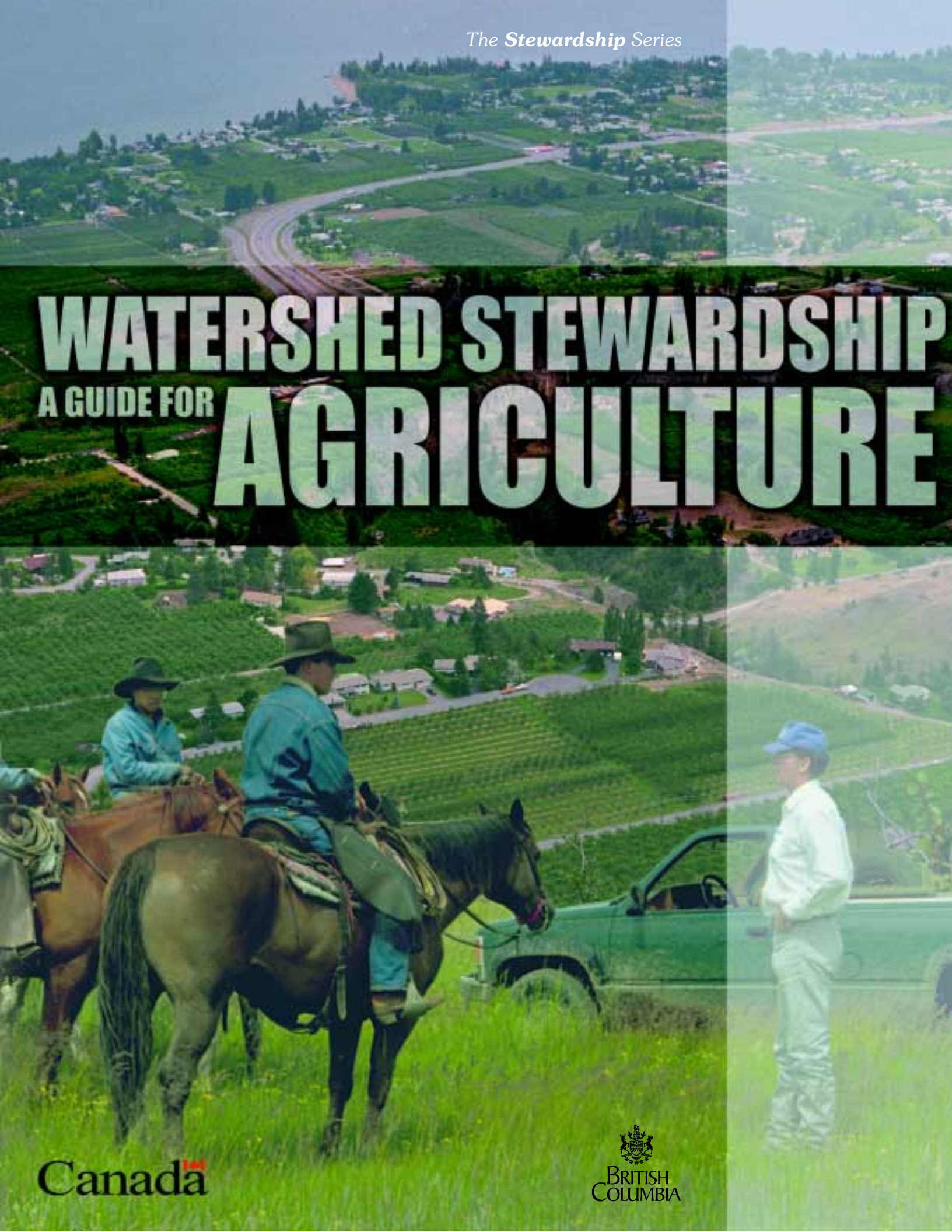
*The **Stewardship** Series*



WATERSHED STEWARDSHIP
A GUIDE FOR AGRICULTURE

Canada

British Columbia

This guide is designed for all agricultural producers - from ranchers to greenhouse growers to hobby farmers.

Much of British Columbia's agricultural land, which is the basis of B.C.'s food production, is located in valley bottoms. These agricultural lands surround the rivers, lakes, streams, and wetlands, which are the foundations of many of B.C.'s most valuable fish and wildlife habitats.

Farmers are therefore key to ensuring our province's aquatic environments are managed for the benefit of all.

The stewardship principles discussed here will enable farmers to improve their operations and enhance the quality of their local environment at the same time.

Others interested in relationships between agriculture and water quality, water quantity, and healthy fish and wildlife habitats, will also find this guide useful.

