lands. Under the Act, it is an offence to harm the habitat of any migratory bird while the bird is resident at the site or to release any substance (including pesticides) harmful to migratory birds into areas frequented by them.

Native birds not protected by this Act (grouse, quail, pheasants, ptarmigan, hawks, owls, eagles, falcons, cormorants, pelicans, crows, jays and kingfishers) are protected by the Provincial *Wildlife Act*. Introduced species are not protected (European starling, house sparrow and created myna).

Pest Control Products Act

Under this Act and its regulations, Health Canada have the authority to regulate pest control products used in agriculture, forestry, industry, public health and domestic situations.

This Act is intended to ensure that no person shall store, display, distribute or use a pest control product under conditions that are unsafe to human or animal health or that will adversely affect the environment.

Pest control products include herbicides, fungicides, insecticides, rodenticides, biological controls such as bacteria and viruses and antimicrobial agents such as those used in wood preservation, water purification systems and material preservatives. The intent of the legislation is to ensure the safety, merit and value of pesticides used in Canada.

Pest control products must be registered in Canada for specific uses and modes of application. This requires health and environmental assessments of impact. Provisions exist in the Act to approve the use of pest control products not registered in Canada for uses registered in the U.S., if no acceptable alternative control is available. The expanded use of registered products for uses not registered on the label may also be granted under specific circumstances.

Pest control products must have Canadian registration to be used legally in Canada. Registered products bear a *Pest Control Products Act (PCP)* registration number on the label. It is an offence under the Act and its regulations to use an unregistered pesticide or to use a product in a way that is inconsistent with the directions or limitations as shown on the product label.

Plant Protection Act

Administered by Agriculture and Agri-Food Canada, this Act is to protect plant life and the agriculture and forestry industries by preventing the importation, exportation, and spread of injurious pests.

Species at Risk Act

The purpose of this Act is to prevent native species in Canada from becoming extirpated or extinct, to provide for the recovery of endangered or threatened species and to manage species of special concern to prevent them from becoming endangered or threatened. Once a species is legally listed, the Act requires that recovery strategies be developed for extirpated, endangered and threatened species, and that action plans be developed where recovery is feasible.

- Schedule 1 of the Act sets out the legal list of species at risk (extirpated, endangered, threatened and special concern) in Canada.

Where the Act applies, it makes it illegal to kill, harm, harass, capture or take a species at risk, or to possess, collect, buy, sell or trade any individual or parts of an individual that is at risk. The Act also prohibits the damage or destruction of either the residence (for example, the nest or den) or the critical habitat of any species at risk. Critical habitat is legally identified in a posted recovery strategy or action plan.

While the Act applies to all land and waters in Canada, these prohibitions only apply to areas of federal jurisdiction including migratory birds, all waters (sea and fresh) in Canada, as well as to all federal lands, including Indian reserves and national parks, and the airspace above them.

On private land, the (SARA) prohibitions apply only to:

- Aquatic species at risk; and
- Migratory birds listed in the *Migratory Birds Convention Act, 1994* and also listed as endangered, threatened or extirpated in Schedule 1 of the Act.

The provisions of the *Species at Risk Act* (known as the 'safety net') could be invoked on BC crown and private lands using a federal order under the Act if provincial action is not sufficient to protect listed species.

Note that SARA prohibitions do not apply to species of special concern, and that species at risk in Canada may also be protected by provincial or territorial laws.

More information about how the Act applies on private land can be found on the *Species at Risk Act* public registry at: www.sararegistry.gc.ca

Transportation of Dangerous Goods Act, 1992

Under this Act, Transport Canada is responsible for regulating the handling and transportation of poisonous substances, flammable and combustible liquids and other products hazardous to the environment. The Act has been adopted as provincial legislation and is administered by the BC Ministry of Transportation and Infrastructure.

Certain dangerous goods cannot be transported unless requirements are met about shipping documents, special product labels, vehicle placards and safety procedures. Training in special safety procedures and certification of individuals may also be required.

Dangerous goods may include pesticides. Transportation of large quantities (more than 500 kg) of pesticides requires shipping documents, special product labels and vehicle placards.

This Act and *Transportation of Dangerous Goods Regulations* provide requirements for the handling and transportation of "poisonous substances" which includes pesticides. Farmers transporting more than 1,500 kg of pesticides in a licensed farm vehicle more than 100 km must comply with special requirements. Farmers moving a sprayer containing more than 6,000 litres of spray mixture for more than 100 km on a public road must comply with special requirements.

Wildlife Act

Administered by the Canadian Wildlife Service, this Act makes provision for Environment Canada to work by itself or in cooperation with others to acquire lands for the research, conservation and interpretation of migratory birds. Wildlife areas established under this Act are called National Wildlife Areas.

A.4 Enforcement By Regulatory Agencies

Municipal Enforcement of Local Bylaws

Enforcement varies with each local government. Under the Local Government Act, local government has the ability to enforce bylaws through a fine, imprisonment, or both.

Local government can authorize officers, employees and agents of a municipality to enter on a property to ascertain whether a requirement is being met or regulations are being observed. They may also authorize the use of ticketing by a bylaw enforcement officer.

Provincial Enforcement of the *Environmental Management Act*

Note that Provincial Acts and Regulations make no provisions for "nonconforming status", as does local government legislation.

Code of Practice for Agricultural Environmental Management (AEM Code). The *AEM Code* applies to manure, agricultural by-products, and wastes used and stored at agricultural operations. The *AEM Code* is enforced by provincial Environmental Protection Officers. An officer may come on site to verify compliance with the *Code* as part of a scheduled inspection of agriculture sites or in response to a complaint. To prepare for a site visit, ensure your agricultural operation is meeting the requirements of the *Code* and keep relevant records for at least 5 years.

The province's response to non-compliance is based on the level of environmental, human health or safety impacts (actual or potential) and the likelihood of compliance. Responses are also based on history, willingness and capacity to comply. A risk-based non-compliance decision matrix is used to determine which tools to apply to restore compliance quickly and to encourage future compliance.

For further information:

Requirements of the *AEM Code*: www2.gov.bc.ca/gov/content/environment/waste-management/industrial-waste/agriculture/regulation-requirements

How compliance under *EMA* is assessed: gov.bc.ca/environmentalcompliance

Non-compliance decision matrix: www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/natural-resource-law-enforcement/environmental-compliance/how-compliance-is-assessed

Environmental Compliance

Work "In and About a Stream" under the Provincial *Water Act*

Any work 'in and about a stream' requires approval from provincial and federal agencies. A detailed publication from the Ministry of Environment and Climate Change Strategy, "Standards and Best Practices for Instream Works", is available at the following web site:

http://www.env.gov.bc.ca/wld/documents/bmp/iswstdsbpsmarch2004.pdf

Federal Enforcement of the *Fisheries Act*

This is federal legislation specifically designed to protect fish and fish habitat. Fish habitat includes spawning grounds and nursery, rearing, food supply and migration areas on which the fish depend **directly** or **indirectly.** Fish do not need to actually physically use an area or be in the area to have the area defined as habitat. Similarly, if they only use it for a small part of the year, it is habitat. Habitat includes the riparian vegetation. In other words, if it influences the life of fish it is protected.

Fish habitat may be created on a farm when a farm project is completed; for instance, when a drainage ditch is dug that empties into a stream and is accessible or used by fish. The ditch is considered an extension of the stream and the *Fisheries Act* provisions will apply.

Primary sections of this *Act* that producers need to be aware of are:

- Harmful alteration, disruption and destruction of fish habitat.
- Introduction of a deleterious substance affecting either fish or fish habitat:
  - This could also be pollution and fall under the provincial *Environmental Management Act* - in such cases where pollution impacts fish or fish habitat, charges may be pursued under both acts; ENV and Fisheries and Oceans Canada may jointly or independently investigate.
- Proper screening of water intakes.
- Destruction of fish by means other than fishing.
- Allowing safe passage of fish.
- Minimum stream flows for fish.

Fisheries and Oceans Canada Authorizations. When planning work "in and about a stream" (any water body) it is the landowner's responsibility to ensure that the work or activity does not cause a harmful alteration, disruption or destruction of fish habitat, except where authorized by the Minister or his designate. It is also the landowner's responsibility to ensure that there is no deposit of any deleterious substance of any type in water frequented by fish or in any place under any conditions where the deleterious substance may enter such waters.

The types of activities that typically require Fisheries and Oceans Canada authorization include; rip rap; riparian alteration (such as removing streamside vegetation); channel alteration (straightening, redirecting, side channel filing, wetland draining); dredging; ditch cleaning; construction close to streams or lakes (fill, retaining walls, docks, bridges, diking); and driving through streams (fording).

Authorization can be obtained by contacting Fisheries and Oceans Canada (DFO) directly. Arrangements and procedures are in place with some provincial agencies, local government, or in some cases, producer groups, to assist in identifying situations requiring authorization.

Where a charge indicates "introduction of a deleterious substance" has occurred it means:

- A substance when added to any water degrades or alters or forms part of a process of degradation or alteration of the quality of that water so that it is rendered or is likely to be rendered deleterious to fish or fish habitat or to the use by man of fish that frequent that water.

Unlike provincial legislation that refers to "wastes", "contamination", or "pollution", the federal *Fisheries Act* refers to depositing and placing a deleterious substance, not only the resulting impact that may occur to the environment.

A publication from the Fisheries and Oceans Canada, "Complying with the Fisheries Act" (containing extracts from the *Fisheries Act* relating to the habitat protection and pollution prevention provisions), is available at the following web site

www-heb.pac.dfo-mpo.gc.ca/publications/pdf/fishhablaw.pdf

A.5 Information For Landowners

It is important to get a basic understanding of the "rules", such as the main Acts, as well as your "rights and responsibilities." MAFF publications, your producer associations, and the enforcement web sites above can be a start.

Use beneficial management practices and review operations on your farm to identify potential sources of pollution. This may be achieved by completing an Environmental Farm Plan. Check with MAFF to see if programs might be available to help reduce costs or provide expertise to help resolve concerns. In this manner, improvements are made on your terms, as your time and resources are available.

If an enforcement officer informs you of an issue, be polite and find out what the issue or problem is. Try to keep an open mind in order to get to the root of the issue. Try to identify and accept the problem then try to think of changes in management or practices would alleviate the concern. In many cases, relatively minor changes can improve or eliminate the problem.

Take notes, keep track of what occurs when talking to an enforcement officer and focus your attention on a solution. Consider first cooperating fully to get the problem under control, and then, if necessary, dealing with the issue of blame, or who caused the problem. While it is reasonable for you to cooperate, you do not have to incriminate yourself. At some point if you are uncomfortable or do not understand the situation in entirety, you may want to seek advice from your industry association or a lawyer.

Influencing Factors in a Prosecution. Five main factors can influence the prosecution of a case. You have some control over the first four of these:

1. **Your Due Diligence** - the need to foresee and prevent a problem before it occurs as well as your reaction to a problem:
   - Diligence is defined in the dictionary as "constant and earnest effort".
   - Due diligence is the action that would be expected, and ordinarily exercised by, a reasonable and prudent professional or expert in the field under the circumstances; *it may not be just the knowledge and skill of an ordinary person*; put another way, an accused must take all reasonable steps to prevent an infraction, however, this does not mean the accused must take all conceivable steps.
   - Due diligence is not something measured by an absolute standard but depends on the facts of each case.
   - You may want to seek assistance or advice to ensure you are in fact exercising 'due diligence.'

The standard of due diligence will be applied to your actions, or lack of actions, prior to, during and after a problem. Should an *Order* be issued, your due diligence may prevent a *Charge* from occurring, depending on the circumstances. As mentioned previously, something as simple as good communication with ENV will help.

A prosecution is likely to occur in circumstances where the problem occurred as a result of carelessness. On the other hand, if the investigation determined that you did everything that could be reasonably expected under the circumstances (i.e., you exercised all due diligence) and the problem still occurred, then this may be considered by officers and the Court should your case proceed to court.

The only defense against an infraction is to demonstrate you have followed due diligence. It is important to note that the Crown doesn't have to prove the lack of due diligence; the onus is on you to prove you exercised due diligence.

2. **Mitigative, Corrective, or Restorative Actions You've Taken to Minimize the Impact** – this is related to due diligence:
   - How you deal with a problem that has been pointed out to you may be recognized in any judgment.
3. **Your Compliance History** – how you're handled any similar past situations may have a bearing on whether an agency places any trust in you to handle current concerns.
4. **Severity of the Impact** – this concerns the problem itself:
   - The more severe the problem the more likely prosecution may proceed.
   - You may have control of the problem through management practices.
   - Prior due diligence may not only reduce the severity of any potential problem but may also serve you well in the face of legal action.

5. **Sensitivity of the Receiving Environment** – this is beyond your control:
   - While the *AEM Code* under the *Agricultural Waste Control Regulation* and other legislation is in place for all of BC, enforcement may be 'heightened' in the more sensitive environments.
   - If you are located near such environments you will need to be diligent.

The Role of an Environmental Farm Plan

Having an Environmental Farm Plan can be a very good step in demonstrating due diligence:

- Use the Environmental Farm Plan Workbook.
- Implement the resulting Action Plan using appropriate Beneficial Management Practices.

BC Environmental Farm Plan: Reference Guide

BC Environmental Farm Plan: Planning Workbook

CHAPTER B TABLE OF CONTENTS

APPENDIX **B**

CLIMATIC INFORMATION

The climate of British Columbia can be divided into 4 broad climatic regions. Within these regions there are a variety of microclimates that also affect farm planning.

The Pacific Coast (Lower Mainland and Vancouver Island) experience warm summers and wet winters. In this area climate affects the spreading and storage requirements for manure. Drainage and stormwater are also important issues for farms.

The Southern BC climate encompasses the Cariboo, Kootenays and Okanagan. Summers are warm and dry with frequent hot days, while winters are cold – precipitation is variable over this area. The temperature and precipitation vary from the north to south of the region and from the lower to higher elevations within the valleys. This area contains some of the driest areas in BC. The climate mainly affects irrigation and other water use.

The north east part of the Province (Peace River area) has a prairie climate. The region is under the influence of cold dry arctic air. The area has short cool summers while winters are typically long with persistent snow cover although precipitation is light. In this area the climate mainly affects manure spreading and storage. Water availability and efficient use of resources is also an issue.

The North BC Mountains is mainly alpine and sub-alpine with long cold winters and short cool summers. Agriculture is limited in this area.

B.1 Precipitation

The map in **Figure B.1** shows agricultural areas of the Province that receive greater than 600 mm of total average precipitation during the period of October 1st through April 30th (based on 1981-2010 monthly average precipitation data). It also suggests manure storage capacity for different areas of the Province.

Table B-1 shows the highest total 25-year precipitation that should be designed for when sizing manure storage facilities and predicting runoff volumes. Operation not near one of the locations listed can estimate the highest total 25-year precipitation by multiplying the average precipitation (over the appropriate storage period) by 1.5.

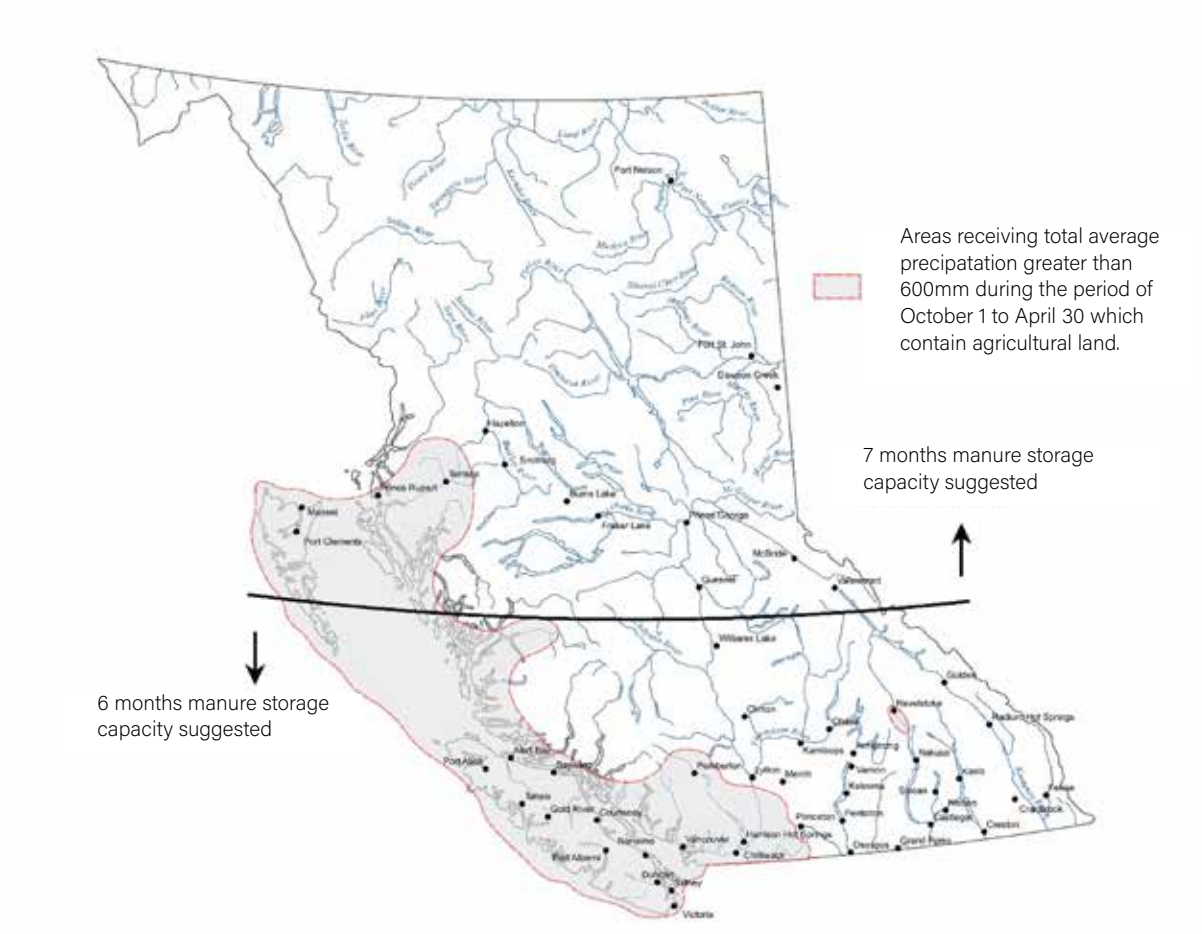

FIGURE B.1 October to April Precipitation & Suggested Manure Storage Capacity for use with Worksheet 1

Table B-1	October to March or April Precipitation That May Need to be Stored for Various BC Locations				Worksheets 1, 2
Location[1]	Storage Period[2] (days)	Precipitation[2] (m)	Location[1]	Storage Period[2] (days)	Precipitation[2] (m)
100 Mile*	180	0.208	Kelowna	180	0.215
Abbotsford	180	1.262	Keremeos	180	0.152
Agassiz	180	1.223	Langley*	180	1.043
Aldergrove*	180	1.127	Lillooet*	180	0.219
Alert Bay*	180	1.261	Lytton*	180	0.304
Armstrong*	180	0.231	Merritt	180	0.177
Ashcroft*	180	0.123	Mission	180	1.262
Barriere*	180	0.217	Nanaimo	180	0.620
Burns Lake*	210	0.304	Oliver*	180	0.150
Campbell River	180	1.197	Osoyoos*	180	0.161
Castlegar	180	0.427	Pemberton*	180	0.783
Chilliwack	180	1.230	Penticton	180	0.146
Comox	180	0.917	Pitt Polder*	180	1.217
Cranbrook	180	0.161	Port Alberni*	180	1.790
Creston	180	0.357	Prince George	210	0.292
Dawson Creek	210	0.178	Princeton	180	0.196
Delta Pebble Hill	180	0.655	Quesnel	210	0.275
Duncan Forestry*	180	0.955	Revelstoke	180	0.567
Enderby*	180	0.253	Saanichton	180	0.707
Fernie	180	0.741	Salmon Arm	180	0.364
Fort St James	210	0.272	Smithers	210	0.288
Fort St. John	210	0.169	Surrey Mun. Hall	180	0.957
Grand Forks	180	0.250	Terrace	210	0.868
Hatzic Lake	180	1.249	Vanderhoof	210	0.270
Hazelton Tamlahan*	180	0.362	Vavenby	180	0.221
			Vernon Coldstream	180	0.222
Hope	180	1.473	White Rock*	180	0.928
Kamloops	180	0.118	Williams Lake	180	0.194

[1] 6 months (180 days) are October to March inclusive, 7 months (210 days) are October to April inclusive.
[2] Average total precipitation over the past 25 years of records to 2016 for the storage period indicated. Precipitation data taken from The Weather Network, unless otherwise stated. To convert metres to millimeters, multiply the precipitation number by 1,000.
* Alternate data source from UBC: http://www.climatewna.com/ClimateBC_Map.aspx

For locations not listed, use an approximation of 1.5 x the average precipitation.
Equation 19, page 208, uses these precipitations to calculate the runoff to be stored from various surfaces.

B.2 Peak Irrigation Flow Requirements

The map in **Figure B.2** gives a general overview of flow rates in BC. If you are near one of the locations listed in **Table B-2** use the flow rate from the table in your calculation, or use the flow rate given on the farm's irrigation water licence. Water provided by a water purveyor may already have a preset flowrate.

The flow rates provided here are for general guidance. The elevation of the farm also affects flow rate requirements. Farms at valley bottoms have higher flow rates than farms in the same area at a higher elevation.

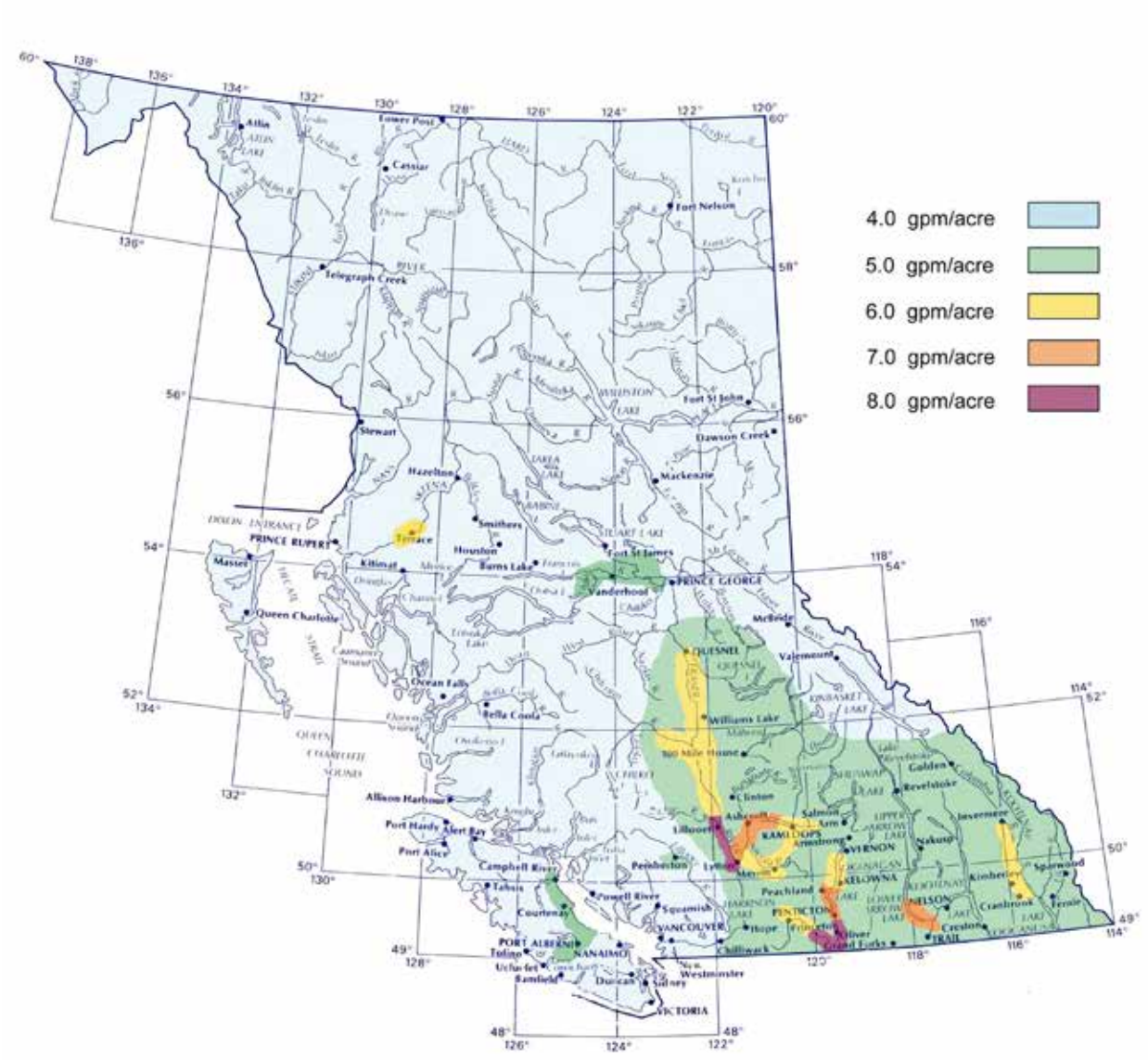

FIGURE B.2 Estimated Peak Irrigation Flow Requirements in BC
US gallons per minute per acre (gpm/acre)

Table B-2	Estimated Peak Irrigation Flow Rate Requirements for Various BC Locations[1, 2]		Worksheets 7, 8
Location	**Flow Rates** USgpm/acre[3]	**Location**	**Flow Rates** USgpm/acre[3]
Abbotsford	4.0	Kettle Valley	7.0
Agassiz	4.0	Kimberly	7.0
Alexis Creek	4.0	Ladner	4.0
Armstrong	5.0	Langley	4.0
Ashcroft	8.0	Lillooet	7.5
Aspen Grove	5.0	Lister	5.0
Barriere	5.0	Lumby	5.5
Baynes Lake	6.5	Lytton	8.0
Campbell River	5.0	Malakwa	5.0
Canal Flats	6.0	Merritt	6.5
Castlegar	8.0	Nanaimo	5.0
Cawston	8.0	Natal	4.5
Chase	5.0	Notch Hill	5.0
Cherryville	5.0	Oliver	6.5
Chilliwack	4.5	100 Mile House	5.5
Clinton	6.0	Osoyoos	7.5
Cloverdale	4.0	Oyster River	4.0
Comox	5.0	Parksville	4.0
Creston	4.5	Pitt Meadows	4.0
Dawson Creek	4.0	Port Alberni	5.0
Douglas Lake	5.0	Prince George	4.0
Duncan	4.0	Princeton	6.0
Ellison	6.0	Quesnel	6.0
Fort Fraser	5.0	Radium	5.0
Fort Steele	5.5	Riske Creek	7.0
Fort St. John	4.0	Saanichton	4.0
Golden	4.0	Salmon Arm	4.5
Grand Forks	5.0	Smithers	4.0
Grandview Flats	5.5	Spallumcheen	5.0
Grasmere	5.5	Sumas	4.5
Grinrod	4.0	Summerland	6.5
Hazelton	5.0	Terrace	5.5
Hixon	4.0	Vancouver	4.5
Hope	5.0	Vanderhoof	5.0
Invermere	6.0	Vernon	5.0
Kamloops	6.5	Walhachin	6.5
Kelowna	6.0	Westwold	6.5
Keremeos	7.5	Williams Lake	6.0

[1] Values based on a 10% risk (may be short of water 1 in 10 years)
[2] Based on evapotranspiration values and on average deep-rooted crop in a medium textured soil
[3] Multiply the values in US gpm /acre by 0.156 to convert to L/s /ha

B.3 Annual crop water Requirements

The map in **Figure B.3** gives a general overview of annual crop water requirements in BC. If you are near one of the locations listed in **Table B-3** use the annual water requirement from the table in your calculation.

An area with a high peak flow rate will not necessarily mean a high annual irrigation requirement. High summer temperatures mean a high peak flow rate. However, if the irrigation season is short the annual water requirement will be lower than an area with a longer irrigation season. For example: Terrace and Kelowna have the same peak flow rate, but Kelowna has a much longer growing season and therefore a larger annual crop water requirement.

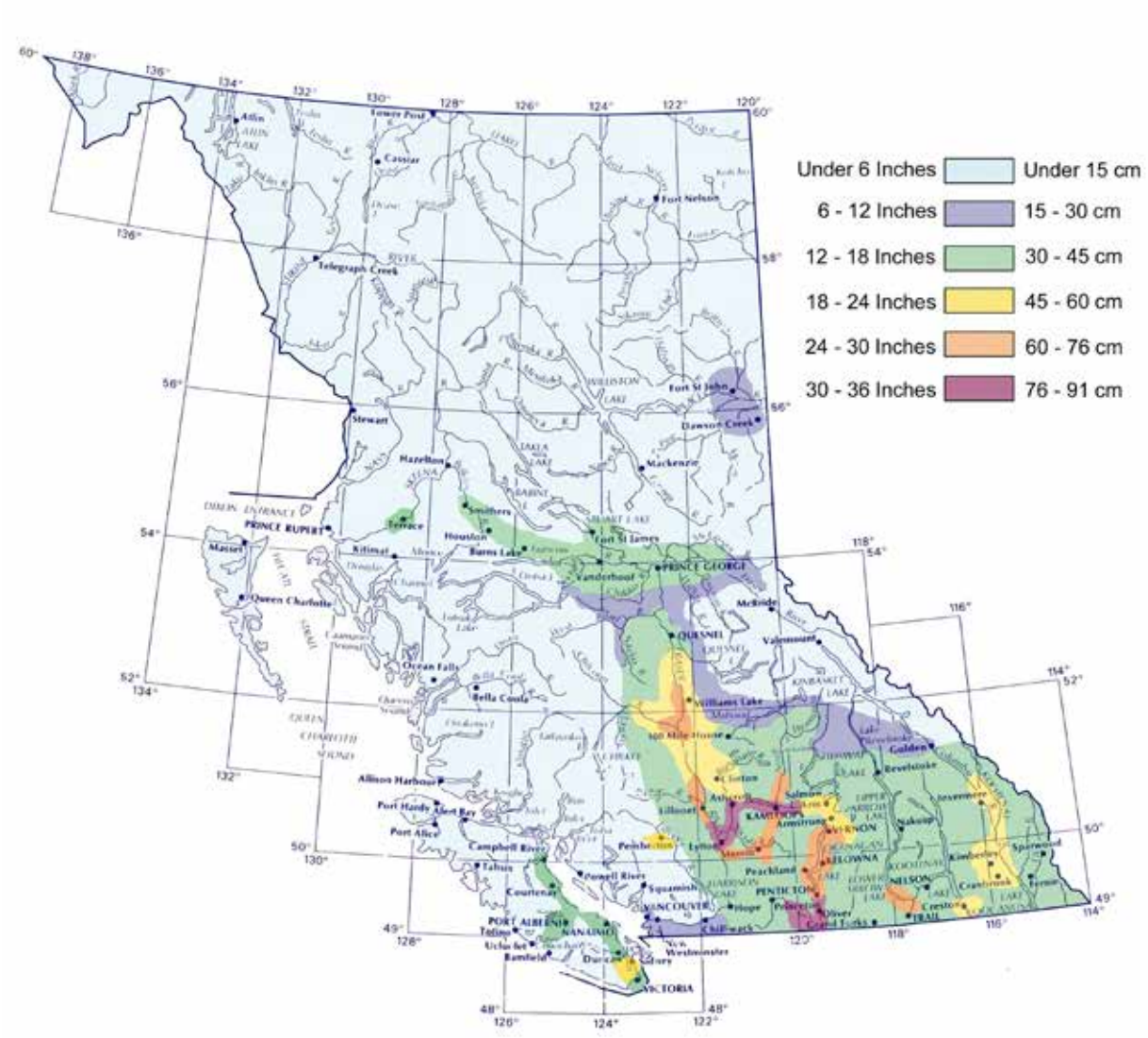

FIGURE B.3 Estimated Annual Crop Water Requirements in BC

Table B-3 Estimated Annual Crop Water Requirements for Various BC Locations[1]

Worksheets 9, 10

Location	Depth per Area		Location	Depth per Area	
	inches	mm		inches	mm
Abbotsford	9	220	Kettle Valley	18	457
Agassiz	4	109	Kimberly	17	439
Alexis Creek	11	274	Ladner	8	201
Armstrong	12	311	Langley	6	165
Ashcroft	25	640	Lillooet	19	494
Aspen Grove	13	329	Lister	16	402
Barriere	13	329	Lumby	15	384
Campbell River	10	256	Lytton	25	640
Canal Flats	14	366	Malakwa	9	220
Castlegar	21	531	Merritt	21	531
Cawston	25	640	Nanaimo	10	256
Chase	15	384	Natal	10	256
Cherryville	14	348	Notch Hill	14	366
Chilliwack	5	128	Oliver	24	622
Clinton	17	439	100 Mile House	17	439
Cloverdale	7	183	Osoyoos	25	640
Comox	12	292	Oyster River	6	165
Creston	16	402	Parksville	10	256
Dawson Creek	7	183	Pitt Meadows	6	146
Douglas Lake	16	402	Port Alberni	12	292
Duncan	9	220	Prince George	10	256
Ellison	17	420	Princeton	18	457
Fort Fraser	8	201	Quesnel	9	238
Fort Steele	10	256	Radium	12	311
Fort St. John	7	183	Riske Creek	16	402
Golden	11	274	Saanichton	10	256
Grand Forks	11	274	Salmon Arm	13	329
Grandview Flats	18	457	Smithers	9	220
Grasmere	13	329	Spallumcheen	14	348
Grinrod	7	183	Sumas	6	165
Hazelton	2	55	Summerland	19	494
Hixon	6	165	Terrace	9	220
Hope	9	238	Vancouver	11	274
Invermere	17	439	Vanderhoof	8	201
Kamloops	23	585	Vernon	16	402
Kelowna	19	475	Walachin	20	512
Keremeos	23	585	Westwold	20	512
Kersley	9	238	Williams Lake	13	329

[1] Based on evapotranspiration values and on average deep-rooted crop in a medium textured soil

APPENDIX C TABLE OF CONTENTS

APPENDIX C

PUBLICATIONS & WEBSITES

C.1 Publications and On-line pdfs

The follow publications are referenced in this Guide for further details on environmentally related subjects.

IAS # is the publication number of the Innovation and Adaptation Services Branch, AFF publications.

IAS publications are available on the web at:

Title	Date	By	IAS#
A Guide to Agroforestry in BC	2001	Small Woodlands Program Forest Renewal BC	
A Guide to Weeds in British Columbia	2002	AFF www2.gov.bc.ca/assets/gov/environment/plants-animals-and-ecosystems/invasive-species/guidance-resources/guidetoweeds.pdf	
A Users Guide to Working In and Around Water	2009	ENV	
Acidifying Soils	1991	AFF www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/agricultural-land-and-environment/soil-nutrients/600-series/638100-1_acidifying_soils.pdf	638.100-1
Advanced Forage Management	1999	Pacific Field Corn Assoc farmwest.com/resources/books/advanced-forage-management-1999/	
Advanced Silage Corn Management	2004	Pacific Field Corn Assoc farmwest.com/resources/books/advanced-silage-corn-management-2004/	
Agency Contact Requirements For Constructed Ditch Maintenance	2005	AFF / DFO www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/agricultural-land-and-environment/water/drainage-management-guide/543100-1_agency_contact_requirements-drainage_guide_factsheet_no3.pdf	543.100-1

Title	Date	By	IAS#
Agency Contact Requirements For Channelized and Natural Stream Maintenance	2005	AFF / DFO www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/agricultural-land-and-environment/water/drainage-management-guide/543000-1_agency_contact_reqts_channel-natural_stream-drainage_guide_factsheet_no20.pdf	543.000-1
Agricultural Building Setbacks from Watercourses in Farming Areas	2010	AFF www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/agricultural-land-and-environment/strengthening-farming/local-government-bylaw-standards/riparian-setbacks/823400-1_agricultural_building_setbacks.pdf	823.400-1
Agricultural Drainage Criteria	2002	AFF www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/agricultural-land-and-environment/water/drainage/535100-2_agric_drainage_criteria.pdf	535.100-2
Agricultural Watercourse Classification	2005	AFF / DFO www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/agricultural-land-and-environment/water/drainage-management-guide/533500-1_agric_watercourse_classification-drainage_guide_factsheet_no2.pdf	533.500-1
Agriculture GIS – Watercourse Classification	2001	AFF www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/agricultural-land-and-environment/water/drainage-management-guide/533500-1_agric_watercourse_classification-drainage_guide_factsheet_no2.pdf	810.200-1
Agriculture Drip Irrigation Scheduling Calculator Users Guide	2009	Irrigation Industry Association of BC http://www.irrigationbc.com/	
Agriculture Sprinkler Irrigation Scheduling Calculator Users Guide	2009	Irrigation Industry Association of BC http://www.irrigationbc.com/	
An Introduction to Water Erosion Control	2001	Alberta Agriculture http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex2074	

Title	Date	By	IAS#
On-Farm Biogas Development Handbook: For Farmers in British Columbia	2019	AFF www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/agricultural-land-and-environment/waste-management/manure-management/an_overview_of_onfarm_biogas_production.pdf	
B.C. Agricultural Composting Handbook	2019	AFF www2.gov.bc.ca/gov/content/environment/waste-management/industrial-waste/agriculture/regulation-requirements/agricultural-composting	
B.C. Agricultural Fencing Handbook (series of Factsheets)	2003	AFF www2.gov.bc.ca/gov/content/industry/agriculture-seafood/business-market-development/structures-mechanization/agricultural-structures-fencing	
B.C. Agriculture Drainage Manual	1997	AFF www2.gov.bc.ca/gov/content/industry/agriculture-seafood/agricultural-land-and-environment/water/drainage/agricultural-drainage-manual	
B.C. Grasslands Stewardship Guide	1997	NRO / ENV / DFO stewardshipcentrebc.ca/PDF_docs/StewardshipSeries/grasslands.pdf	
B.C. Greenhouse Gas Inventory Report 2012	2012	ENV www2.gov.bc.ca/assets/gov/environment/climate-change/data/provincial-inventory/2012/pir-2012-full-report.pdf	
B.C. Landscape Standard		BC Landscape and Nursery Association www.bcsla.org/sites/default/files/PREVIEW%20Pages%20from%20Landscape_Standard_2012_Updated%20October%2015%2C%202013.pdf	
B.C. Livestock Watering Handbook (series of Factsheets)	2006	AFF www2.gov.bc.ca/gov/content/industry/agriculture-seafood/agricultural-land-and-environment/water/water-supply-conservation/livestock-watering-handbook	
B.C. Irrigation Management Guide	2005	Irrigation Industry Association of BC www2.gov.bc.ca/gov/content/industry/agriculture-seafood/agricultural-land-and-environment/water/irrigation/irrigation-management-guide#:~:text=The%20B.C.%20Irrigation%20Management%20Guide,uses%20of%20the%20water%20resource.	

Title	Date	By	IAS#
B.C. Sprinkler Irrigation Manual	1998	Irrigation Industry Association of BC www2.gov.bc.ca/gov/content/industry/agriculture-seafood/agricultural-land-and-environment/water/irrigation/sprinkler-irrigation-manual	
B.C. Trickle Irrigation Manual	1999	Irrigation Industry Association of BC waterbucket.ca/aw/2006/06/05/b-c-trickle-irrigation-manual-2/	
Beaver Damage Control in Agricultural Areas of B.C.	2001	ENV www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/best-management-practices/beaver-guide.pdf	
Berry Production Guide		AFF www2.gov.bc.ca/gov/content/industry/agriservice-bc/production-guides	
Best Practices Guide for Grapes for British Columbia Growers		B.C. Wine Grape Growers www.bcwgc.org/best-practices-guide	
Biodiversity and Riparian Areas – life in the green zone		Cows and Fish Program, Alberta www.cowsandfish.org	
Bird Predation Management Plan – Blueberries	2009	AFF www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/agricultural-land-and-environment/strengthening-farming/670300-1_bird_predation_mgmt_for_blueberries.pdf?bcgovtm=CSMLS	670.300-1
Bridge Construction (constructed ditches)	2005	AFF / DFO www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/farm-management/structures-and-mechanization/300-series/373020-1_bridge_construction-drainage_guide_factsheet_no14.pdf	373.020-1
British Columbia Approved Water Quality Guidelines	2006	ENV www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines/approved-water-quality-guidelines	
Game Farm	2014	AFF www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/agricultural-land-and-environment/strengthening-farming/farm-practices/870218-12_game_farms.pdf	870.218-12

Title	Date	By	IAS#
Calibration Worksheet – Boom Sprayer	2015	AFF www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/farm-management/structures-and-mechanization/200-series/234005-2_calibration_worksheet_-_boom_sprayer.pdf	234.005-2
Canadian Farm Buildings Handbook	1988	AAFC openlibrary.org/books/OL15100357M/Canadian_farm_buildings_handbook.	
Canadian Water Quality Guidelines for the Protection of Agriculture Water Uses	1999	Environment Canada ceqg-rcqe.ccme.ca/download/en/313	
Caring For The Greenzone: Riparian Areas and Grazing Management (3rd edition)	2003	Cows and Fish Program, Alberta www.cowsandfish.org	
Cattle Wintering Sites: Managing for Good Stewardship	2001	Alberta Agriculture open.alberta.ca/publications/2448125	
Chemigation Guidelines for British Columbia	1993	AFF www2.gov.bc.ca/gov/content/industry/agriculture-seafood/agricultural-land-and-environment/water/irrigation/chemigation-guidelines	
Choosing and Calibrating Manure Application Equipment	2005	AFF www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/agricultural-land-and-environment/soil-nutrients/600-series/631500-6_calibrating_and_choosing_equip_factsheetno8_sep2010.pdf	631.500-6
Climate Change Impacts and Adaptation: A Canadian Perspective	2004	Natural Resources Canada cfs.nrcan.gc.ca/publications?id=27428	
Complying with the Fisheries Act	2020	DFO www.canada.ca/en/environment-climate-change/services/environmental-enforcement/publications/compliance-enforcement-policy-fisheries-act.html	
Conservation Buffers: Design Guidelines for Buffers, Corridors and Greenways	2008	USDA / Forest Service Southern Research Station www.fs.usda.gov/nac/buffers/index.html	
Control of Beaver Damages	2001	Alberta Agriculture www.alberta.ca/beavers.aspx	
Control of Insect and Related Pests of Livestock and Poultry in BC	2014	AFF www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/agricultural-land-and-environment/strengthening-farming/farm-practices/870218-49_pest_management.pdf	870.218-49
Control of Rats and Mice on Poultry Farms	2015	AFF	384.200-6