This guide aims to:

- Discuss stewardship and explain its role in protecting the aquatic resources of B.C.
- Outline fish and wildlife habitat requirements.
- Show how agriculture and the environment can both benefit from good stewardship.
- Provide examples of stewardship practices which can be incorporated into agricultural operations.
- Profile success stories where good stewardship has benefited producers, as well as fish and wildlife in B.C.
- Summarize the agency approvals to be obtained before working in or near a stream.

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Photo Credit: MELP

Abbreviations Used in this Publication

ALC	Agricultural Land Commission
ALR	Agricultural Land Reserve
AEPC	Agriculture Environmental Protection Council
BCFA	British Columbia Federation of Agriculture
DOE	Environment Canada
DFO	Department of Fisheries and Oceans
FLR	Forest Land Reserve
FPC	Forest Practices Code
FSZ	Fisheries Sensitive Zone
IIABC	Irrigation Industry Association of British Columbia
MAFF	Ministry of Agriculture Fisheries and Food
MELP	Ministry of Environment, Lands and Parks (BC Environment)
MOF	Ministry of Forests
WCB	Workers Compensation Board
PARC	Pacific Agriculture Research Centre, Agriculture and Agri-Food Canada

Sustainability and our Natural Resources

Sustainable
"to keep going continuously" or "from generation to generation".

Photo Credit: O.E. Langer

Using sustainable practices will help ensure that your farm continues to produce food economically while supporting fish and wildlife populations from generation to generation.

British Columbia has an abundance of natural resources including water, forests, fish, wildlife, minerals, fertile soils, and beautiful landscapes. Our development of these resources has fueled rapid growth of B.C.'s population and economy for more than a century.

Population growth and increasing public demand for more production by resource-based industries places growing pressures on our environment. We can only sustain the natural legacy that makes B.C. such a desirable place to live if we all make significant changes. By changing how we do things potential impacts can be avoided, the effects of past impacts can be reduced, and natural resources will continue to be available for generations to come.

The challenge - finding a sustainable balance

Our challenge is to find a balance that allows us to sustain our environment, economy, and our social well-being.

Non-sustainable practices trade short term benefits for a future with narrowed options, and a greater risk of economic, social, and environmental decline.

Achieving a **sustainable** balance in B.C. will require efforts in every watershed and commitment from all sectors of the economy, including agriculture.

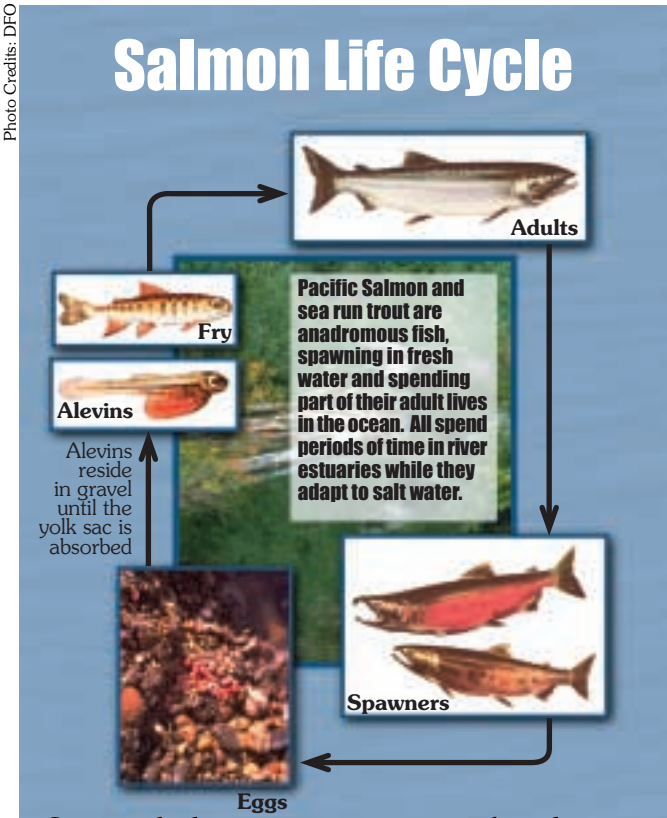
With every British Columbian working to attain a healthy environment we will make steady progress towards sustainability. In the long term, our economy, environment, and social well-being will all benefit from the positive actions we take now.

Salmon - one indicator of a healthy environment

Pacific salmon and sea-run trout are anadromous fish which spawn in freshwater, and spend their adult lives in the ocean. Some salmon species require small streams for rearing, and coho and chum even spawn in very small streams. These streams are easily disturbed by human activities.

Salmon and trout are very sensitive to environmental disruptions. Their numbers therefore serve as important indicators of environmental health. Factors which impact salmon will also affect people, wildlife, and other fish species. Similarly, when stream habitats are protected, many desirable species share the benefits.