Title	Date	By	IAS#
Crop Production Guides		www2.gov.bc.ca/gov/content/industry/agriculture-seafood/animals-and-crops/crop-production/crop-production-guides	
Cryptosporidium Infection		Ministry of Health Services http://www.healthlinkbc.ca/healthfiles/hfile48.stm	
Culvert Installation in Constructed Ditches	2005	AFF / DFO www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/agricultural-land-and-environment/water/drainage-management-guide/542140-1_culvert_installation-drainage_guide_factsheet_no15.pdf?bcgovtm=buffer	542.140-1
Dealing with Drought: A Handbook for Water Suppliers in British Columbia	2016	ENV www.canada.ca/en/environment-climate-change/services/environmental-enforcement/publications/compliance-enforcement-policy-fisheries-act.html	
How to Plan Trees and Shrubs for Wildlife	2020	Canadian Wildlife Federation	
Estimating Crop Residue Cover For Soil Erosion Control	2000	AFF www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/agricultural-land-and-environment/soil-nutrients/600-series/641220-1_estimating_crop_residue_cover.pdf	641.220-1
Energy Free Water Fountains	2006	PAMI www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/agricultural-land-and-environment/water/livestock-watering/590307-4_energy_free_water_fountains_pami_706.pdf	
Enhancing Livestock Water Quality	1996	AFF www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/agricultural-land-and-environment/water/livestock-watering/590301-4_enhancing_livestock_water_quality.pdf	590.301-4
Manure Management	2014	AFF www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/agricultural-land-and-environment/strengthening-farming/farm-practices/870218-44_manure_storage_and_use.pdf	870.218-44

Title	Date	By	IAS#
Farm Storage and Handling of Petroleum Products	2005	AFF docshare04.docshare.tips/files/19036/190368273.pdf	210.510-1
Farm Water Storage	2003	AFF www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/agricultural-land-and-environment/water/water-supply-conservation/510100-1_farm_water_storage.pdf	510.100-1
Watershed Stewardship: A guide for Agriculture	1996	AAFC / AFF www.bclss.org/cms/wp-content/uploads/2017/05/WatershedStewardship-Guide4Agriculture.pdf	
Field Crop Production Guide		AFF www2.gov.bc.ca/gov/content/industry/agriservice-bc/production-guides	
Field Guide to Invasive Alien Plant Pests and Diseases that Threaten BC Agriculture		AFF books.google.ca/books/about/Invasive_Alien_Plant_Pests_and_Diseases.html?id=z2VKPQAACAAJ&redir_esc=y	
Field Guide to Harmful and Beneficial Insects and Mites of Tree Fruits	2008	agris.fao.org/agris-search/search.do?recordID=US201300301793	
Field Guide to Noxious and other Selected Weeds of BC		AFF bcinvasives.ca/resources/publications/field-guide-to-noxious-weeds-and-other-selected-invasive-plants-of-BC	
Field Shelterbelts for Soil Conservation	2007	Alberta Agriculture www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex2073/$file/277_20-3.pdf?OpenElement	
Fine Particulates – What They Are and How They Affect Us	1995	ENV	
Fishery Timing Windows For Maintenance Work in Constructed Ditches	2005	AFF / DFO	543.000-2
Flood Construction Levels and Setbacks for Farm Building Situations	2008	AFF	820.400-3
Floriculture Production Guide		AFF	
Forage Production on Poorly Drained Soils in the Southern Interior of British Columbia	1992	AFF	536.100-1
Freshwater Intake End-of-Pipe Fish Screen Guideline	1995	DFO	512.100-1
Fringe Benefits: A Landowner's Guide to the Value and Stewardship of Riparian Habitat	1996	Fraser River Action Plan	
Giardiasis ("Beaver Fever")		Ministry of Health http://www.healthlinkbc.ca/healthfiles/hfile10.stm	

Title	Date	By	IAS#
Grassland Monitoring Manual for British Columbia		Grasslands Conservation Council of BC bcgrasslands.org/wp-content/uploads/2018/01/bc_grassland_monitoring_manual_for_bc.pdf	
Grassed Waterways	1994	OMAFRA	
Grazing Management Guide	2005	AFF / BCAC	
Growing Greenhouse Peppers in British Columbia		www2.gov.bc.ca/gov/content/industry/agriservice-bc/production-guides/vegetables/peppers	
Guide for Bylaw Development in Farming Areas	1998	AFF	840.000-1
Guidelines for Canadian Drinking Water Quality	2008	Health Canada	
Guidelines for Farm Practices Involving Fill	2006	AFF	820.200-1
Guidelines for Minimum Standards in Water Well Construction	1982	ENV	
Guidelines for Off-Farm Inputs for Anaerobic Digestion Facilities	2010	www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/agricultural-land-and-environment/waste-management/manure-management/an_overview_of_onfarm_biogas_production.pdf	
Guidelines on Storage, Use & Disposal of Wood Residue for the Protection of Fish & Fish Habitat in British Columbia	1985	Environment Canada www.for.gov.bc.ca/hfd/library/FFIP/Liu_S1996.pdf	
How to Disinfect Drinking Water		Ministry of Health http://www.healthlinkbc.ca/healthfiles/hfile49b.stm	
Improved Livestock Access to Water Using GeoGrids	2006	AFF	590.302-2
Integrated Fruit Production Guide for Commercial Tree Fruit Growers		www.bctfpg.ca	
Integrated Weed Management: Making It Work On Your Farm, Manitoba Agriculture		AFF www.gov.mb.ca/agriculture/crops/weeds/integrated-weed-management.html	
Invasive Plant Council of BC		www.invasiveplantcouncilbc.ca/	
IPM for Turfgrass Managers		ag.umass.edu/turf/fact-sheets/integrated-pest-management-for-turf	
Irrigation Scheduling Techniques	2011	AFF	577.100-1
Irrigation Scheduling with Tensiometers	2006	AFF	577.100-2
Irrigation System Assessment Guide	2005	AFF / BCAC	
Irrigation System Cross Connection Control	1985	AFF	578.130-1
Irrigation System Maintenance	1994	AFF	577.200-1
Irrigation Tips to Conserve Water on the Farm	2004	AFF	500.310-1
Key Drought Management Tips	2005	AFF	665.000-2

Title	Date	By	IAS#
Lakes and Wetlands (a Caring For The Greenzone publication)		Cows and Fish Program, Alberta www.cowsandfish.org	
Land Management Guide for Horse Owners and Small-Lot Farmers	2008	Langley Environmental Partners Society	
Landscaped Buffer Specifications	1993	Agricultural Land Commission	
Large Animal Disposal: On-Farm Burial Option	2006	AFF	384.300-3
Liming Acid Soils in Central B.C.	1991	AFF	637.000-1
Livestock Watering Requirements – Quantity and Quality	2006	AFF	590.301-1
Maintenance and Checking of Performance of Subsurface Drainage Systems	1985	AFF	543.200-1
Management Guide for Grapes		www.bcwgc.org/best-practices-guide	
Management of Dust in Broiler Operations	1999	AFF	
Management of Flies in Layer Barns	2008	AFF	305.104-1
Manure Treatment Options vs. Available Land Base	1994	AFF	382.910-1
Metro Vancouver Agricultural Boilers Emission Regulation		http://www.metrovancouver.org/boards/Bylaws1/GVRD_Bylaw_1098.pdf	
Mitigating Cattle Losses Caused by Wild Predators in British Columbia		www.cattlemen.bc.ca/docs/mitigating_cattle_losses_a_field_guide_for_ranchers_smaller_file.pdf	
Mushroom Production Guide – Guide to Best Management Practices in British Columbia	2008	www2.gov.bc.ca/gov/content/industry/agriculture-seafood/animals-and-crops/crop-production/mushrooms	
National Farm Building Code of Canada	1995	National Research Council	
Nursery and Landscape Pest Management & Production Guide	2017	AFF www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/animal-and-crops/crop-production/nursery-production-guide.pdf	
On-Farm Anaerobic Digestion Waste Discharge Authorization Guideline	2010	ENV	
On-Farm Hydroelectric Generation	2006	AFF	430.200-1
On Farm Pesticide Storage and Handling Facility	1994	AFF	373.130-2
On-Site Testing of Growing Media and Irrigation Water		AFF	
Planning for Biodiversity: A Guide for BC Farmers and Ranchers	2008	AFF / BCAC	
Plug and Bedding Plant – Water, Media and Nutrition	1998	AFF	
Preparing a Complete Nutrient Solution		AFF	
Protecting Your Shorelands for Better Farming and Ranching, and Healthier Fish Habitat		DFO	
Pumping Livestock Water – It's All About the Energy Choices!	2005	AFF	590.305-1
Rangeland Handbook for BC	1998	BC Cattlemen's Assoc.	

Title	Date	By	IAS#
Reducing Nitrogen and Phosphorus in Manure Through Ration Changes	1993	AFF	382.910-2
Riparian Area Management: A User Guide to Assessing Proper Functioning Condition and the Supporting Science for Lotic Areas	1998	USDA	
Riparian Areas – A Users Guide to Health	2003	Cows and Fish Program, Alberta www.cowsandfish.org	
Riparian Health Assessment for Streams and Small Rivers – Field Workbook (a Caring For The Greenzone publication)	2008	Cows and Fish Program, Alberta www.cowsandfish.org	
Riparian Management Field Workbook	2005	AFF / BCAC	
Rotten Luck: The Role of Downed Wood in Ecosystems.	1995	Fraser River Action Plan	
Septic System Maintenance Pure & Simple		Fraser River Action Plan	
Seven Steps to Managing Your Weeds: A Manual for Integrated Weed Management in British Columbia		www2.gov.bc.ca/assets/gov/environment/plants-animals-and-ecosystems/invasive-species/guidance-resources/7stepstomanagingyourweeds.pdf	
Sewerage System Standard Practice Manual	2006	Ministry of Health	
Siting and Management of Dairy Barns	2010	AFF	305.104-2
Siting and Management of Poultry Barns	2008	AFF	305.104-1
Sizing Dairy Manure Storage Facilities	1990	AFF	383.100-2
Soil Compaction – A Review of its Origin and Characteristics	1990	AFF	613.100-1
Soil Liming – Understanding Your Soil Test Recommendation	1993	AFF	637.200-1
Soil Management Handbook for the Lower Fraser Valley	1991	AFF	610.000-1
Soil Management Handbook for the Okanagan and Similkameen Valleys	1994	AFF	610.000-6
Soil pH	2001	AFF	637.100-1
Soil Sampling for Nutrient Management	2005	AFF	
Soil Sampling in Fertilizer Banded Fields	1991	AFF	611.100-2
Species at Risk Act application to private land		www.sccp.ca/sites/default/files/species-habitat/documents/Species_at_Risk_on_Private_Land_in_BC.PDF	
Sprinkler Irrigation Scheduling using a Water Budget Method	2004	AFF	577.100-3
Soil Water Storage Capacity and Available Soil Moisture	2002	AFF	619.000-1
Standards and Best Practices for Instream Works (lower mainland)	2004	ENV www.env.gov.bc.ca/wld/documents/bmp/iswstdsbpsmarch2004.pdf	
Starlings and Livestock Farms	2000	AFF	384.200-7
Stewardship Options for Private Landowners in B.C.	1996	Environment Canada / ENV	
Suggestions For Field Sprayer Operation And Maintenance	1986	AFF	234.005-1

Title	Date	By	IAS#
The Health Of Our Air	1999	AAFC publicentrale-ext.agr.gc.ca/pub_view-pub_affichage-eng.cfm?publication_id=1981E	
The Health of Our Soils	1995	AAFC sis.agr.gc.ca/cansis/publications/manuals/1995-health/The_Health_of_Our_Soils.pdf	
The Health Of Our Water	2000	AAFC www.pfra.ca/doc/Water%20Status/TheHealthofOurWater.pdf	
The RUSLEFAC – Revised Universal Soil Loss Equation for Application in Canada	2002	AAFC	
Treatment of Greenhouse Recirculation Water: Bio-Sand Filtration	1999	AFF	512.000-2
Treating Irrigation and Crop Wash Water for Pathogens	2003	AFF	5121.000-3
Treatment of Greenhouse Recirculation Water – Biosand Filtration	1999	AFF	512.000-2
Trees and Shrubs for Prairie Shelterbelts		AAFC www4.agr.gc.ca/AAFC-AAC/display-afficher.do?id=1192201777018&lang=eng	
Trickle Irrigation Scheduling using Evapotranspiration Data	2004	AFF	577.100-4
Understanding Different Soil Test Methods	2010	AFF	631.500-9
Understanding a Water Licence	2006	AFF	502.100-4
Understanding Wetlands: A Wetland Handbook for British Columbia's Interior	1998	Ducks Unlimited	
Use Caution When Bringing Non-Agricultural Waste or Products onto Your Farm	2000	AFF	654.000-1
Vegetable Production Guide – Beneficial Management Practices for Commercial Growers in British Columbia		AFF www2.gov.bc.ca/gov/content/industry/agriservice-bc/production-guides	
Ventilation Handbook	1985	AFF	306.400-4
Water-Borne Diseases in BC		Ministry of Health www.healthlinkbc.ca/healthfiles/hfile49a.stm	
Water Licence Holders Rights and Obligations	2006	ENV	
Water Quality Evaluation of Agricultural Runoff in the Lower Fraser Valley	1994	AFF	511.300-1
Water Rights in British Columbia	2006	ENV	
Water Wells ..... that last for generations	2001	Alberta Agriculture	
Watering Livestock Directly from Watercourses	2006	AFF	590.302-1
Watershed Stewardship: A Guide for Agriculture	2006	DFO / ENV / AFF	648.000-3

Title	Date	By	IAS#
Wetlands of British Columbia: A Guide to Identification	2004	Ministry of Forests, Natural Resource Operations and Rural Development	
Wetland Ways: Interim Guidelines for Wetland Protection and Conservation in British Columbia	2009	Wetland Stewardship Partnership www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/best-management-practices/wetland_ways_ch_2_general.pdf	
Wildlife damage control guidelines		www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/agricultural-land-and-environment/strengthening-farming/farm-practices/870218-59_wildlife_damage_south_bc.pdf	
Wildlife Damage Control – Interior BC	2003	AFF	870.218-60
Wildlife Damage Control – South Coastal BC	2009	AFF	870.218-59
Wind and Snow Fences	1997	AFF	307.230-1
Woodwaste Use – Precautions To Horse Owners	2005	AFF	655.000-2
Woodwaste Use in Agriculture	1992	AFF	655.000-1

C.2 Websites

The follow web sites are referenced in this Guide for further details on environmentally-related subjects.

Web Address	Content
BC Government www.gov.bc.ca	
http://www.alc.gov.bc.ca	Provincial Agricultural Land Commission
www2.gov.bc.ca/gov/content/governments/organizational-structure/ministries-organizations/boards-commissions-tribunals/bc-farm-industry-review-board	Farm Industry Review Board
http://www.frontcounterbc.gov.bc.ca/	Front Counter BC
www.bclaws.ca	Provincial listing of Acts and Regulations
https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/drought-flooding-dikes-dams/dam-safety	Dam Maintenance and Safety
Ministry of Agriculture, Food and Fisheries www.gov.bc.ca/al/	
www2.gov.bc.ca/gov/content/industry/agriculture-seafood/agricultural-land-and-environment/strengthening-farming/publications	Strengthening Farming / Farm Practices
www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/invasive-species	Invasive plants
www2.gov.bc.ca/gov/content/industry/agriculture-seafood/animals-and-crops/crop-production/crop-production-guides	Crop Production Guides
www2.gov.bc.ca/gov/content/industry/agriculture-seafood/programs/environmental-farm-plan	Publications & plans
www2.gov.bc.ca/gov/content/industry/agriculture-seafood/animals-and-crops/plant-health/pesticides-agriculture/pesticide-labels	Pesticide Label Information
bcinvasives.ca/resources/invasive-species-training/pesticide-applicator-course	Pesticide Applicator Course
www2.gov.bc.ca/gov/content/industry/agriculture-seafood/animals-and-crops/plant-health/weeds	Weeds

Web Address	Content
Ministry of Environment and Climate Change Strategy http://www.gov.bc.ca/env/	
www2.gov.bc.ca/gov/content/environment/climate-change	Climate Change
www2.gov.bc.ca/gov/content/governments/organizational-structure/ministries-organizations/ministries/environment-climate-change	Climate Change Impacts
www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/conservation-data-centre	BC Conservation Data Centre – provincial species at risk listing
www2.gov.bc.ca/gov/content/environment/pesticides-pest-management	Pesticide and Pest Management
www2.gov.bc.ca/gov/content/environment/pesticides-pest-management/certification-training	Pesticide Certification Information
www2.gov.bc.ca/gov/content/environment/waste-management/industrial-waste/agriculture/regulation-requirements/agricultural-boilers-heaters	Agricultural Boiler and Heaters
www2.gov.bc.ca/gov/content/environment/waste-management/industrial-waste/fuel-tanks	Managing Fuel Tanks
www2.gov.bc.ca/gov/content/environment/air-land-water/air/air-pollution/smoke-burning/regulations/openburningregulation/smoke-sensitivity-zone-maps	*Open Burning Smoke Control Regulation* and Smoke Sensitivity Zone Maps
http://www.env.gov.bc.ca/atrisk/toolintro.html	BC Species and Ecosystem Explorer
www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality	Water Quality
www2.gov.bc.ca/gov/content/environment/air-land-water/water/drought-flooding-dikes-dams/drought-information	Drought Information
Ministry of Forests, Lands, Natural Resources Operations and Rural Development www.gov.bc.ca/for	
www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/laws-policies-standards-guidance/legislation-regulation/forest-range-practices-act	*Forest and Range Practices Act (FRPA)*
www2.gov.bc.ca/gov/content/industry/rangelands/forage/health	Pasture and Range Health
www2.gov.bc.ca/gov/content/safety/wildfire-status/wildfire-situation	Current Wildfire Activity
Ministry of Health www.gov.bc.ca/hls/	
http://www.healthlinkbc.ca/healthfiles/httoc.stm	Health Files - Factsheets
Federal Government	
http://www4.agr.gc.ca/AAFC-AAC/display-afficher.do?id=1186590611493&lang=eng#ben	Agriculture and Agri-Food Canada
www.dfo-mpo.gc.ca/species-especes/sara-lep/index-eng.html	Aquatic Species at Risk
www.inspection.gc.ca	Canadian Food Inspection Agency
laws-lois.justice.gc.ca/eng/acts/	Federal listing of Acts and Regulations
www.nrcan.gc.ca/energy-efficiency-regulations/6845	*Energy Efficiency Regulations*

Web Address	Content
www.dfo-mpo.gc.ca/index-eng.htm	Fisheries and Oceans Canada (DFO)
www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html	Species at Risk Act Registry
www.sccp.ca/sites/default/files/species-habitat/documents/Species_at_Risk_on_Private_Land_in_BC.PDF	Species at Risk Act application to private land
firesmoke.ca/forecasts/current/	Smoke Control Forecast
Local Government and Other Websites	
http://www.ardcorp.ca	BC Agricultural Research & Development Corporation
www.bcagclimateaction.ca	Climate Change Mitigation and Adaptation
http://www.bcgwa.org/	BC Ground Water Association
www.bcac.bc.ca	BC Agriculture Council
www.arb.ca.gov/diesel/verdev/vt/cvt.htm	California Air Resource Board
www.cleanfarms.ca	Clean Farms – pesticide container disposal locations
www.deltafarmland.ca	Delta Farmland and Wildlife Trust
www.productcare.org	Paint Disposal Centers
www.cowsandfish.org	Riparian
www.farmwest.com	T-sum calculator - current Evapotranspiration - current
www.hctf.ca	Habitat conservation
www.irrigationbc.com	Irrigation Industry Association
http://www.epa.gov/otaq/retrofit/verif-list.htm	US Environmental Protection Agency
www.waterbucket.ca	Integrated Water Management in BC
www.omafra.gov.on.ca/english/crops/facts/weedman.htm	Weed Management

GLOSSARY OF TERMS

APPENDIX D

The following are terms used in this Reference Guide, as well as other closely related terms.

100 year flood: a flood of such a magnitude that the chance of it being equaled or exceeded in any given year is at least one in one hundred

100 year floodplain: land where the chance of a flood occurring in any given year is at least one in one hundred

100 year peak flow: a watercourse flow where the chance of a peak flow occurring in any given year is at least one in one hundred

A

abattoir: facility for butchering animals; may include cutting, wrapping, freezing and processing facilities

absorption: the incorporation of a substance **into** the body of another (also see **adsorption**)

acre-foot: the amount of water that will cover one acre to a depth of one foot; equal to 1,233.84 m^3, [1,233,840 L], or 43,560 ft^3 [325,829 US gal]

adaptation: adjustment of agri-food practices to maintain competitive production advantages during comparatively rapid changes in the regional climate

adsorption: the attachment or adhesion of a substance generally **onto** the surface of another solid material (also see **absorption**)

aeration: providing optimum availability of air in a material, such as into soil for crop growth

aerator with dribble bar: a system to apply manure in bands onto soil behind a soil aerator

aerobic: the presence of sufficient oxygen in a biological decomposition process (e.g., composting) to allow oxygen consuming microbes to flourish (also see **anaerobic**)

afforestation: [from Environment Canada] The direct human-induced conversion of land that has not been forested since December 31, 1989 to forested land through planting, seeding and/or the human-induced promotion of natural seed sources

aggregates: grouping of soil particles cohering so as to behave mechanically as a unit; the way in which aggregates are grouped together is called soil structure (also see **soil**)

Agriculture Land Reserve: a provincial-wide land classification under the *Agricultural Land Commission Act*

agricultural by-product: materials that a produced due to the agricultural operations but are incidental or secondary to the primary product produced such as: manure; soiled animal bedding; dropped or spoiled feed; vegetative debris; compost products; used mushroom-growing substrate; and soilless media. It does not include: mortalities; waste from hatcheries or dairy processing; digestates from anaerobic digestion; or materials produced or used in accordance with the Organic Matter Recycling Regulation

agroforestry: a land management approach that deliberately combines the production of trees with other crops and/or livestock

air: [from the *Environmental Management Act*] the atmosphere but does not include the atmosphere inside a human made enclosure that is not open to the weather (also see **atmosphere**)

air contaminant: means a substance that is introduced into the air and that

> (a) injures or is capable of injuring the health or safety of a person, (b) injures or is capable of injuring property or any life form, (c) interferes with or is capable of interfering with visibility, (d) interferes with or is capable of interfering with the normal conduct of business, (e) causes or is capable of causing material physical discomfort to a person, or (f) damages or is capable of damaging the environment; (also see contaminant)

air gap: an open air space (at least 30 cm, suggested) between a hose or tap from a potable water source and the water level of non-potable water; maintained so as to prevent backflow contamination of the potable water source, such as when filling pesticide sprayers (also see **backflow**)

air shed: a geographic region that shares an air mass that has similar characteristics and is separated from other air masses by weather patterns or topography

algae: aquatic plants that lack true stems, roots or leaves and are often green, blue-green or brown in colour

algae bloom: rapid growth of algae in water due to high nutrient levels

anaerobic: the absence of oxygen in a biological decomposition process. (e.g., bio-gas or methane production); may occur in soil or water (also see aerobic)

anhydrous ammonia: is a chemical fertilizer (NH_3) whose properties make it one of the most potentially dangerous chemicals on a farm; *anhydrous* means without water; consequently, when anhydrous ammonia and moisture come into contact, they rapidly combine; when it is injected into the soil, the liquid ammonia expands into a gas and is readily absorbed in the soil moisture; usually provided to a farm by a contracted applicator

annual: a plant that lives for one year or season

anti-siphon device: see fuel storage

antisapstain chemical:

(a) treatment chemical applied to processed wood which make the wood residue unsuitable for use on farms; (b) [from the *Antisapstain Chemical Waste Control Regulation*] chlorophenol, 2-(thiocyanomethylthio) benzothiazole (TCMTB), copper-8-quinolinolate (Cu-8), 3-iodo-2-propynyl butyl carbamate (IPBC) and didecyldimethyl ammonium chloride (DDAC)

approval: [from the *Water Sustainability Act*] approval under section 8 (short-term use of water) or approval under section 9 (changes in and about a stream)

aquatic life: plant and animal life growing or living in or near water (also see species)

aquifer: a geologic formation, group of formations, or part of a formation capable of storing, receiving and transmitting water; the formation is capable of yielding enough water to support a well or spring

artesian aquifer: contains water under pressure as a result of hydrostatic head; also called a confined aquifer (also see well – artesian well)

confined aquifer: an aquifer overlain by a confining layer of impermeable soil or rock material; the water table is separated from the atmosphere by the impermeable layer; this type of aquifer is sometimes called an artesian aquifer

unconfined aquifer: an aquifer without an upper confining layer of impermeable soil or rock material; the water surface is exposed to the atmosphere through a series of interconnected openings in the overlying permeable soil and/or rock layers and is in equilibrium with atmosphere pressure; particularly susceptible to entry of surface contaminates; the water surface is called the water table (also see water table)

artesian: see aquifer and see well

atmosphere: the layer of gases surrounding the earth, composed primarily of nitrogen, hydrogen and oxygen

authorization: as required under the federal *Fisheries Act* Section 35(2) regarding any works that may harm fish habitat

avoid: to employ, practice or implement risk treatment measures to prevent (eliminate) or reduce (mitigate) the occurrence of pollution, damage and/or the deposit of deleterious substance into the environment. The natural characteristics of a site such as soil properties, topographic conditions, depth to groundwater or annual precipitation may help to mitigate environmental risk.

B

backflow: the reverse flow of a liquid from the distribution system back to the water source, such as from a sudden pressure drop in a supply line creating a siphon-back condition; the source may become contaminated

backflow prevention: piping arrangements to protect a water source, such as vacuum breakers or automatic valves, whereby the supply water is prevented from reverse flow (also see air gap; backflow can be prevented if the supply pipe is kept away from any contaminated liquids, such as keeping pesticide sprayer filling water lines above and separate from the sprayer tank)

bacteria: a large group of single-celled microscopic organisms lacking an organized nucleus; some can cause disease, such as Salmonella or Cholera

coliform bacteria: bacteria found in faeces, soil, and vegetation, which is used to indicate the bacteriological quality of water; given as "*total coliforms*" in a water test

E.coli: bacteria sometimes found in under-cooked meat, such as ground beef; causes "hamburger disease"

fecal coliform: bacteria present in virtually all warm-blooded animals; commonly used as an indicator organism in water contamination testing due to low testing cost; given as "*fecal coliforms*" in a water test (also see **fecal**)

banding: see **fertilizer: side dressing**

baseflow: the amount of water in a stream that results from normal conditions (groundwater discharge) rather than from storm conditions or releases from storages such as reservoirs

bathymetric: the measurement of water depth at various location in a body of water, as is done to establish the volume of a reservoir

bed-level: see **stream crossing**

beneficial management practice: see **BMP**

berm: a constructed strip or ridge of soil to divert or retain runoff, such as an embankment, but not a dyke (also see dyke)

bioaccumulate: the process by which certain chemicals are consumed and retained by organisms, either from the environment directly or by eating food containing the chemicals

biodegradable: capable of being broken down by living organisms into inorganic compounds

biodiversity: [from the *Canadian Environmental Protection Act*] the variability among living organisms from all sources, including, without limiting the generality of the foregoing, terrestrial and marine and other aquatic ecosystems and the ecological complexes of which they form a part and includes the diversity within and between species and of ecosystems (also see **species** and **ecosystem**)

biofilter: an air filtration system that exhausts air up through a bed of fibrous organic material, as may be used for a mushroom composting facility to extract odours and other compounds from the exhaust air

BOD or **biological oxygen demand**: see **oxygen demand**

biomass: plant or plant-based materials that have no more than 20% moisture content, are or come from agricultural vegetative debris, seeds or clean wood, and have been processed for use in producing energy. Does not include materials containing coal or petroleum products, pharmaceutical, medicinal or medical biological materials, manure, or paper or paper

biosolids: [from the *Organic Matter Recycling Regulation*] stabilized municipal sewage sludge resulting from a municipal waste water treatment process or septage treatment process which has been sufficiently treated to reduce pathogen densities and vector attraction to allow the sludge to be beneficially recycled in accordance with the requirements of this regulation

boiler: a vessel used for generating hot water or steam, typically fuelled by natural gas, oil, or solid fuels such as wood or coal

emission standards: are set by Local Government and by the *Code of Practice for Agricultural Environmental Management*

BMP or beneficial management practice: a structural, non-structural, or managerial technique recognized to be an effective and practical means to reduce or remove the risk of pollution occurring while still allowing the productive use of resources

blind inlet: also know as a french drain; allows surface water to percolate to subsurface drainage systems; used when the quantity of surface water is small or the sediment load is heavy (refer to page 190 of *BC Agricultural Drainage Manual*)

browse: (noun) woody forage, such as leaves and shoots of plants, eaten by animals; (verb) to search for or consume browse

browsing: consumption of woody forage from trees and shrubs (also see **grazing**)

buffer: a specially managed area that is used to separate farm activities from sensitive areas, such as riparian areas, or from neighbouring farm or non-farm activities. Buffers may include a strip of vegetation, often grass, shrubs, or trees; some can act as a "treatment system" to remove contaminates before they reach sensitive areas.

permanent vegetated buffer: a strip of permanent vegetation which separates an environmentally-sensitive area from farm areas

pesticide drift buffer: setbacks from areas where pesticide application occurs, generally intended for watercourses or for non-target terrestrial areas

filter strip: may contain grasses, trees, or other dryland plants to help filter soil particles out of runoff

visual buffer: a vegetated buffer that is used primarily to alter aesthetic impact

building: farm structures to store farm supplies or equipment or to house livestock

building code: safety measures legally required for farm buildings contained in the National Farm Building Code of Canada; only enforced where proclaimed by local government

perimeter drain: see perimeter drain

building setback: see setback

burning: see open fires and see outdoor burning

C

C:N or carbon-nitrogen ratio: the ratio of the weight of organic carbon to that of total nitrogen in an organic material; important ratio when composting organic material such as wood residue, where it should only be applied to soils having a C:N ratio of 30:1 or lower

calibration: see pesticide and nutrient

carbon dioxide (CO_2): a greenhouse gas produced by the combustion of fossil fuels and biomass and from deforestation or clearing of agricultural land. It is a major contributor to the greenhouse effect and is therefore associated with climate change

carbon monoxide (CO): an air contaminant that originates mainly from the combustion of fuels used to heat buildings and greenhouses, and to power farm equipment; at high concentrations the gas can cause asphyxiation, and at lower levels it produces symptoms of impaired perception and reflexes

carbon offsets: reduction and sequestration projects can generate carbon offsets. It is possible to market carbon offsets as a product if it can be proven that the activity or change in activity results in a real and permanent reduction in GHG's in the atmosphere.

carbon sequestration: plants and soil organic matter play an important role in removing carbon dioxide from the air and storing (sequestering) it. Carbon is the main component in plant material and soil organic matter. Any uptake of carbon dioxide from the air by plant material or soil reduces the effects of climate change

casing: see well casing

catch basin: any excavated, dyked, or walled structure, or combination of structures, designed to intercept and temporary store runoff contaminated by farm waste

catch crop: a crop planted with the specific goal of catching available soil nutrients which would otherwise be lost by leaching

calving pen: see confined livestock area

changes in and about a stream: [from the *Water Sustainability Act*]

(a) any modification to the nature of a stream including the land, vegetation, natural environment or flow of water within a stream, or (b) any activity or construction within the stream channel that has or may have an impact on a stream, refer to page 9-8

channelized stream: permanent or relocated streams that have been dyked, diverted or straightened and carry drainage flows from headwaters or significant sources of groundwater. Reaches of channelized streams may be confined by roads and fences and in many cases can also meander through fields.

Man made channels that divert irrigation water from a stream but return overflow water back to a stream in a manner that allows fish access are classified as channelized streams.

chemical fertilizer: see fertilizer

chemigation: application of a chemical (such as a fertilizer or pesticide) to a crop through an irrigation system by mixing them with the irrigation water

backflow: see backflow

chemigation guidelines: a series of recommended practices outlined in the publication *Chemigation Guidelines for BC*

spent nutrient solution: the water and nutrient solution that is left over after fertilizing via chemigation

cistern: a non-pressurized tank for storing water

Class A Compost: as defined by the *Organic Matter Recycling Regulation* – see page A-6

clean water: see water quality

climate change: [from the United Nations Framework Convention on Climate Change (UNFCCC), Article 1] a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods

coliform: see bacteria

compaction: see soil

compost: [from the *Organic Matter Recycling Regulation*] a product which is

(a) a stabilized earthy matter having the properties and structure of humus, (b) beneficial to plant growth when used as a soil amendment, (c) produced by composting, and (d) only derived from organic matter

composting: [from the *Organic Matter Recycling Regulation*] the controlled biological oxidation and decomposition of organic matter in accordance with the time and temperature requirements specified in Schedule 1 of the *Regulation*

compost bulking agent: an ingredient in a mixture of composting raw materials included to improve the structure and porosity of the mix, e.g., sawdust

compost leachate: water passing through uncovered compost piles will produce various compounds which can pollute water and must be contained; in high rainfall areas, piles should not be on uncovered areas on bare ground but should be covered and on a surface such as concrete

composting site: the location of the organic material being composted, including buildings, clean water diversion, runoff collection and visual screening where used, as shown in Figure 2.3, page 2-29

curing area: [from the *Organic Matter Recycling Regulation*] an area where organic matter which has undergone the rapid initial stage of composting is further matured into a humus-like material

concentrated flow: see overland flow

concern: (a) something of interest or importance, a responsibility; (b) worry, anxiety

concrete: a mixture of Portland cement, water, air, and aggregates (sand and gravel)

fly ash additive: replaces a part of the cement in the mix, to indirectly reduce air pollution by virtue of reduced fuel use in what is a high energy use process

confined livestock area: (from the *AEM Code*) means an outdoor area, other than a grazing area, seasonal feeding area or temporary holding area, where livestock are confined by structures or topography.

calving pen: a confined livestock area used to birth cattle

feedlot: a confined livestock area for the finish-feeding of livestock

horse riding arena: a confined livestock area used for riding horses

permanent vegetated buffer: see buffer

soil-based: see soil-based yard

conifer: a cone-bearing tree

conservation: the continuing protection and management of natural resources in accordance with principles that assure their optimum long-term economic and social benefits

productive conservation: a practice designed and managed simultaneously to protect the environment and to provide economic returns, such as riparian management that protects both the water resource and biodiversity while providing livestock grazing or a harvestable crop such as berries or floral products

conservation tillage: see tillage

constructed channels: man made drainage channels that carry drainage water from more than one property but do not carry water from headwaters or significant sources of groundwater; flows in agricultural constructed channels may be year round and are not regulated; constructed channels may also deliver water for irrigation purposes

constructed ditches: man made drainage channels that carry drainage water from one property but do not carry water from headwaters or significant sources of groundwater; flows in agricultural constructed ditches may be year round and are not regulated; may also deliver water for irrigation purposes

contaminant: anything added to a substance that makes the substance impure or unfit for its intended use (see deleterious substance and pollutant)

air contaminant: [from the *Environmental Management Act*] a substance that is emitted into the air and that

(a) injures or is capable of injuring the health or safety of a person, (b) injures or is capable of injuring property or any life form, (c) interferes or is capable of interfering with visibility, (d) interferes or is capable of interfering with the normal conduct of business, (e) causes or is capable of causing material physical discomfort to a person, or (f) damages or is capable of damaging the environment

potential contaminant: any material handled, stored or used on a farm that if allowed to enter the environment (other than when normally used) would cause pollution, such as petroleum or pesticide losses from storage; to be considered when locating farm storages, dispensing sites, etc.

secure containment of potential contaminants: structures and practices that take into account the appropriate environmental risks associated with handling, storing and using various farm materials

contamination: (a) introducing a substance into the environment that will render it unfit for its intended use; (b) [from the *Environmental Management Act*] the presence in soil, sediment, water or groundwater of (i) a hazardous waste, or (ii) another prescribed substance (also see deleterious substance and pollution)

contaminated site: [from the *Environmental Management Act*] an area of the land in which the soil or any groundwater lying beneath it, or the water or the underlying sediment, contains (i) a hazardous waste, or (ii) another prescribed substance

contaminated surface water: surface water that contains dissolved or suspended chemicals or particulates such that, if released, it would cause pollution of the receiving environment

probable source of contamination: see well

contingency plan: a written document which describes how a farm (owner, manager, employees, etc.) will react to prevent the release of materials into the environment under unusual circumstances, such as due to the effects of fire, vandalism, floods, storage failure, etc. The plan describe actions which should be taken to prevent or actions which should be taken in the event of an escape of potential contaminants which are transported, stored, dispensed and applied on a farm. It should include emergency contacts.

fertilizer contingency: chemical fertilizer storage

manure contingency: solid, semisolid, or liquid storages

mass mortality: for mass mortalities

pesticide contingency: for all stored pesticides

petroleum contingency: fuel and oil storage

visible place for plan: as contingency plans may be needed quickly during emergencies, they need to be readily available, such as posted on an office wall near a telephone, posted at or near storage sites or mounted in an emergency tube in the farm yard

corral: a small enclosure for handling livestock

cover crop: plants grown alone or in mixtures for protection of the soil against erosion, amelioration of soil structure, enhancement of soil fertility, suppression of pests and alteration of micro-climate; not generally grown for harvest or forage, but rather to fill gaps in either time or space when cash crops leave the soil bare; also known as: green manure, living or dead mulches, plow down, companion, relay, double or catch crops

relay crop: a method of cover cropping where a cover is seeded before the main crop is harvested to reduce weed growth during the growing season and ensure cover establishment

critical habitat: see habitat

crops: includes all agricultural crops

outdoor crop: crops grown without cover of buildings, such as field crops

stewardship crops: crop and non-crop plantings for land and/or stewardship purposes, such as lure or sacrifice crops grown to draw wildlife away from cash crops (also see stewardship)

crop drying: the process of removing moisture from a crop to prevent spoilage and allow storage

aeration drying: the process by which natural air is blown through a crop for drying, usually without auxiliary heat

automatic controls: crop drying equipment operated with feedback from air and crop conditions of temperature and humidity, such that energy use is optimized

crop production: farming where plants are grown for various purposes, such as livestock or human feed

crop rotation: a succession of different crops planted on the same land, as opposed to growing the same crop time after time; to improve yields and soil health, and improve pest control

crop residue: (a) the portion of a plant or crop left in the field after harvest, usually having soil benefits; (b) crop prunings, waste plants and other organic matter that may be used as a soil conditioner (also see soil)

intensively-managed: continuous crop production with fertilizer and irrigation, as required to maximize output during the crop growing season

crop storage: area where harvested crops are stored, with water contamination prevention measures in place, such as silos with silage effluent collection

covered crop storage: storage constructed to protect the crop from deterioration from the weather, such as roofed hay storage

cross connection: a situation where piping carrying contaminated liquid is connected to piping containing clean liquid, such as water; usually connected mistakenly

Crown land: land, whether or not it is covered by water, or an interest in land, vested in the Crown

Cryptosporidium parvum: "crypto"; a microscopic coccidian pathogen of most mammals; is transmitted by water and can infect humans; transmission occurs by way of oocysts which are highly resistant to destruction (very young beef and dairy calves may carry the organism for a short time)

culvert: a transverse drain, such as to flow water under a road; must be sized for both expected water flow and, where present, for fish passage (also see **free passage of water and fish**)

open channel culvert: is one that does not flow full (termed a pipe if full)

inlet structure: where required, allows proper flow and protects for the surrounding structure; may include debris catcher

outlet structure: where required, decreases erosion potential and allows fish entry

D

dam: a structure of earth, rock, concrete, or other material designed to retain water, creating a pond, lake, or reservoir; typically requires a water licence to store water (also see **water licence**)

dangerous wildlife: see **wildlife**

deforestation: [from Environment Canada] permanent, human-induced land use change from forest to non-forest land cover. Forest harvesting, including clearcutting, is not considered deforestation, as the land use does not change and the land cover is expected to revert to forest.

zero net deforestation: is achieved when the area of afforestation is equal to or greater than the area of deforestation.

deleterious substance: [condensed from the federal *Fisheries Act*] any substance that, if added to any water, would degrade or alter the quality of that water so that it is likely to be deleterious (harmful) to fish or fish habitat or to the use by man of fish that frequent that water (also see **contamination** and **pollution**)

detention pond: see **stormwater**

direct farm sales: see **on-farm**

discharge: total amount of a solid, liquid or gaseous material introduced into the environment from works

disposal: the introduction of waste into the environment through any discharge, deposit, emission or release to any land, water or air by means of facilities designed, constructed and operated so as to minimize the effect on the environment

dirty water: see **water quality**

dissolved oxygen: the amount of oxygen dissolved in a given quantity of water at a given temperature and pressure; usually expressed as a concentration in parts per million, or as a percentage of saturation

ditch: a waterway constructed to intercept surface runoff and to act as an outlet for subsurface drainage (also see "**constructed ditch**")

interceptor ditch: used to divert or redirect runoff around and away from a farm area to prevent contamination of the runoff, such as around an outdoor livestock area

diversion: a channel or dam constructed across a slope to intercept surface water flow and transfer it to a safe or convenient discharge point, such as placed for a water system intake, or used above a area to be protected from surface water flow

point of diversion: [from the *Water Sustainability Regulation*] in relation to a steam, the location on the stream channel where water is diverted from the stream in in relation to an aquifer, the location of a well from which water is diverted from the aquifer.

domestic purpose: (a) [from the *Drinking Water Protection Act*] the use of water for (a) human consumption, food preparation or sanitation, (b) household purposes not covered by paragraph (a), or (c) other prescribed purposes; (b) [from the *Water User's Communities Act*] the use of water for household requirements, sanitation and fire prevention, the watering of domestic animals and poultry and the irrigation of a garden not exceeding 1,012 m^2 adjoining and occupied with a dwelling house

domestic water sources: surface water or groundwater that is used or intended to be used for domestic purposes

domestic water system: [from the *Drinking Water Protection Act*] a system by which water is provided or offered for domestic purposes, including

(a) works used to obtain intake water, (b) equipment, works and facilities used for treatment, diversion, storage, pumping, transmission and distribution, (c) any other equipment, works or facilities prescribed by regulation as being included, (d) a tank truck, vehicle water tank or other prescribed means of transporting drinking water, whether or not there are any related works or facilities, and (e) the intake water and the water in the system, but excluding equipment, works or facilities prescribed by regulation as being excluded

drinking water: [from the *Drinking Water Protection Act*] water used or intended to be used for domestic purposes

drinking water health hazard: [from the *Drinking Water Protection Act*] (a) a condition or thing in relation to drinking water that does or is likely to (i) endanger the public health, or (ii) prevent or hinder the prevention or suppression of disease; (b) a prescribed condition or thing; or, (c) a prescribed condition or thing that fails to meet a prescribed standard

drinking water source: [from the *Drinking Water Protection Act*] a stream, reservoir, well or aquifer from which drinking water is taken

drainage: the removal of excess water from the land surface and/or from the soil profile

drainage maintenance: work required to ensure the operation of a drainage system; must be conducted (methods and timing) to minimize impacts to riparian areas and water quality

drainage water quality: see water quality

surface drainage system: designed system using natural or constructed channels and ditches open to the land surface being drained; may include water control structures to allow controlled back flooding crop land

subsurface drainage system: a system using drain tiles or perforated pipes buried under the land surface being drained, including the collection of drains, structures and pumps, having three modes as follows:

1. **conventional subsurface system:**, designed solely for the removal and disposal of excess water
2. **controlled drainage system:** a system where the outflow is controlled to maintain an effective drainage depth; used to conserve water; a type of subirrigation where no additional water is added; may have the capacity to isolate and allow management of contaminated runoff
3. **subirrigation drainage:** a controlled drainage system where additional water can be added to back flow into the soil to raise the water table as required for irrigation of a crop; must be designed for both drainage and irrigation needs

drawdown: see wells

drift: see off target

drop structure: used to remove erosive energy from water moving down a grassed waterway or ditch

drought: (a) a prolonged chronic shortage of water, as compared to the norm, often associated with high temperatures and winds during spring, summer and fall; (b) a period without precipitation during which the soil water content is reduced to such an extent that plants suffer from lack of water

dry matter content: percent of total product weight which is not water; equals 100 minus moisture content

due diligence: a principle whereby an accused can avoid liability only by providing that they took all reasonable care to avoid a situation; demonstrating your actions represent a reasonable approach to a problem is due diligence, ignoring it and hoping it will go away is not

dump and grade: a system to apply manure on the soil surface by dumping truck loads on the ground and then spreading the manure by using a grader type of equipment

dugout: a constructed depression that collects and stores water and differs from a reservoir in that a dam is not relied upon to impound water; may or may not be water licenced

dust: see particulates

dwelling, private: [from the *Drinking Water Protection and Public Health Acts*] (a) a structure that is occupied as a private residence, or (b) if only part of a structure is occupied as a private residence, that part of the structure

dyke: an artificial embankment constructed to prevent flooding

E

ecosystem: the complex set of interactions between living organisms and their environment; ecosystems include plants, insects, fish, birds, animals, water and soil

E.coli: see bacteria

efficient: the use equipment or methods such that energy needs or use are minimized, such as the use of low energy lighting or high efficiency motors

effluent: (1) [from the *Environmental Management Act*] a substance that is discharged into water or onto land and that (a) injures or is capable of injuring the health or safety of a person, (b) injures or is capable of injuring property or any life form, (c) interferes or is capable of interfering with visibility, (d) interferes or is capable of interfering with the normal conduct of business, (e) causes or is capable of causing material physical discomfort to a person, or (f) damages or is capable of damaging the environment; (2) [from the *Sewerage System Regulation*] domestic sewage that has been treated by a treatment method and discharged into a discharge area

EC or electrical conductivity: a measure of the ability of water to conduct electricity; used to estimate the amount of soluble salts in water and soil water

emergency contacts and emergency plan: see contingency plan

emission: total amount of a solid, liquid or gaseous material emitted into the atmosphere from works

energy efficiency: the greatest possible reduction of the total amount of energy needed

enteric fermentation: a process that takes place in ruminant livestock which converts carbon in feed to methane; contributes to a net increase in atmospheric methane concentrations

ENV: Ministry of Environment and Climate Change Strategy

ENV-approved/permitted landfill: a disposal site, whether on or off farm, that has been approved and or permitted by the ENV for use as disposal of defined wastes

environment: [from the *Environmental Management Act*] the air, land, water and all other external conditions or influences under which humans, animals and plants live or are developed

- **environmental assessment:** the critical appraisal of the likely effects of a proposed or existing project, activity, or policy on the environment, both positive and negative
- **environmental impact:** a measurable change to the environment from an activity or action; may be negative or positive
- **environmentally sensitive area:** may be a sensitive water body, habitat area or wildlife population on a non-production area on a farm that is sensitive to farm activities, such as contaminated runoff of pesticide drift

ephemeral: see stream

Environmental Farm Plan (EFP): an on farm or ranch assessment conducted by a planning advisor to identify potential environmental risks which results in a work plan that lists beneficial management practices that could be implemented.

erosion: the detachment and movement of soil and rock particles by gravity, wind, water, freezing and thawing, and/or other natural phenomena and may be intensified by human land use practices; erosion is a source of sediments, suspended solids, total dissolved solids and particulate matter turbidity in natural waters

- **incisement:** vertical erosion (downcutting) of a stream channel; a stream is considered "incised" when the normal two-year high water flow cannot reach the floodplain
- **lateral cutting:** erosion of a stream bank as the water channel moves sideways
- **rill erosion:** small channels that form in the soil as a result of surface water flow; they are easily removed when the soil is worked with farm equipment
- **sheet erosion:** the loss of a uniform layer of soil by wind or water, evidenced by exposure of once hidden roots or stones
- **scour:** erosion that occurs along stream banks and in stream beds through water action

eutrophication: the natural process by which lakes or ponds become enriched with dissolved nutrients resulting in increased algae and plant growth; may be natural or accelerated by human activities

evaporation: the process of liquid water becoming water vapour from water surfaces, land surfaces and snow

ET or evapotranspiration: the combined loss of water to the atmosphere from a given area by evaporation from the land and transpiration from plants; used in determining crop irrigation needs (also see evaporation and transpiration)

exotic pest: see pest

F

farmstead: the main area of a farm or ranch; it is usually where the home site is located, where machinery, fertilizers, chemicals, etc. are stored, and where the major livestock buildings are located

fecal: waste matter, feces, from the gut or gastrointestinal tract of animals

- **fecal coliform:** see bacteria

feed bunk: a structure, either portable or permanent, in which feed can be placed for convenient access by livestock

- **portable feed bunk:** a movable-location structure which is moved so as to distribute manure over the feeding area, usually crop land (when used on non-crop land or when not moved, the manure should be managed as for a permanent feed bunk)
- **permanent feed bunk:** a fixed-location structure which requires manure to be scrapped and removed for spreading onto crop land

feedlot: see confined livestock area

fertilizer: any natural or manufactured material, either organic or inorganic, that is added to soil to supply one or more plant nutrients, but not managed as a soil conditioner (also see soil – soil conditioner)

- **chemical fertilizer:** a manufactured or processed fertilizer with a known chemical content
- **organic fertilizer:** manure or compost

fertilizer versus soil conditioner: materials that have properties that allow them to be used as both a fertilizer and a soil conditioner should be managed as a fertilizer; see Tables 6.4 and 6.5, pages 6-6 and 6-7

side dress: fertilizer applied as a band between rows of a growing crop

fertigation: the application of nutrients through an irrigation or nutrient circulation system (also see **chemigation**)

field capacity: the amount of water remaining in a soil when the downward water flow due to gravity becomes negligible

filter strip: see **buffer**

fish: [from the federal *Fisheries Act*] includes fish or parts of fish, shellfish, crustaceans, marine animals and any parts of shellfish, crustaceans or marine animals, and the eggs, sperm, spawn, larvae, spat and juvenile stages of fish, shellfish, crustaceans and marine animals

fish bearing stream: a stream that has, or is likely to have, fish at anytime

fish habitat: see **habitat**

fish passage: [from the *Water User's Communities Act*] fish in a stream are able to pass by or through in both upstream and downstream directions

fish screening: see **intake**

wildlife, fish: see **wildlife**

flail broadcast: a system to apply manure on the soil surface that uses a flail to throw and spread the manure

flood: the temporary inundation of normally dry land areas resulting from the overflowing of the natural or artificial confines of a watercourse

floodplain: relatively flat, low lying areas next to watercourses that are periodically flooded

active floodplain: the area of land that is flooded every 2 to 3 years

flotation: ability of tractor or implement tires to stay on top of soil surface; usually related to soil conditions, equipment weight, and contact area between tires and soil surface

flow: the rate of water discharged from a source, expressed in a volume over a time period, such as cubic metres per second (m^3/s)

fly ash: fine, solid, non-combustible particles removed from combustion exhaust gasses used as an additive in concrete to reduce cement requirements, indirectly reducing energy costs and air pollution

food: [from the *Food Premises Regulation*] any raw or processed substance intended for human consumption

food premises: [from the *Food Premises Regulation*] any place where food intended for public consumption is sold, offered for sale, supplied, handled, prepared, packaged, displayed, served, processed, stored, transported or dispensed

forage: plants that are grown for animal feed

forb: any broad-leafed, flowering plant with non-woody stem that is not a grass or grass-like plant

foreign matter: [from the *Code of Practice of Agricultural Environmental Management*] a contaminant that does not readily decompose during an agricultural composting process, and does not include silt, sand, rocks or stones, gravel less than 2.5 cm in diameter, or other mineral materials naturally found in soil.

forest: [from Environment Canada] a minimum area of one hectare, at least 20 metres wide, with tree crown cover (or equivalent stocking level) of more than 25% with trees having the potential to reach a minimum height of 5 metres at maturity. A forest may consist of closed forest formations (where trees of various storeys and undergrowth cover a high proportion of the ground) or open forest. Young natural stands and all plantations which have yet to reach a crown density of 25% or tree height of 5 metres are considered to be forest. As well, forest includes areas normally forming part of the forest area that are temporarily unstocked as a result of human intervention (such as harvesting) or natural causes, but which are expected to revert to forest.

fossil fuel: fuel (e.g. oil, gasoline, diesel, propane and natural gas) that is produced from carbon chains that have been stored underground for millions of years. When combusted, these fuels release carbon dioxide into the atmosphere.

freeboard: the distance between the full storage level and the upper edge of the storage structure; provided to prevent overtopping due to unforeseen conditions (i.e., for water in a ditch it is the distance from the surface of the water to the top of the ditch bank)

free passage of water and fish: in-stream structures constructed so as not to restrict "normal" passage of water and fish (i.e., culverts that can pass the flood flow and allow fish to move through freely)

french drain: see **blind drain**

freshet: a sudden rise or overflow of a watercourse as a result of heavy rains or rapidly melting snow

fuel storage: containment of gasoline or diesel fuels in stationary storages

mobile storage: any containers that will be transported containing fuel, such as jerry cans, truck-box tanks

stationary storage: any containers, whether above or below ground, permanently located

above ground storage: fuel tanks spaced above the earth surface on a non-combustible stand, requiring spill containment, drip prevention, mechanical protection from vehicles, etc., as shown in Figure 2.2, page 2-19

below ground storage: fuel tanks buried in the earth, requiring secondary containment, such as a double walled tank, leak detection, etc

anti-siphon device: installed in the tank discharge line if a self closing nozzle is not used

gas emissions: vapour release from fuel storage into the atmosphere due to heating of the fuel, such as from exposure to the sun

pressure relief valve vent cap: a device to reduce gas emission release to the atmosphere by allowing a slight pressure increase in the fuel tank prior to venting; best incorporated with tanks that are painted a light colour and/or roofed to reduce tank heat and therefore pressure buildup

secondary containment of fuel: see secondary containment, and leak detection

self closing nozzle: installed in the tank discharge line to prevent accidental release of fuel, such as a spring-return handle valve

fur farm: farm production of fur-bearing animals

G

game farm: [from the *Game Farm Regulation*] the land on which game is kept with the intention of using the game for commercial purposes.

game: [from the *Game Farm Regulation*] fallow deer, bison and reindeer

gas emissions: see fuel storage

gear up – throttle down: a tractor driving technique to reduce fuel use whereby the driver reduces engine speed and shifts up a gear to maintain the same ground speed

geosynthetic: man-made materials used to improve soil conditions

geotextile: a man made plastics fabric used to increase the bearing capacity of soil by acting as a blanket to add reinforcement and separation; placed on the soil or subsoil to form a mat between the underlying soil and products that are placed on them, such as used under gravel at a livestock watercourse access point

global warming potential (GWP): GWP is a relative unit measured against the baseline of carbon dioxide that is a measure of the ability of a greenhouse gas to trap heat and its viable time in the atmosphere.

grassed waterway: a natural or constructed watercourse or outlet that is shaped or graded and planted with suitable vegetation for the purpose of dispersing surface water flow without causing erosion

grasslands: important wildlife habitat and forage lands for grazing livestock; cover 1.5% of BC's land area

grazing area: [from the *AEM Code*] a pasture or rangeland where livestock, poultry feed primarily sustained by direct consumption of plants growing on the pasture or rangeland.

grazing: the consumption of standing forage (herbaceous plants) by livestock or wildlife, such as on a pasture or rangeland (also see browse)

intensively-managed grazing: subdivision of a grazing area into small units, with grazing periods typically less than five days; may involve an increase in stocking rates, forage utilization, labour, resources, and/or capital; results in increased production per unit area or per animal (also see livestock production)

greenhouse effect: the warming of the earth's atmosphere caused by a build-up of carbon dioxide or other gases; it is believed this build-up allows sunlight to heat the earth but prevents a counterbalancing loss of heat

GHGs/greenhouse gases/global warming gases: carbon dioxide, methane, nitrous oxide, that contribute to the greenhouse effect

green manure crop: a cover crop, often a forage species such as barley or oats, that is plowed down into the soil late in the fall or early in the spring for to provide nutrients and organic matter to the soil

ground level ozone: see ozone

groundwater: [Code of Practice for Agricultural Environmental Management] water that naturally occurs below the surface of the ground. [From the *Municipal Sewage Regulation*] subsurface water at or below a water table in fully saturated geologic materials and formations

groundwater contamination potential: the potential for contaminants to move through the soil into groundwater; influenced by risk of spills from storage or mixing areas, the absence of secondary contaminant or impermeable floors, soil characteristics and the level of the water table

groundwater mining: removal of groundwater exceeding recharge

groundwater recharge: the inflow of water to an aquifer

recharge area: land area over which water infiltrates to replenish an aquifer; for unconfined aquifers the area is essentially the entire land surface overlaying the aquifer; for confined aquifers the recharge area may be part of or unrelated to the overlying area (see aquifer)

seepage area: see seepage

groundwater table: see water table

gulley: a furrow, channel, or miniature valley, usually with steep sides through which water commonly flows during and immediately after rains or snow melt; too large for farm equipment to cross

H

habitat: the air, soil, water, food and cover components of the environment on which a plant or animal depend directly or indirectly in order to carry out their life processes such as eating, staying safe from predators, and reproducing

connectivity: availability of habitat for species depends on the species' ability to move between habitat patches; keeping habitat patches connected in a corridor increases the value of habitat patches

critical habitat: [from the *Species at Risk Act*] the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in the recovery strategy or in an action plan for the species

fish habitat: [from the federal *Fisheries Act*] spawning grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly in order to carry out their life processes

wildlife habitat: [from the *Wildlife Act*] the air, soil, water, food and cover components of the environment on which wildlife or species at risk depend directly or indirectly in order to carry out their life processes

hard-surfacing: impervious layer installed on outdoor areas subject to concentrated impacts, especially in high precipitation areas, such as concrete livestock yards (also see high precipitation)

hay and haylage: see livestock feed

hazardous waste: [from the *Hazardous Waste Regulation*] dangerous goods that are no longer used for their original purpose, as listed in the Regulation

health hazard: [from the *Public Health Act*](a) a condition, a thing or an activity that
(i) endangers, or is likely to endanger, public health, or
(ii) interferes, or is likely to interfere, with the suppression of infectious agents or hazardous agents, or (b) a prescribed condition, thing or activity, including a prescribed condition, thing or activity that(i) is associated with injury or illness, or (ii) fails to meet a prescribed standard in relation to health, injury or illness;

heating system: heat supply and control for a building (also see natural heating)

interlocked heating and ventilation system: the controls for both heating and ventilation are combined so as to minimize energy use

high efficiency (energy use): lighting, heating or ventilating systems that, by their design or operation, require less energy than other similar systems (efficiency usually is the combination of all system components, including the structure, climatic conditions, controls, etc)

high efficiency lighting: (1) lights – the use of fluorescent, sodium, and metal halide lighting that is more efficient than incandescent lighting; (2) controls – the use of timers and motion sensors to reduce the energy needs of any lighting system

high precipitation: see precipitation

high-risk area: [from the Code of Practice for Agricultural Environmental Management] means any of the following:
(a) a high-precipitation area;
(b) a vulnerable aquifer recharge area;
(c) a phosphorus-affected area;
(d) an area identified by a director as having permanent or usual geographic, topographic, weather-related or other features that present a high risk for adverse impacts on the environment or human health

holding tank: see septic tank

hummocking: small-scale relief or ground disturbance characterized by raised mounds of soil; may result from trampling by large animals (also see **pugging**)

humus: well decomposed organic matter which gives soil its dark colour and earthy smell; holds nutrients and binds mineral particles in soil

hydraulic conductivity: a measure of the rate at which water will move through a permeable soil or rock layer; for a particular soil or rock it may not be the same in the horizontal direction as in the vertical direction

hydrologic cycle: the constant circulation of water from the sea, through the atmosphere, to the land, and back to the sea by over-land, underground, and atmospheric routes

hydrology: the science of waters of the earth, including its properties, circulation, principles, and distribution

I

impermeable: see **permeability** and **impervious**

impervious: see **protective base.** (1) a material that does not allow liquid to move through it, such as sealed concrete, roofs and hard surfaced roads (2) a soil having a permeability not greater than 1×10^{-7} cm per second when subjected to a head of 0.305 m of water; impervious surfaces decrease (or eliminate) infiltration and increase (or maximize) runoff

incorporation: mixing of fertilizers into the soil so plant roots can absorb nutrients more easily; done by tillage or by equipment placing the fertilizer in a band below the soil surface

indoor: enclosed and protected from precipitation and wind, such as in a building, but not a shipping container used for passive storage

inert: a material that does not show a chemical or biological action

infiltration: the downward entry of water into the Earth's surface (usually into soil or rock); the movement of water or any liquid through the top surface layer (less than 1 cm) of the soil; the terms hydraulic conductivity, percolation, and permeability usually refer to water movement within a soil or rock layer

injector: a system to apply manure in bands under the soil surface rather than on top of the soil

inorganic: see **organic**

instream crossing: see **stream crossing**

insulation: material used to resist the flow of heat into or out of a structure, considerably more resistant than structural materials; usually in conjunction with moisture control (vapour barrier); required levels are set by building codes

intake: a structure or mechanism to divert water into a domestic or irrigation system

> **fish screening:** a specific design to both prevent fish from being drawn into a water system (with screen openings that do not exceed 2.54 mm) and to prevent fish being forcefully drawn against the screen (by ensuring low intake water velocity), as outlined in Water Intakes, on page 9-13

Integrated Pest Management: (a) a management method requiring pests to be monitored in order to target pesticide applications, with the expectation that pesticide use will be reduced; (b) [*Integrated Pest Management Act*] decision making process that uses a combination of techniques to suppress pests and that must include but is not limited to the following elements: (i) planning and managing ecosystems to prevent organisms from becoming pests; (ii) identifying potential pest problems; (iii) monitoring populations of pests and beneficial organisms, pest damage and environmental conditions; (iv) using injury thresholds in making treatment decisions; (v) reducing pest populations to acceptable levels using strategies that may include a combination of biological, physical, cultural, mechanical, behavioural and chemical controls; (vi) evaluating the effectiveness of treatments

intensively-managed livestock: see **livestock production**

interlocked heating and ventilation system: see **heating system**

introduce into the environment: [from the *Environmental Management Act*] in relation to waste includes discharge, emit, dump, abandon, spill, release and allow to escape into the environment

invasive pest: see **pest**

inversion: an atmospheric condition of a stable air mass where air temperature increases with an increase in altitude above the earth and stagnant air remains near the surface (also see **open burning** - ventilation index)

irrigation: the controlled withdrawal of water from an assured supply and its application as crop water to the soil to replenish water removed by evaporation, by growing plants, and by drainage below the root zone; as needed by climatic conditions

annual water use: the water used for irrigation during one season; given as inches of water over the crop area, or, as on a water licence, as acre-feet of water (also see acre-foot)

centre pivot irrigation: automated systems where a wheel line pivots in circle around a field

flood irrigation: water is turned into a field without any flow control such as furrows, boarders or corrugations. This is the least efficient, least uniform and least effective method of irrigation.

irrigation efficiency: the ratio of the average depth of water that is beneficially used to the average depth applied, expressed as a percentage

irrigation gun: water is sprayed or sprinkled in high volumes through the air to the ground surface; may be used to apply liquid manure onto soil

irrigation interval: the average time interval between the commencement of successive irrigation on a field

irrigation set: the area of a field irrigated at one time

irrigation system uniformity: the ability of a system to apply water evenly over the crop; desirable to minimize water use and particularly important when chemigating; will vary with system design, maintenance, etc.

irrigation water quality: see water quality

peak flow: the water flow rate necessary to meet the expected maximum water demand of an irrigation system

sprinkler irrigation: water is sprayed or sprinkled through the air to the ground surface

subirrigation: application of irrigation water below the ground surface by raising the water table to within or near the root zone

trickle irrigation: a method of microirrigation where frequent, low pressure of water is applied to the soil surface as drops or small streams through emitters at the plant location; includes tape, drip emitter or spray emitter systems

L

land: [from the *Environmental Management Act*] the solid part of the earth's surface including the foreshore and land covered by water

leachate: (a) a product from water moving through a material, such as wood residue, manure or soil, creating a contaminated liquid, or (b) [from the *Mushroom Composting Facilities Regulation*] liquid effluent originating from organic materials being received, processed, composted, cured or stored at a mushroom compost facility, or any water, precipitation or runoff that has come into contact with, or mixed with, the liquid effluent.; refer to Figure 9.6, page 9-63

silage leachate: see livestock feed

wood residue leachate: see wood residue

leaching: the natural process by which salts and other soluble materials are removed from soil or other materials by percolating water; they may then move into and through the soil (also see percolation)

leak detection: a method or system whereby a storage facility is monitored for escape of stored material, such as manure in semi-solid or liquid pits, or petroleum fuel from under ground tank storage

lighting: the introduction of light into a farm structure to maintain adequate conditions for livestock, plants or other reasons using natural or artificial means

natural lighting: the use of natural site, environmental and structural conditions to supply light, such as structure orientation in a southerly direction, the use of overhead panels, etc.

lignosulfonates: material used for dust suppression on roads

lime: calcium carbonate, or agricultural limestone; a soil amendment used on acidic soils (pH less than 7)

livestock: domestic animals raised for breeding or food purposes, including all farm animals and birds

livestock bedding: (a) material upon which livestock may recline; often supplied material is wood-based, such as sawdust or shavings, which should be applied to soil of known C:N ratio (see C:N); (b) area where livestock may recline; needs to be selected considering potential impacts to water, fish, and habitat

livestock housing: a structure, usually roofed, that contains livestock, whether temporary or continuously

livestock management: application of technical principles and business methods to livestock production

livestock access: see livestock watering

livestock feed: crop grown and harvested for livestock

hay: dried grass or legumes harvested and stored for livestock feed; typically less than 20 percent moisture content

haylage: low-moisture silage; usually 40 to 50 percent moisture content

silage: green forage converted to animal feed through fermentation; usually 65 to 70 percent moisture content

silage leachate: normally generated from stored silage; is a high oxygen-demanding material which is toxic to aquatic life and must be contained

livestock feed storage: structures design to store feed protected from the effects of weather, especially water; incorporate methods to control roof stormwater, and to manage material leachate where appropriate

silo: structure for storing silage or haylage; may be a vertical cylinder, or a horizontal trench or bunker

livestock production:
the business of producing livestock

extensive grazing livestock: providing a pasture or grazing area large enough to supply all the animals nutrient requirements

intensive grazing livestock: providing supplemental feed to animals in addition to the feed on a pasture or grazing area as the area does not supply all the animals nutrient requirements

intensively-managed livestock: where significant management is required for both livestock production and environmental protection

livestock watering: either in-stream or off-stream systems to supply livestock water

livestock water development: a new or improved source of water, such as a well, spring, or pond, together with a storage and delivery system

in-stream watering: a system where livestock access a watercourse directly, sometime with restricted or managed access locations

off-stream watering: a system where livestock are provided water, usually by pipe and water trough located back from the watercourse, that reduces impacts to the watercourse

managed access: the duration, timing and intensity of livestock access to a watercourse is controlled to minimize the impact on water quality and riparian area health

low precipitation: see soil-based yards

low livestock density: see soil-based yards

lure crops: crops such as cereal grains or vegetables which are planted on lands surrounding a specific area where wildlife or waterfowl tend to congregate; grown as a sacrifice crop to try to distract the wildlife away from cash crop area

M

macropore: the large pores responsible for rapid water movement in soil; usually greater than 0.1 mm diameter

MAFF: Ministry of Agriculture, Food and Fisheries

manage: (a) to have under effective control; (b) to use to the best advantage

managed access: see livestock watering

manure: animal feces and urine, plus materials such as bedding and waste water

manure, liquid: [*Code of Practice for Agricultural Environmental Management*]: raw or untreated liquid excreta from livestock or poultry, whether or not it is mixed with wastewater, or animal bedding, feed or other solids

manure, solid: [*Code of Practice of Agricultural Environmental Management*]: raw or untreated solid excreta from livestock or poultry, whether or not mixed with animal bedding, feed or other solids

manure spreading: application of manure onto crop land according to its nutrient content; should be part of a Nutrient Management Plan (also see Nutrient Management Plan)

manure handling: the agitation, movement or transport of manure within the farm site or between storage or treatment locations

manure testing: laboratory analysis of a sample of manure for dry matter, nitrogen, phosphorous, potash, and other nutrients; a part of a Nutrient Management Plan (also see Nutrient Management Plan)

manure used as a fertilizer: application of manure according to its fertilizer value (also see fertilizer)

manure storage: [from the *AEM Code under the Agricultural Waste Control Regulation*, item 4] on-farm agriculture waste must be produced or used on that farm

manure storage facility: [from the *AEM Code* under the *Agricultural Waste Control Regulation*] includes a structure, reservoir, lagoon, cistern, gutter, tank or bermed area for containing agricultural waste prior to its use or disposal, but does not include a vehicle or any mobile equipment used for transportation or disposal of agricultural waste

earthen storage: a structure constructed primarily of natural geological materials, usually for liquid manure storage

field storage: field storage - "temporary": [*Code of Practice for Agricultural Environmental Management*] the storage of solid agricultural by-products or wood residue outside in a field, but not in a structure, before their use or disposal

secondary containment: a facility that prevents manure loss into the environment in the case that the primary containment facility fails

structurally sound: manure storage built to specifications that prevent manure loss or structural failure

sufficient capacity: capacity to store waste produced or used on a farm for the period of time needed to allow for either the application as a fertilizer or soil conditioner or its removal

marine plant: [from the federal *Fisheries Act*] includes all benthic and detached algae, marine flowering plants, brown algae, red algae, green algae and phytoplankton

meanders: where a stream flows from side-to-side creating loops, bends and curves (also see **sinuosity**)

metals: chemical elements which are usually found in small amounts in soil, some of which are required in trace amounts to plants (micronutrients), but can become toxic to plants, animals and soil biology; examples are arsenic, cadmium and lead

methane (CH_4): a greenhouse gas that is produced during anaerobic decomposition of organic wastes such as manure.

micronutrients: chemical elements that are necessary in only trace amounts (usually less than 1 ug/mL in plants) for the growth of plants; examples are boron, copper, iron, zinc

milkhouse waste: waste from the milking process, including manure, spilled milk, udder washings, and equipment wash water containing detergents, acids and chlorine

minimum tillage: see **tillage**

mitigation: projects, actions and management practices that result in a reduction of greenhouse gas emissions from farms and agri-food activities

monitoring: the process of checking, observing, or keeping track of something for as specified period of time, or at specified intervals

mortality: [From the *Code of Practice for Agricultural Environmental Management*] livestock or poultry that have died from causes other than slaughter and are not fit for human consumption

mass mortality: livestock losses exceeding normal death loss, usually due to uncontrollable circumstances such as disease, vandalism, loss of electrical power, etc; requires a response contingency plan (also see **contingency plan**)

mortality record: a record of the location, amount and type of material in on-farm mortality pits

mortality disposal: methods to properly dispose of livestock based on the cause of death, as outlined in **Table 3.4**, **page 3-32**

burial: [From the *Code of Practice for Agricultural Environmental Management*] mortalities that are buried must be done in pits that are not closer than 60 m to one another (unless each pit has be been unused for 10 years), must contain no more than 2.5 tonnes, must not be placed in or over soil that has a saturated hydraulic conductivity of more than 10-3 cm/s (coarse-textured soil), in or in the vicinity of, unstable soils, in any area where there is standing water or water-saturated soi, or in fields prone to flooding or within a 200-year flood plain. There must be 1.5 m of clearance from the bottom of the pit to either bedrock or seasonal high water table, and the buried materials must be covered with at least 0.6 m of soil.

mortality composting: [From the *Code of Practice for Agricultural Environmental Management*] mortalities may be composted as long as the pile is not located in any area in which there is standing water or water-saturated soil or in any areas prone to flooding. The pile must not remain for a period of more than 15 months and no other pile may be placed in the same location for at least 3 years.

mortality incinerator: designed such that emissions of particulate matter from the incinerator, determined under standard conditions of an O2 reference level of 11%, at 25°C and 101.3 kPa, do not exceed the following limits:
(i) for an existing incinerator, 180 mg/m3;
(ii) for a new incinerator that has a chamber capacity of
(A) less than 181 kg, 175 mg/m3, or
(B) 181 kg or more, 155 mg/m3.

natural disposal: wildlife consumption of mortalities; normally the least preferred method; used only in appropriate areas of BC and those remote from neighbours

secondary users: rendering plants

mulch: a protective covering spread or left on the ground to reduce evaporation, maintain even soil temperature, prevent erosion, control weeds or enrich the soil; such as leaves or wood residue

mushroom compost: [from the *Mushroom Compost Facilities Regulation*] a growing medium for mushrooms produced through the biological decomposition of organic materials under controlled circumstances

mushroom media: the growing material for mushrooms, produced from composting

fresh media: ready-to-use media from composting

spent media: the growing material after a mushroom crop has been harvested, having no further production potential; is subsequently applied to land as a soil conditioner

Mycorrhizae fungi: a beneficial soil fungus well known to facilitate access to water and phosphorus absorption in corn and many other crops

N

native species: [from the *BC Wildlife Act*] a species that is (a) indigenous to BC, or (b) has extended its range into BC from another part of North America, unless the species was introduced by human intervention or activities, or any part of the extension of its range within North America was aided by human intervention or activities. Native species refer to species that naturally occur in an area, such as antelope sage brush in the Okanagan. Native species include plants and animals

natural flow: see stream

natural stream: watercourses that have not been significantly altered by human activity and are predominantly in their natural state.

natural heating: heat derived from natural sources, such as earth heat or solar heat, including equipment, controls, etc; for a building, water trough, etc

nitrate test: [From the *Code of Practice for Agricultural Environmental Management*] a test for residual levels of nitrates in soil conducted in accordance with section 54 of the AEM

nitrogen: a primary plant nutrient; taken up by plants primarily as nitrate (NO_3^-) or ammonium (NH_4^+)

inorganic nitrogen – ammonium (NH_4^+): common form used by plants; is soluble and found in the liquid fraction of soil

inorganic nitrogen – ammonia (NH_3): a gaseous compound of nitrogen and hydrogen dominant at pH > 7, soluble in water and easily volatized

inorganic nitrogen – nitrate (NO_3^-) and nitrite (NO_2^-): nitrite is an unstable transitional form of nitrate; nitrate does not generally bind to soil particles and is therefore prone to leaching; both can be toxic to fish

organic nitrogen: most of nitrogen in soil (98%) is tied up in organic matter and unavailable to plants

denitrification: a microbiological process where nitrate is reduced resulting in gaseous nitrogen compounds. depending on the environmental conditions and bacterial populations, the process may result in nitrogen or other forms of nitrogen including nitrous oxide and nitrogen oxides; nitrate nitrogen (NO_3^-) is changed to nitrite (NO_2^-) and then to gases, nitrous oxide (N_2O), nitric oxide (NO), and nitrogen (N_2); occurs under anaerobic conditions caused by excessive moisture and/or soil compaction; nitrogen may be lost from the soil to the atmosphere

nitrification: the oxidation (process of combining with oxygen) of ammonium (NH_4^+) to nitrite (NO_2^-) and then to nitrate nitrogen (NO_3^-) in soil by soil bacteria; occurs readily under conditions of warm temperatures, adequate oxygen and moisture, and optimum pH; a vital process in providing nitrogen for plant growth

nitrogen cycle: the continuous recycling of nitrogen in the environment, as shown in Figure 8.2, page 8-4

nitrogen fixation: the process of nitrogen combining with oxygen and hydrogen; a major source of nitrogen for terrestrial ecosystems; may be fixed by various soil organisms; the fertilizer industry fixes nitrogen in manufacturing nitrogen fertilizers

nitrogen oxides (NO_x): air contaminants that contribute to the production of ground level ozone which results in adverse health effects, negatively impacts crop growth and can contribute to acid rain production

nitrous oxide (N_2O): a greenhouse gas produced in the soil from the biochemical reduction of nitrate nitrogen to gaseous nitrogen compounds

non-agricultural waste: waste generated by a non-agricultural operation

Normal Farm Practice: [from *Farm Practices Protection (Right to Farm)* Act] means a practice that is conducted by a farm business in a manner consistent with (a) proper and accepted customs and standards as established and followed by similar farm businesses under similar circumstances, and (b) any standards prescribed by the Lieutenant Governor in Council, and includes a practice that makes use of innovative technology in a manner consistent with proper advanced farm management practices and with any standards prescribed under paragraph (b).

noxious weed: [from *Weed Control Act*] a weed designated by regulation to be a noxious weed, and includes the seeds of the noxious weed; specified in *Weed Control Regulation*, Schedule A

nuisance: a source of annoyance, such as noise, odour or dust

nursery: production of young plants for transplanting

container nursery: nursery plants grown in containers

nutrient: (a) a chemical element that is essential for growth, development or reproduction of living organisms (i.e., plants, animals); (b) as a pollutant, any element or compound that fuels abnormally high organic growth in aquatic ecosystems, such as nitrogen or phosphorous causing eutrophication of a lake (also see plant nutrients)

Nutrient Management Plan: a technical process that optimizes the relationship between land-based application of nutrients, farm management techniques, crop requirements and land use to maximize on site nutrient use and minimize environmental impact; the process attempts to balance nutrients on an individual crop or field basis as well as on a whole farm basis; refer to page 6-11

nutrient applicator calibration: a detailed method of ensuring nutrient application is uniform and in appropriate amount

nutrient cycle: the movement of nutrients from plants to animals and back, such as the growth of forage which is grazed by livestock whose manure is spread onto the forage land for crop growth

O

odour: the term used to describe the effect of various substances on the human olfactory system. Odours are generally characterized using the four basic parameters of detection threshold, intensity, persistency, hedonic tone (subjective experience). While "odour" is listed as a possible air contaminant within the *Environmental Management Act*, the *Code of Practice for Agricultural Environmental Management* clarifies that an odour does not interfere with the normal conduct of business if it is produced in carrying out an agricultural operation in accordance with normal agricultural practices, and ammonia, sulphur and other harmful compounds associated with the odour do not settle out of the air into a watercourse or across a property boundary

at a level that would cause injury, interference, discomfort or damage

off-farm: any activity, construction or practice that occurs on land other than a farm

on-farm: any activity, construction or practice that occurs on land of a farm, either at a farmstead site or at farm fields

direct farm sales: sale of farm products directly to the consumer on-farm

on-farm processing: processing of farm products, such as washing, grading, packaging, or processing to increase product value, such as making wine or ice cream

opacity: the degree to which a discharge of an air contaminant reduces the passage of light or obscures the view of a background object; expressed as zero percent (transparent) to 100 percent (opaque)

open fires: as regulated by the *Wildfire Act*; within 1 km of forest land or grass land (as outlined in Appendix A, page A-15) (see also outdoor burning)

Danger Region: three provincial regions (*Wildfire Regulation*, Schedule 1)

Fire Danger Class: five classes depending on the Buildup Index and the Fire Weather Index (*Wildfire Regulation*, Schedule 2)

Buildup Index: [from *Wildfire Regulation*] five levels the same as in the Canadian Forest Fire Weather Index System (Canadian Forest Service)

Fire Weather Index: [from *Wildfire Regulation*] three provincial regions as defined in the Canadian Forest Fire Weather Index System (Canadian Forest Service)

Restrictions on High Risk Activities: requirements regarding the top three Fire Danger Classes (*Wildfire Regulation*, Schedule 3)

organic: (a) referring to, or derived from, living organisms; (b) in chemistry, any compound containing carbon

inorganic: matter other than plant or animal, and not containing a combination of carbon/hydrogen/oxygen as in living things

organic matter: (1) [from *Organic Matter Recycling Regulation*] those materials, other than agricultural wastes, set out in Schedule 12 that are suitable for composting (also see **soil organic matter**). This includes: animal bedding, biosolids, brewery waste, winery waste, domestic septic tank sludge, fish waste, food waste, hatchery waste, manure, milk processing waste, plant matter derived from processing plants, poultry carcasses, red-meat waste, untreated and unprocessed wood residuals, whey, and yard waste.

organic soil subsidence: a gradual lowering of the surface elevation of an organic muck soil, or a reduction in the thickness of organic matter. The organic matter is lost or broken down in a number of ways: wind erosion , water erosion , biological oxidation (drainage and tillage add air to the soil, speeding the degradation of organic materials by aerobic bacteria.)

organism: a living thing

outdoor burning: the combustion of material with or without control of the combustion air and without a stack or chimney to vent the emitted products of combustion to the atmosphere (see also open fires)

open burning: [from *Open Burning Smoke Control Regulation*] the combustion of vegetative debris using an open fire, other than for a domestic or an agricultural purpose, if all of the vegetative debris is branches or other pieces of vegetative debris, with or without leaves, each branch or piece of which is less than 3 cm in diameter, or a campfire.

open fire: the combustion of material without using a stack or chimney to vent the emitted products of combustion to the atmosphere.

smoke: the gases, particulate matter and products of combustion emitted into the atmosphere when debris is open burned

ventilation index: a measure of the ability of the atmosphere to vent or disperse smoke or other particulates: 0-33 is poor; 34-54 is fair; 55-100 is good (see **inversion**)

outdoor livestock area: see **confined livestock area, seasonal feeding area**, and **grazing area**

overland flow: water that moves over the land surface (see also **runoff**)

concentrated flow: surface water flow that accumulates or converges into well-defined channels; influenced by soil and soil cover; depending on the grade (water velocity) may lead to soil erosion

sheet flow: surface water flow that is spread out like a sheet on the land

overwintering: see **seasonal feeding area**

oxygen demand: the need for oxygen to meet the needs of biological and chemical processes in water

BOD or **biological oxygen demand;** a measure of dissolved oxygen required by micro-organisms in the biochemical oxidation of organic matter, such as wastes in water (also see **dissolved oxygen**)

ozone: a form of oxygen with a sharp smell

ground level ozone: formed in the presence of sunlight by reactions between nitrogen oxides and volatile organic compounds (VOCs); ground level ozone is a pollutant that along with other substances forms smog and can be harmful to plant, animal and human health

ozone depleting substance: a substance listed in Class I or Class II of Schedule A of the *Ozone Depleting Substances and Other Halocarbons Regulation*

ozonosphere: also know as 'the ozone layer'; the atmospheric region about 40 km above Earth characterized by a high ozone content; is affected by ozone depleting substances

P

paddock: an outdoor livestock area; may be either a confined livestock area (horse paddock) or a grazing area (pasture)

pasture: (a) a grazing area enclosed and separated from other areas by fencing or other barriers; (b) the management unit for grazing land

intensively-managed pasture: forage production is maximized with fertilizer and irrigation, as required, for continuous livestock grazing during the crop growing season

particulates: solid particles in the atmosphere either formed in the air by reactions among gasses or injected into the air by processes on the ground. (for particulates in water see **suspended solids**)

parts per million: the number of "parts" by weight of a substance per million parts of water (written as ppm); used to represent pollutant concentrations

pathogen: an organism capable of causing disease in humans, animals or plants

peak flow: see irrigation and stormwater management

percent slope: the rise in land (vertical distance from the horizontal) divided by the *run* (horizontal distance) expressed as a percentage; e.g., a 5% slope would be a 5 m rise over 100 m length

percolation: the downward movement of water through layers of soil, rock or other material

perennial: a plant that lives for more than two years

perimeter drain: a piping system to carry clean roof water and soil moisture away from a building foundation, for structural-integrity purposes

Tracing dye: such as a water soluble disodium salt of fluorescein, used to test if water flow is connected between "clean" drains and "dirty" drains

permanent storage structure: [Code of Practice for Agricultural Environmental Management]: a structure designed and built for storing, before their use or disposal, agricultural by-products or agricultural products, wood residue, or natural or synthetic materials used for the purposes of an agricultural operation, whether or not produced by the agricultural operation, and does not include equipment used to transport these items or dispose of them, or to apply them to land

permeability: a measure of the relative ease with which water will move through soil or rock

impermeable: see impervious

Pest Management Plan: [from the *Pesticide Control Act*] a plan that describes (a) a program, for managing pest populations or reducing damage caused by pests, based on integrated pest management, and (b) the methods of handling, preparing, mixing, applying and otherwise using pesticides within the program

pest: [from the *Integrated Pest Management Act*] an injurious, noxious or troublesome living organism, but does not include a virus, bacteria, fungus or internal parasite that exists on humans or animals (also see weed)

exotic pest: non-native species of pests

invasive organism: species that were absent in undisturbed portions of the original landscape, such as invasive plants that will invade or increase following disturbance or continuous heavy grazing of the native plants

pest record: a record of pest monitoring and of the control methods used on-farm

pesticide: [from the Integrated Pest Management Act] is a micro-organism or material that is represented, sold, used or intended to be used to prevent, destroy, repel or mitigate a pest, and includes (a) a plant growth regulator, plant defoliator or plant desiccant, (b) a control product as defined in the *Pest Control Products Act* (Canada), and (c) a substance that is classified as a pesticide by regulation, but does not include micro-organisms, materials, substances or control products excluded from this definition by regulation

pesticide application equipment calibration: a four step process of ensuring that pesticide application is uniform and at the appropriate rate; the steps are setting up the equipment, measuring the delivery rate, adjusting delivery rate, and for sprayers, calculating how much pesticide to add to the tank; refer to Equipment Calibration, page 5-16

pesticide applicator certificate: (a) [from the *Integrated Pest Management Act*] a certificate issued to a person who has passed an examination, set by the administrator, in the appropriate applicator category; (b) required for purchase and use of certain pesticides, as listed in *Crop Production Guides*, as shown on page 5-6

pesticide application record: a record of all pesticide applications including the site, date, pesticide and amount used, crop stage, harvest date, application method, spray volume, weather observations, and precautions followed (eg. Buffer zones)

pesticide groupings: pesticides are grouped in four ways; according to (1) the pest they control (fungicides, herbicides, insecticides, miticides, nematicides, rodenticides, molluscicides), (2) the way they enter or affect the target pest (contact or systemic), (3) their chemical structure grouping, (4) resistance management

pesticide resistance: a build-up of immunity to a pesticide, usually due to overuse or appropriate use over an extended period

Pesticide Use Permit: permit required under the *Pesticide Control Act* for application of pesticide

rinsing pesticide containers: see rinsing method

pH: the numeric value that describes the intensity of the acid or alkaline condition of a substance; a scale range of 0 to 14, where 7 is neutral, less than 7 is acidic, more than 7 is alkaline

phosphorus: a primary plant nutrient; its availability depends, among other factors, on the soil pH. Phosphorus-affected areas are listed in Schedule A of the AEM however there is no concentration threshold associated with these areas. Surface water, or land that is next to or hydraulically connected to surface water, that
(a) is located within the boundaries of an area shown on a map listed in the Code of Practice for Agricultural Environmental Management Schedule A [Phosphorus-affected Areas], and
(b) has been, or may be, adversely affected by high phosphorus loading due to the sensitivity of the receiving environment

photosynthesis: the manufacture by plants of carbohydrates and oxygen from carbon dioxide and water in the presence of chlorophyll, using sunlight as an energy source

pitless adaptor: see well casing

plant age mix: see range health

plant nutrients: chemical elements required for plant growth; carbon/hydrogen/oxygen, taken primarily from the air or water, plus others divided into three groups (primary and secondary macronutrients and micronutrients), normally absorbed from the soil by plant roots

- **carbon/hydrogen/oxygen:** basic plant life building blocks
- **primary plant nutrients:** nitrogen, phosphorous, potassium
- **secondary plant nutrients:** calcium, magnesium, sulphur
- **micronutrients:** iron, manganese, boron, chlorine, zinc, copper, molybdenum, and chlorine

plough pan: a compacted layer, restricting root and water movement, which may form in some soils just below the tilled area after several years of primary tillage to the same depth (also see tillage)

point bar: collection of deposited slit, soil, and gravel found on the inside of meanders in a stream

point of diversion: see diversion

pollutant: material which causes harm to organisms directly or to their environment

pollution: [from the *Environmental Management Act*] the presence in the environment of substances of contaminates that substantially alter or impair the usefulness of the environment (also see contamination and deleterious substance)

- **non-point source:** pollution discharged over a wide land area with no well-defined source, such as erosion from disturbed soil; may be difficult to identify and control
- **point source:** pollution discharged from a well-defined location, such as a pipe

porosity: the percentage of the volume of a material that is occupied by pore spaces; is an indication of the capacity of the material to hold water

potassium: a primary plant nutrient

potable water quality: see water quality

potential contaminant: see contaminant

precipitation: (1) [from the *Organic Matter Recycling Regulation*] as determined by the Canadian Atmospheric Environmental Service Reports of Environment Canada; (2) the process by which water vapour condenses in the atmosphere or onto a land surface in the form of rain, hail, sleet or snow

- **high precipitation:** from [*Code of Practice for Agricultural Environmental Management*]: an area that has, on average, precipitation of 600 mm or more in total during the period that begins on October 1 and that ends on April 30 of the next year
- **low precipitation:** less than 600 mm precipitation October 1st to April 30th inclusive

pressure relief valve vent cap: see fuel storage

probable source of contamination: see well

problem wildlife: see wildlife

processing waste: [from the *Code of Practice for Agricultural Environmental Management*] is solid waste, semi-solid waste and wastewater, as those terms are defined in the Code of Practice for the Slaughter and Poultry Processing Industries

productive conservation: see conservation

protective base: a layer of soil that is at least 30 cm thick, and has a saturated hydraulic conductivity that is less than or equal to 10-7 cm/s, or any material that does not allow leaks or liquids to soak through, such as: concrete or asphalt pad; a tarp; synthetic liner; or engineered compacted soil

pugging: tracks of large animals left in soft soil; wet clayey or silty soil has the consistency to hold pug marks; upon drying, pugged areas have a honeycombed appearance and a hard, dry, irregular surface difficult to walk across (also see **hummocking**)

puddled soil: dense, massive soil artificially compacted when wet and having no aggregated structure. The condition commonly results from the tillage of a fine-textured or clayey soil when it is wet

R

range or **rangeland:** land supporting vegetation that is grazed or that has the potential to be grazed, and is managed as a natural ecosystem

- **forested range:** woodlands having understory vegetation suitable for grazing
- **grassland range:** lands on which the vegetation is dominated by grasses, grass-like plants, or forbs

range health: on a site, the combination of the plant community, the layers of plants present, the moisture retention, soil erosion and invasive plants present

- **plant age mix:** the type, amount and age of plants at a site; a range health indicator

rangeland: land on which the native vegetation is predominately grasses, grass-like plants, forbs, or shrubs

reach: length of a stream with similar characteristics, selected for study or observation

receiving waters: watercourses that receive stormwater, runoff, or wastewater discharges

recharge: see groundwater

reclaimed water: [from the *Municipal Sewage Regulation*] effluent from a sewage facility that is suitable for a direct designated water use or a controlled use

refuse: [from the *Environmental Management Act*] discarded or abandoned materials, substances or objects

- **refuse disposal site:** a site selected, planned and managed in such a way to receive farm refuse in an environmentally sound manner
- **refuse records:** a record of the location, amount and type of material in on-farm refuse sites

renewable resource: natural resource which can be re-established mainly because of its ability to reproduce, such as trees or animals, or water, due to the water cycle

reservoir: a water impoundment requiring a constructed dam, such an artificial lake, pond or basin used for the storage, regulation and control of water, silt, debris and other liquid or liquid-carried material (also see **dugout**)

residue: see **crop production**

return period: the frequency of occurrence of a hydrologic event whose intensity and duration can be expected to be equalled or exceeded; usually expressed in years, such as "the reservoir will fill four years in five"

reuse and recycle:

- **reuse of farm waste:** the first step in using waste, this is a process where a waste is used again for its original purpose or for a purpose similar to the original, such as silage bags reused as tarps to cover hay
- **recycle of farm waste:** the second step in using wastes, this is a process where a waste can no longer be used for its original or similar purpose but is reprocessed into a new product, such as metal equipment parts being recycled as scrap iron
- **recyclable material:** [from the *Environmental Management Act*] a product or substance that has been diverted from disposal, has no reuse value in its present form and satisfies at least one of the following criteria: (a) is organic material that has been diverted from residential, commercial or institutional sources and is capable of being composted, or is being composted, at a site; (b) is managed as a marketable commodity with an established market by the owner or operator of a site; (c) is being used in the manufacture of a new product that has an established market or is being processed as an intermediate stage of an existing manufacturing process; (d) has been identified as a recyclable material in a plan

revetment: installation of materials such as trees, boards, etc., that dissipate or deflect a stream's energy protecting stream banks from erosion

right of way: includes (a) an easement, (b) a statutory right of way, and (c) a limited interest in the land or a licence or a permit that grants the right to construct, operate or maintain works of a lineal nature on, over or under land

rill: see **erosion**

rinsing method: a requirement of the *Hazardous Waste Regulation* for empty pesticide containers as outlined in Table 5.2, page 5-12

pressure rinse: [from the *Hazardous Waste Regulation*] to clean by means of pressurized spraying of an appropriate solvent into an empty container for at least 30 seconds so that all interior surfaces of the container are rinsed

rinse: [from the *Hazardous Waste Regulation*] to introduce an appropriate solvent into an empty container in an amount not less than 20% of its volume, to close and shake the container so that the solvent makes contact with all interior surfaces, and to open and empty the container

triple rinse: a prescribed rinse method for glass pesticide containers

riparian, area or zone: (a) transition area between watercourses and the surrounding, usually drier, upland areas, (b) the area of land that is adjacent to a stream, river, lake or wetland, and contains vegetation that, due to the presence of water, is distinctly different from the vegetation of adjacent upland; in dry locations, is easily identified by the green vegetation in contrast to the browns and yellows of the drier uplands

riparian continuity: where riparian vegetation is uninterrupted by gaps, breaks, or areas of bare ground

riparian vegetation: plant communities dependent upon the presence of free water near the ground surface (high water table)

riparian condition: an assessment of condition leads to an evaluation of riparian health; three levels of functioning condition are:

proper functioning condition: healthy riparian areas with the most stable, non-eroding lands and the best fish habitat

functional at risk: areas that are lacking in some healthy features, and will experience some stream bank erosion and lowering of the water table and fish habitat at risk

non-functional: areas that have few if any healthy features, and which are most likely to have highly eroding banks, and which over time will experience channel deepening and subsequent lowering of the water table and poor fish habitat

river: a stream of water of substantial volume (also see **stream**)

roads: farm access used for normal farm operation

critical slope: except for short lengths, road grade or slope should not exceed 10 percent (1 m fall in 10 m length) to reduce soil erosion

natural contours: where possible to construct, a road using the existing land contour (along a slope) is preferred over one crossing contours (up or down a slope) to reduce soil erosion, etc.

rockwool: an inert, non-polluting, non-degradable spun-rock fiber manufactured from lava rock; used as a soilless rooting media in hydroponic greenhouse systems and nursery crops

root zone: depth of soil that plant roots readily penetrate and in which the predominant root activity occurs

runoff: [from the *Code of Practice for Agricultural Environmental Management*] any of the following, if flowing along the surface of the ground:
(a) water from equipment, washing or other sources;
(b) precipitation;
(c) meltwater from snow, hail or ice.

Also called overland flow; it is the portion of rainfall precipitation (stormwater), snow melt, or irrigation water that moves across the land as surface water flow; occurs when the stormwater amount, snow melt, or irrigation application rate, exceeds the soil infiltration rate, or from the surfacing of subsurface flows before they reach a receiving watercourse or a defined drainage channel

runoff filtration: standing crops and crop residues decrease water velocities resulting in fewer suspended solids and dissolved chemicals being carried by runoff water

runoff storage: containment of runoff (to prevent its entry into groundwater or watercourses) until proper disposal can be done; usually contains little solid material

stormwater: one source of runoff (see *stormwater*)

yard runoff: runoff from livestock yards, possibly containing manure or other contaminates

S

seasonal feeding area: [from the *Code of Practice for Agricultural Environmental Management*] an area, other than a confined livestock area, confined poultry area, grazing area or temporary holding area,
(a) used for forage or other crop production, and
(b) used seasonally for feeding livestock or poultry that are sustained primarily by supplemental feed

seasonal feeding location: the site within a seasonal feeding area where feeding is actually occurring, usually during the non-crop growing season, often in winter; these sites must be moved through the entire area to ensure manure is properly distributed for the following years' crop needs (note that manure spreading in winter is otherwise not recommended)

free range: an outdoor seasonal feeding area used by poultry

overwintering: a seasonal feeding area used during the non-growing season to feed livestock

perennial versus annual crop: considerations that must be made when managing a seasonal feeding area; some such areas on annual crop land may be characterized as confined livestock areas and must be managed as such

seasonal high water table: [from the *Code of Practice for Agricultural Environmental Management*] the 10-year average highest level to which, at any time during a year, the water table below the surface of the ground rises

secondary containment: a system whereby leakage from, or failure of, a storage facility, piping system, etc., is prevented from escape into the environment; may be a requirement or a beneficial practice for materials that are potential contaminants

liquid manure secondary containment: (a) a method of capturing leaks while in storage; (b) when piped near a watercourse, a second, larger diameter pipe enclosing the manure pipe to collect and direct leaks away from the watercourse

petroleum secondary containment: double-walled tank used for an above- or below-ground storage, or impervious curb and floor under above-ground tanks

seepage: the infiltration and percolation of surface water from overland flow, ditches, channels, or other watercourses

seepage area: a surface area that frequently emits groundwater; it is usually found at the upper contact between a lower impermeable layer and an upper permeable layer

sediment: matter settled to the bottom of a watercourse

sediment load: the amount of sediment carried by running water or wind

self closing nozzle: see fuel storage

self-sealing layer: a layer of soil, or mixed soil and manure, that forms between the manure pack and the underlying soil in a confined livestock area, creating a barrier that does not allow leaks or for liquids to soak through

sensitive area: an area on or near a farm that may need to be protected from an unreasonable adverse affect caused by a farm activity; the sensitive area may be an area identified as wildlife habitat, habitat of a specific species recognized for its biodiversity value, human dwellings and activity areas, non target crops in the case of pesticides and nutrient application, or aquatic and riparian areas

septic field: the part of a sewage system that receives the septic tank discharge and disposes of it (also see sewerage system)

septic tank: [from the *Sewerage System Regulation*] a water tight container for receiving, treating and settling domestic sewage (also see sewerage system)

holding tank: [from *the Sewerage System Regulation*] a water tight container for holding domestic sewage until the domestic sewage is removed for treatment

septic tank maintenance: the periodic removal (usually every 3 to 5 years) of accumulated solids from a septic tank to prevent their moving to the septic adsorption field, thus maintaining the effectiveness and extending the life of the field

set-a-side: an area of cultivated land which has been seeded to a mixed stand of perennial grass and legume forage species; the land is left unharvested for a period of 1 to 5 years specifically for the benefits of soil conservation and wildlife habitat

setback: [from the *Code of Practice of Agricultural Environmental Management*] the distance between a structure or place where an activity is performed for the purposes of an agricultural operation, and a drinking water source, a watercourse or a property boundary

building setback: a distance set as a guideline to reduce risks to a watercourse from a farm building, usually chosen based upon the type of watercourse

sewerage system: [from the *Sewerage System Regulation*] a system for treating domestic sewage that uses one or more treatment methods and a discharge area, but does not include a holding tank or privy(also see septic tank and septic field)

sheet flow: see overland flow

shelterbelt: windbreak of living trees and shrubs established and maintained for protection of farm lands or buildings

shrub: woody plants that are usually multi-stemmed

silage: see livestock feed

siltation: the accumulation of sediments on the bottom of watercourses

sinuosity: the amount of curvature in a stream channel (also see meanders)

sleighfoot: a system to apply manure in bands on the soil surface underneath a grass canopy

slope: a slant or incline of the land surface, measured in degrees from the horizontal, or in percent (change in elevation per 100 of the same units of horizontal distance)

soil: a mixture of living organisms (such as bacteria, fungi, plant roots), mineral particles, water, air, and dead organic matter; includes the entire mantle of unconsolidated material above bedrock; provides nutrients, moisture, and anchorage for land plants

- **soil aggregates:** a group of soil particles held by cohesion, in such a way that they behave as a unit
- **soil amendments:** includes all materials managed to provide nutrients for crops (fertilizers) and/or all materials managed for their beneficial impact on the biological, physical or chemical nature of the soil (soil conditioners)
- **soil buffering capacity:** the ability of soil to resist a change in its pH
- **soil cultivation:** tillage to prepare land for seeding or transplanting and later to control weeds and loosen the soil
- **soil compaction:** the loss of pore structure and aggregate stability with soil, caused by traffic and tillage, particularly in wet soil; reduces the movement of water, air, nutrients and soil microbes in soil
- **soil conditioner:** (1) [from the *Organic Matter Recycling Regulation*] (a) managed organic matter that measurably improves specific chemical or physical characteristics of soil or chemical or physical processes for a given use, or (b) a plant growth medium; (2) materials that contain limited amounts of nutrient, but are managed for their beneficial impact on the biological, physical or chemical nature of the soil, but not managed as fertilizer (also see fertilizer)
- **soil conditioner versus fertilizer:** materials that have properties that allow them to be used as both a fertilizer and a soil conditioner should be managed as a fertilizer; see Tables 6.4 and 6.5, pages 6-6 and 6-7
- **soil moisture:** see soil water
- **soilless medium:** a material that is manufactured for the growing of plants
- **soil organic matter:** organic matter that has become part of the humus portion of the soil (not crop residue or organic matter on the soil surface)
- **soil quality:** a measure of soil health, having adequate pore space and nutrients, high level of organic matter, good drainage, and an active soil life (such as earthworms, fungi, bacteria)
- **soil salinity:** the relative amount of soluble salts present in the soil expressed in terms of percentage, parts per million, or dS/m; salt in excess can have negative impacts on soil quality and crop production; see electrical conductivity
- **soil structure:** the way groups of soil particles (aggregates) are grouped together; a soil that has lots of small aggregates, lots of pore space, and does not crust, has good soil structure
- **soil texture:** the relative portions of clay, sand or silt (the mineral particles) in a soil; described as "sandy loam", "silty clay", etc.
- **soil water:** water in the soil above the water table (also see water table)

soil fumigation: pesticide application to the soil to control soil borne pests such as nematodes

soil-based yard: a confined livestock area where livestock use and climatic conditions do not require hard-surfaced yards; is best suited to sites that have both of the following (refer to Worksheet #1, page 44) (also see confined livestock area):

- **low precipitation:** see precipitation
- **low livestock density:** areas of 2 m^2 or greater per 100 kg of livestock for day use, or 6 m^2 or greater per 100 kg of livestock for continuous use

solid: [from the *Code of Practice of Agricultural Environmental Management*] a material that contains more than 18% solid matter by mass, and will not flow when piled

special management areas: areas along agricultural land boundaries with residential or other areas that have restricted farming practices so as to reduce neighbour conflicts

special waste: see hazardous waste

species: [from the *Wildlife Amendment Act 2004*] a species, sub-species, variety or genetically or geographically distinct population of (a) animals, (b) fish, (c) plants, or (d) other organisms, except bacteria and viruses

aquatic species: [from the *Species at Risk Act*] a wildlife species that is a fish or a marine plant, as defined in the federal *Fisheries Act* (see fish, and see marine plant)

endangered species: [from the *Species at Risk Act*] means a wildlife species that is facing imminent extirpation or extinction [from the *Wildlife Amendment Act 2004*] means a species designated by regulation under section 6(2) or (4) as an endangered species

extirpated species: [from the *Species at Risk Act*] a wildlife species that no longer exists in the wild in Canada, but exists elsewhere in the wild [from the *Wildlife Act*] means a species designated by regulation under section 6(1) as an extirpated species

native species: [from the *Wildlife Act*] a species that (a) is indigenous to BC, (b) has extended its range into BC from another part of North America, unless (i) the species was introduced to North America by human intervention or activities, or (ii) any part of the extension of its range within North America was aided by human intervention or activities

species at risk: [from the *Species at Risk Act*] an extirpated, endangered or threatened species or a species of special concern; listed in the Act

species of special concern: [from the *Species at Risk Act*] a wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats

threatened species: [from the *Species at Risk Act*] a wildlife species that is likely to become an endangered species if nothing is done to reverse the factors leading to its extirpation or extinction [from the *Wildlife Act*] means a species designated by regulation under section 6(2) or (4) as an endangered species

wildlife species: [from the *Species at Risk Act*] a species, subspecies, variety or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and (a) is native to Canada; or (b) has extended its range into Canada without human intervention and has been present in Canada for at least 50 years

specified risk material (SRM): the tissues of ruminant animals that are of highest risk of transmitting bovine spongiform encephalopathy (BSE)

spent mushroom media: see mushroom media

spill: (a) [from the *Environmental Management Act*] the introduction of a substance into the environment, whether intentional or unintentional, otherwise than as authorized under this Act; (b) [from the *Spill Reporting Regulation*] release or discharge, except as authorized or allowed, into the environment of a substance in an amount equal to or greater than the amount listed in column 2 of the Schedule of this *Regulation* for that substance

fertilizer spill: [from the *Spill Reporting Regulation*] amounts exceeding 50 kg or 50 litres must be reported

manure spill: [from the *Spill Reporting Regulation*] any polluting substance in amounts exceeding 200 kg or 200 litres must be reported

pesticide spill: [from the *Spill Reporting Regulation*] amounts exceeding 5 kg or 5 litres must be reported

petroleum spill: [from the *Spill Reporting Regulation*] amounts exceeding 100 litres must be reported

spinning discs: a system to apply manure onto soil that uses spinning discs to throw and spread the manure

splash plate: a system to apply manure on the soil surface by having pumped manure hit an inclined plate causing the manure to spread out in a fan shape

spoil bank: excavated soil piled along a canal or ditch; may act as a berm (see berm)

spray drift: see off target

spring: groundwater flows that become surface water flows upon exiting from the ground (also see watercourse)

sustainable: land management practices that provide a flow of goods and services from a ecosystem over long periods of time without degradation of the site or decline in yields

stewardship: the conducting, supervising or managing of something, especially the careful and responsible management of something entrusted to one's care; for example, stewardship of biodiversity on agricultural land

stewardship crops: see crops

stockpiled feed: forage grown throughout the summer that is saved expressly for grazing during the dormant season (fall, winter, spring)

stormwater: the portion of runoff that originates as rainfall precipitation; is one source of runoff (also see runoff)

- **detention pond:** a pond constructed to collect peak stormwater flow and then release the water at a reduced rate, no greater than historic flow rates
- **peak flow:** when stormwater is flowing at a maximum rate; if the peak flow is increased above historic levels it may cause erosion, habitat loss, etc.
- **stormwater management:** ensuring peak flow rates from a farm during storm events are not increased from those prior to a farm development, such as by the use of detention ponds

stream: [from the *Water Sustainability Act*] a natural watercourse, including a natural glacier course, or a natural body of water, whether or not the stream channel of the stream has been modified, or a natural source of water supply, including, without limitation, a lake, pond, river, creek, spring, ravine, gulch, wetland or glacier, whether or not usually containing water, including ice, but does not include an aquifer. Any body of running water moving under gravity through a clearly defined natural channel to progressively lower levels (also see watercourse)

- **ephemeral stream:** a channel (usually vegetated) where water flows only during and immediately after rainfall or snowmelt, normally for less than 30 consecutive days
- **intermittent stream:** a stream (usually unvegetated) with distinct channel development in which water flows during storms or the wet season but dries up during the dry season or drought, usually flows continuously for a month or more; may be either spring-fed or surface fed
- **permanent stream:** a well-defined channel where water usually flows all year
- **natural flow:** the flow as it would be if unaltered by upstream diversion, storage, import, export, or change in upstream use caused by development

stream bed: see stream channel

stream channel: (a) [from the *Water Sustainability Act*] the bed of the stream and the banks of the stream, both above and below the natural boundary and whether or not the channel has been modified, and includes side channels of the stream

stream crossing: a means, natural or constructed, whereby livestock and/or machinery may cross a watercourse

- **in-stream or bed-level:** a crossing constructed at the bottom of a stream with a erosion-resistant surface; water flows over the structure and users must cross through the water
- **over-stream or mid-level:** a crossing constructed above the normal water level; water flows under or through the structure and users cross above the water

stream scour: see erosion

strip cropping: the alternation of crop rows and/or forages across the slope of the land to slow water runoff and reduce erosion

structurally sound: see manure storage facility

subsoilers: soil-working tool operated below normal tillage depth to break up impervious soil layers and improve root and water penetration

sufficient capacity: see manure storage facility

sulphur oxides (SOX): air contaminants resulting from the combustion of fossil fuels or biomass to fuel heating appliances or boilers that contribute to acid rain

surface water: water flowing or stored on the earth's surface (also see groundwater)

- **surface water contamination potential:** the potential for contaminants to be transported by water (runoff) into watercourses; influenced by the risk of contaminants to leave storage areas, the distance between contaminants and watercourses, and the pathways from contaminants to watercourses (such as slope of the land, etc.)

surface water flow: see runoff

suspended solids: solids that are not in true solution and that can be removed by filtration

swirl chamber: see windbreak

T

target & non-target: target pests are those which a pesticide is specifically designed to kill; anything else affected by the pesticide is non-target

- **off target:** when applying pesticides, indicates unwanted movement of pesticide to environmentally sensitive areas; typically by:
  1. **direct transport:** movement of soil, vegetation, and other materials that contain pesticide residue
  2. **drift:** movement of spray droplets or vapour in the air
  3. **leaching:** movement in the water through soil
  4. **runoff:** in water or by pesticide bound to eroding soil

temporary holding area: [from the *Code of Practice for Agricultural Environmental Management*] an outdoor holding area on rangeland where livestock are confined by structures while being collected from a grazing area

temporary field storage: [from the *Code of Practice for Agricultural Environmental Management*] the storage of solid agricultural by-products or wood residue outside in a field, but not in a structure, before their use or disposal

thalweg: the deepest part of a stream channel (from *Thal* = valley, and *weg* = path)

tillage: mechanical soil-stirring action for nurturing crops by providing suitable soil environment for seed germination, root growth, and weed and moisture control. The removal of crop residues from the surface can have negative impacts to soil and water conservation. Several alternatives exist, including conservation tillage

- **conservation tillage:** a method which reduces the amount of crop residue incorporated or removed into the soil, but leaves 30% or more of the soil surface covered with crop residue after planting; objectives are soil moisture retention, reduced compaction, and saving of fuel, time, and labour
- **minimum tillage:** a system of farming, primarily used in annual crops, that uses the least number of tillage operations to prepare seedbeds, plant crops, control weeds and harvest the crop; can be as few as one tillage pass which involves the application of fertilizer and the planting of the crop; herbicides are often used to suppress weeds; objectives are to save fuel, time, labour, and moisture, and reduce soil compaction
- **primary tillage:** first operation in preparing cropland, reaching full depth of intended root zone, unless subsoilers are used (also see plough pan and subsoilers)
- **secondary tillage:** follows primary tillage to prepare soil for planting or to control weeds; usually not as deep as primary tillage

timing window: indicate when it is appropriate to proceed with the proposed development in water bodies or watercourses. These timing constraints typically coincide with critical periods in the life cycle of fish (reproduction, incubation and nursery activities)

topography: description of a landscapes' features such as hills, valleys, rivers, etc.

toxin: a poison produced by a living organism

transpiration: the process by which water absorbed by plants, usually through the roots, is evaporated into the atmosphere from the plant surface, principally from the leaves

treated wood: wood with chemicals added to slow decay

- **water-based preservatives:** preservatives which do not present a significant leaching problem, such as chromated copper arsenic
- **oil-based preservatives:** preservatives which leach from wood, such as creosote

triple rinse: see rinsing method

T-sum: the accumulated mean daily temperatures (in °C) above zero, starting on January 1 (below-zero temperatures are ignored); used as a method to determine when to make the first application of nitrogen fertilizer in the spring; refer to web site

https://farmwest.com/climate/tsum

U

ungulate: a mammal having hooves

upland: the area away from the riparian area that shows no effects of the riparian moisture; in dry locations, is easily identified by the brown and yellow vegetation in contrast to the green of the wetter riparian area; farm activities in the upland can impact riparian areas and watercourses

used oil: see waste oil

V

vector: [from the *Code of Practice of Agricultural Environmental Management*] an organism that is capable of transmitting a pathogen from one animal, place or thing to another

ventilation: the movement of air through a farm structure to maintain adequate conditions for livestock or plants; removes moisture, excess heat odours and gases, air-borne dust, and provides fresh air

- **natural ventilation:** the use of fixed and adjustable openings in a building, along with natural site and environmental conditions, to achieve air movement

ventilation index: see open burning

volatile organic compounds (VOC) organic chemicals released from manure, some crops, some pesticides and petroleum products; may contribute to the production of ground level ozone and the formation of fine particulate matter in the presence of other compounds

volatilize: the process of chemicals moving from the liquid phase to the gaseous phase

vulnerable aquifer recharge area: [from the *Code of Practice of Agricultural Environmental Management*] is land that is located within the boundaries of an area shown on a map listed in Schedule B, and from which surface water may infiltrate the ground to reach an aquifer that is, due to the nature of the overlying soil layers, highly or moderately vulnerable to pollution or contamination from the land surface, or is, or is at risk of being, adversely affected by nitrates

W

waste: [from the *Environmental Management Act*] includes air contaminants, litter, effluent, refuse, biomedical waste, hazardous wastes, and any other substance designated by the Lieutenant Governor in Council

waste discharge: the introduction of a waste into the environment

- **waste discharge approval:** [from the *Environmental Management Act*] a director may approve the introduction of waste into the environment for a period of up to 15 months without issuing a permit
- **waste discharge permit:** [from the *Environmental Management Act*] a director may issue a permit authorizing the introduction of waste into the environment subject to requirements for the protection of the environment that the manager considers advisable

waste oil: [from the *Hazardous Waste Regulation*] automotive lubricating oil, cutting oil, fuel oil, gear oil, hydraulic oil or any other refined petroleum based oil or synthetic oil where the oils are in the waste in a total concentration greater than 3% by weight and the oils through use, storage or handling have become unsuitable for their original purpose due to the presence of impurities or loss of original properties; under the *Hazardous Waste Regulation* cannot be applied to roads for dust suppression

wastewater: [from the *Code of Practice for Agricultural Environmental Management*] includes the following: (a) wastewater from flush barns and mushroom growing barns and pads; (b) wastewater from washing, grading or packaging agricultural products; (c) milk house wastewater and milk-based waste; (d) used or recycled water from irrigation or fertigation

water: [from the *Environmental Management Act*] includes groundwater (as defined in the *Water Sustainability Act*) and ice

water bar: an obstruction to divert water from the surface of a road or trail onto an adjacent vegetated area

water cycle: see hydrologic cycle

water intake: structure for diverting surface water into an open ditch, subsurface drain or pipeline; is sized for the expected flow and is fish-protected as required

- **intake maintenance:** work required to ensure the operation of an intake; must be conducted (methods and timing) to minimize impacts to riparian areas and water quality

water licence: a legal document issued under the *Water Sustainability Act* which specifies the terms and conditions under which a right to use (surface) water is granted

- **appurtenant:** a water licence belongs, or is appurtenant, to the land of the licensee; on the sale of the land the licence is transferred to the new landowner
- **conditional licence:** a licence that authorizes the construction of works or the diversion and use of water before the issue of a final licence; has all the rights of a final licence
- **final licence:** a licence that authorizes the diversion and use of water, and does not authorize the construction of additional works or an extension of the use of water
- **priority date:** a seniority system of water rights; usually the licence issuance date; when more than one licence has been issued for a stream, the licence with the earliest priority date has first right to the water
- **purpose:** the water use allowed under the licence
- **storage:** the conditions of water storage
- **unrecorded water:** water in a stream or aquifer that is not licensed or reserved for other purposes under a regulation or act, e.g., *Water Sustainability Act (WSA)*

water quality: a term used to describe the chemical, physical, and biological characteristics of water with respect to its suitability for a particular use; for an extensive glossary of water quality terms go to www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-reference-documents/glossary_of_water_quality_terms.pdf

clean water: a relative term from a specific farms point of view; water flowing by or on a farm, regardless of its original water quality, that **has not had** contamination added by that farms activities; the farm **is not responsible** for this water quality

dirty water: a relative term from a specific farms point of view; water flowing by or on a farm, regardless of its original water quality, that **has had** contamination added by that farms activities; the farm **is responsible** for this change in water quality

drainage water quality: outlet water quality that does not cause pollution

irrigation water quality: water used for irrigation that meets the guidelines given in **Table 9.2, page 181**, such that soils are protected from salt accumulation and crops are safe to eat

polluted water: water containing a natural or man-made impurity

potable water quality: [from the *Drinking Water Protection Act*] water provided by a domestic water system that meets the standards prescribed (in Schedule A of the regulation) and is safe to drink and fit for domestic purposes without further treatment

reclaimed water quality: water that has been treated at a municipal waste treatment facility and is of an acceptable quality to be reused

water quality guidelines: specific levels of water quality which, if reached, are expected to render a body of water suitable for a designated purpose

water quality objective: a provincial guideline adapted to protect the most sensitive designated water use at a specific location taking local circumstances into account

water rights: see **water licence**

water supply system: [from the *Drinking Water Protection Act*] a domestic water system that serves more than one single-family residence

water table: (a) the upper surface of a saturated zone beneath the soil surface (i.e., where all the soil pore spaces are completely filled with water) where the water is at atmospheric pressure; (b) the upper surface of an unconfined aquifer (see aquifer, unconfined; and see soil water); a water table may fluctuate throughout the year

perched water table: a water table separated by unsaturated material from an underlying body of groundwater

watercourse: [from the *AEM Code* under the *Environmental Management Act*] includes a0 an area of land that perennially or intermittently contains surface water (other than puddles; groundwater and dugout ponds for livestock watering; furrow, grassed waterways and other temporary ponded areas that are normally farms or drainage ditches that lead to the above. (also see **stream**)

watercourse access: a livestock watering method where livestock directly water from a watercourse

managed access: the duration, timing, and intensity of livestock access to a watercourse is controlled to minimize impact on water quality and health of the riparian area; access location(s) may be improved with added footing, erosion protection, etc such as gravel, or geotextile and gravel

unrestricted access: livestock have full access to a watercourse

watercourse classification: see *Riparian Management Field Workbook* or *Drainage Management Guide*

watershed: an area of land that collects and discharges water into a single creek or river through a series of small tributaries

weed: unwanted plant; classified on the basis of longevity

annual weed: complete their life cycle in less than 12 months, either summer or winter annuals

aquatic weed: undesirable plant that grows in water, such as Eurasian Watermilfoil

biennial weed: require between 12 and 24 months to complete their life cycle

perennial weed: survive for several years, either creeping or non-creeping types

biological control: weed control of introduced plants by exposing them to their natural enemies

noxious weed: a weed designated and listed by the *Weed Control Regulation* to be a noxious weed, and includes the seeds of the noxious weed; lists province-wide and regional weeds

weir: (a) a structure across a watercourse to control or divert the flow; (b) a device for measuring the flow of water

well: [from the *Water Sustainability Act*] an artificial opening in the ground made for the purpose of
(a) exploring for or diverting groundwater,
(b) testing or measuring groundwater,
(c) recharging or dewatering an aquifer,
(d) groundwater remediation,
(e) use as a monitoring well,
(f) use as a closed-loop geoexchange well, or
(g) use as a geotechnical well,
but does not include
(h) an artificial opening, other than a water source well, to which the *Geothermal Resources Act* or the *Oil and Gas Activities Act* applies, or
(i) an artificial opening of a prescribed class, made for a prescribed purpose or in prescribed circumstances

abandoned well: a well no longer used that has been permanently closed or plugged

artesian well – flowing: [from the *Groundwater Protection Regulation*] a well in which water (a) naturally rises above the ground surface or the top of any casing, and (b) is observed to flow naturally, either intermittently or continuously
(also see aquifer)

artesian well – non-flowing: a well where the water level raises above the water level in the aquifer due to underground hydrostatic pressure
(also see aquifer)

drawdown: (a) the lowering of the water surface or water table from the withdrawal of water; (b) the difference between the static water level and the level when pumping at a given discharge

horizontal well: a water source developed by horizontally drilling into a perched water table or underground water source

probable source of contamination: a term used in *Public Health Act*, (a) [from the regulations] wells to be separated from probable sources of contamination, such as a privy vault, cesspool, manure heap, stable or pigsty; (b) interpreted in this *Reference Guide* to include farm sources, such as storages of petroleum, pesticides, compost, wood residue, etc.

safe well yield: amount of groundwater that can be withdrawn from an aquifer without degrading quality or reducing pumping level (also see recharge)

sand point well: constructed by driving assembled lengths of pipe into the ground composed of loose soils such as sand; usually small diameter (5 cm) and shallow (less than 15 m deep)

well cap:[from the *Water Sustainability Act*] a secure cap or lid that prevents vermin, contaminants, debris or other foreign objects or substances from entering the interior of the production casing, and includes a sanitary well seal

well cover: [from the *Water Sustainability Act*] a secure cover, lid or structure that prevents vermin, contaminants, debris or other foreign objects or substances from entering the well

well test: determination of the well yield versus drawdown relationship with time

well casing: [from the *Groundwater Protection Regulation*] pipe, tubing or other material installed in a well to support its sides

casing above ground: the extension of a well casing above the ground level (0.3 m suggested) to prevent the entrance of surface water into the inside of the casing and contaminating groundwater

sealant: [from the *Groundwater Protection Regulation*] (a) a non-toxic, commercially available material or mixture of materials, including (i) bentonite clay, (ii) bentonite clay and water mixture, (iii) bentonite clay and sand and water mixture, (iv) neat cement grout, (v) sand cement grout, and (vi) concrete grout, or (b) a non-toxic material or mixture of materials that has a lower permeability than the surrounding geologic formation to be sealed

surface seal: [from the *Groundwater Protection Regulation*] a sealant placed in the annular space around the outside of the outermost well casing and between multiple well casings and extending to or just below the ground surface (see sealant, above)

pitless adaptor: [from the *Groundwater Protection Regulation*] a mechanical device attached to a well casing, usually below the frost-level, for underground conveyance of water to or from the well (note – used to eliminate the water quality concerns of a dug pit around a below-ground surface well casing)

wellhead: [from the *Water Sustainability Act*] means
(a) the physical structure, facility, well cover, adapter or device
(i) that is at the top of, or at the side and near the top of, a well, and
(ii) from or through which groundwater flows or is pumped from the well, and

(b) any casing, well cap, valve, grout, liner, seal, vent or drain relating to the well, but does not include a well pump or a pump house

well pump: [from the *Water Sustainability Act*] a pump that
(a) is at or in a well, and
(b) is used or intended to be used for the purposes of
(i) diverting groundwater from a well,
(ii) adding water to a well to recharge the well or an aquifer, or
(iii) dewatering an aquifer

wetland: (a) area of wet soil that is inundated or saturated long enough to promote wetland or aquatic processes as indicated by the presence of poorly drained soils, hydrophytic (water loving) plants, and various kinds of biological activity adapted to a wet environment; [from the *Water Sustainability Act*] a swamp, marsh, fen or prescribed feature

wet meadow: a meadow where the surface remains wet or moist throughout the growing season, usually characterized by plants such as water-tolerant grasses, sedges and rushes

wildlife: [from the *Wildlife Act*] raptors, threatened species, endangered species, game or other species of vertebrates prescribed as wildlife and includes fish, but does not include species at risk

amphibian: [from the *Wildlife Act*] a vertebrate of the class Amphibia and includes the eggs and other developmental life stages

big game: [from the *Wildlife Act*] (a) any member of the family Cervidae, (b) mountain sheep, mountain goat, bison or pronghorn antelope, (c) bear, cougar or wolf, or (d) a mammal prescribed as big game

bird: [from the *Wildlife Act*] an animal of the class Aves, and its eggs

dangerous wildlife: [from the *Wildlife Act*] bear, cougar, coyote or wolf, or a species of wildlife that is prescribed as dangerous wildlife; it is unlawful to feed dangerous wildlife

fish: [from the *Wildlife Act*] any (a) vertebrate of the order Petromyzontiformes (lampreys) or class Osteichthyes (bony fishes), or (b) invertebrate of the class Crustacea (crustaceans) or class phylum Mollusca (mollusks) from or in non-tidal waters of British Columbia, and includes their eggs and juvenile stages

game: [from the *Wildlife Act*] big game, small game, game birds and fur bearing animals, and other species prescribed as game

problem wildlife: wildlife that conflict with agricultural production, such as grazing farm tame pastures, or damaging fruit or vegetable crops

raptor: [from the *Wildlife Act*] a bird of the order Falconiformes known as vultures, eagles, falcons and hawks or the order Strigiformes known as owls, and includes its eggs

wildlife habitat: see habitat

wildlife pond: a pond managed primarily to provide wildlife habitat

wildlife species: see species

wildlife tree: trees and shrubs that provide food, shelter, or both, such as standing dead trees with cavities for birds

windbreak: a screen, natural, man-made or of vegetation, that reduces wind velocity so as to protect land, structures or livestock; will cause deposit of snow where it is carried with the wind

swirl chamber: the downwind reaction when wind-carried snow encounters a windbreak; constructed windbreaks must be carefully setup around buildings, etc. to account for where snow will accumulate

winter precipitation: total precipitation during the period of October 1st to April 30th inclusive

wood-fired boiler: see boiler

woodlands: farm woodlots that may be operated on privately owned or Crown land

wood residue: [from the *AEM Code*] wood or wood products that are chipped or ground that come from wood processing or clearing of land, if greenery is removed and soil is not present; has no treatment or coating with chemical preservatives; glues; paints; varnishes; oils or other finishes; and does not contain foreign substances that are harmful to humans, animal or plants when combusted; not exposed to salt water or removed from construction or demolition

wood residue leachate: the liquid generated from water moving through wood residue; characterized by a dark colour, "oily" sheen and a foul odour

woody debris: wood from trees and shrubs that is scattered on the ground or in the water; returns essential nutrients into the soil or water as it decays; may provide critical habitat for fish and wildlife

works: [from the Water Sustainability Act]

(a) anything that can be or is used for

(i) diverting, storing, measuring, conserving, conveying, retarding the flow of, confining or using water,

(ii) producing, measuring, transmitting or using electricity,

(iii) collecting, conveying or disposing of sewage or garbage, or

(iv) preventing or extinguishing fires,

(b) booms and piles placed in a stream,

(c) obstructions placed in or removed from streams or the banks or beds of streams,

(d) changes in and about a stream,

(e) access roads to any of the works referred to in paragraphs (a) to (d) or (f) (i), and

(f) wells and works related to wells, including

(i) wellheads,

(ii) anything that can be or is used for injecting or otherwise adding water or any other substance to a well,

(iii) anything that can be or is used for constructing, deactivating or decommissioning a well,

(iv) anything that can be or is used for exploring for, testing, diverting or monitoring groundwater,

(v) anything that can be or is used for disinfecting a well,

(vi) an injection system attached to a work that is used for conveying, from a well, groundwater that will be used for applying fertilizers or pesticides, and

(vii) anything that can be or is used in relation to a monitoring well or a well made for the purpose of groundwater remediation.

(2) [from the *Environmental Management Act*]

(a) a drain, ditch, sewer,

(b) a waste disposal system including a sewage treatment plant, pumping station and outfall,

(c) a device, equipment, land and a structure that

(i) measures, handles, transports, stores, treats or destroys waste or a substance that is capable of causing pollution, or

(ii) introduces into the environment waste or a substance that is capable of causing pollution,

(d) an installation, plant, machinery, equipment, land or a process that causes or may cause pollution or is designed or used to measure or control the introduction of waste into the environment or to measure or control a substance that is capable of causing pollution, or

(e) an installation, plant, machinery, equipment, land or a process that monitors or cleans up pollution or waste

METRIC CONVERSION

Table E.1	Metric to Imperial Conversions		
Multiply Metric		By	To Obtain Imperial or US
Area	square metres (m^2)	10.76	square feet (ft^2)
	hectares (ha)	2.47	acres (ac)
Concentration	microgram/gram (µg/g)	1	parts/million (ppm)
Flow	metres/second (m/sec)	3.28	feet/second (ft/sec)
	litres/minute (L/min)	0.26	Liquid gallons/minute (g/m)
Length	millimetres (mm)	0.039	inches (in)
	centimetres (cm)	0.39	inches (in)
	metres (m)	3.28	feet (ft)
	kilometres (km)	0.62	miles (mi)
Pressure	megapascals (MPa)	145	pounds/square in (psi)
Temperature	degrees Celsius (0C)	1.8, then add 32	degrees Fahrenheit (0F)
Volume	litres (L)	0.26	Liquid gallons (gal)
	litres (L)	0.035	cubic feet (ft^3)
	cubic metres (m^3)	1.31	cubic yards (yd^3)
Volume/Area	cubic metres/hectare (m^3/ha)	14.29	cubic feet/acre (ft^3/ac)
Weight	kilograms (kg)	2.2	pounds (lb)
	metric tonnes (t)	1.1	tons (t)
Weight/Area	kilograms/hectare (kg/ha)	0.89	pounds/acre (lb/ac)
	tonnes/hectare (t/ha)	0.45	ton/acre (t/ac)
Weight/Volume	milligram/litre (mg/L)	1	parts/million (ppm)

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Note: Entries in **Bold** are major information sections