Photo Credits: DFO



Stream habitats are an essential and fragile part of the salmonid life cycle. Without careful protection of salmon spawning and rearing grounds, whole populations of fish can be lost.

The Fisheries Resource

The commercial, aboriginal, and recreational fisheries are a cornerstone of the B.C. economy. These fisheries depend upon abundant and renewable fish stocks. Fish harvesting and processing have provided an important food source as well as livelihoods for many families in B.C. for numerous generations.

Some Facts about B.C. Fisheries:

- Fish and seafood products are B.C.'s number one food export.
- The value of the landed catch for seafood is estimated to be $880 million annually.
- Fishing is extremely important to the culture and social systems of aboriginal people, in addition to being an important food source.
- Fishing in tidal areas provides recreation for about 300,000 British Columbians and an additional 100,000 visitors each year.
- About $498 million (1990 dollars) is directed each year toward expenditures on lodging, guides, and boat rentals associated with recreational fishing.
- Collectively, expenditures on recreational fishing account for one third of every tourism dollar spent in B.C. (1992).

Photo Credit: MELP

We need to take better care for our streams so they can continue to support present and future generations.

Causes for concern:

Returns of some Pacific salmon runs in B.C. have deminished. For example, evidence suggests that Fraser River coho stocks have declined by about 40% since the early 1970's even though harvests have been substantially reduced.

Some B.C. salmon stocks have disappeared altogether causing the loss of genetic diversity. Examples of lost runs can be found both in the B.C. interior and in coastal streams.

Declining fish populations should be of concern to all British Columbians. They are a warning that we need to take better care of B.C.'s streams so they can continue to support present and future generations.

Photo Credit: DFO

Commercial fishing products are B.C.'s number one food export.

Photo Credit: DFO

In addition to being a food source, fishing is important to the culture of aboriginal people.

Photo Credit: DFO

About $498 million (1990) are spent on recreational fishing.

Stewardship and our Working Landscape

We are each responsible for maintaining the health of our environment. We all need to make changes in our lives to reduce the impacts which we have on the environment and on our neighbours. Some changes are being required by law. However, government intervention cannot accomplish all that is required. Many of the changes must be achieved through voluntary stewardship efforts.

The Upper Bridge Creek Protection Society has volunteers collecting water quality data from 23 lakes in the South Cariboo region, near 100 Mile House. The volunteers are a diverse group of people who share a strong interest in their local environment. They plan to add another seven lakes to their monitoring program.

What is Stewardship?

Stewardship begins with the realization that land, water, and wildlife are entrusted to our care. It is our collective responsibility to pass on to our children - and generations to come - an environment as healthy and diverse as the one we inherited.

This guide encourages voluntary stewardship actions on individual farms, and through cooperative efforts with urban neighbours and fellow producers.

Stewardship in B.C.

Examples of stewardship efforts being made by British Columbians include:

- The introduction of the Forest Practices Code, which was developed to bring about sustainable forest harvesting and protection of non-timber resources;
- Bluebox recycling;
- Composting of yard and kitchen wastes;
- Soil, water and energy conservation;
- Monitoring of streams and restoration of fish habitat by volunteer community groups. More than 150 new Streamkeepers groups were formed in B.C. between 1995 and 1997;
- Community watershed planning;
- Cooperative ventures between ranchers, conservation groups such as Ducks Unlimited, and agencies such as the Department of Fisheries and Oceans and the Ministry of Environment.

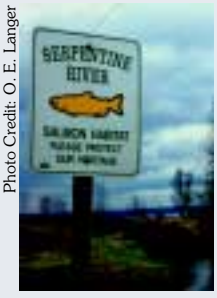
Photo Credit: O. E. Langer

This constructed wetland provides storm water detention and improves water quality, creates diversity, and provides aquatic habitat.

Photo Credit: P. Scales

Community groups can work together to restore fish habitat. These Girl Guides are an example of the many volunteer groups in B.C. caring for streams.

Photo Credit: O. E. Langer



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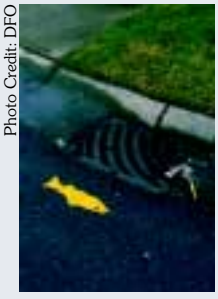


This guide encourages voluntary stewardship actions on individual farms, and through cooperative efforts with urban neighbours.

Trends in B.C. Agriculture

A growing B.C. population has increased demands for high quality food, and B.C. producers have responded to these provincial needs. Agricultural production has been increased and diversified through more intensive land use and more efficient farm practices.

More intensive land use of any sort can potentially increase the risks of impacting surface waters, fish, and wildlife populations.

Hobby farms are becoming more common in many areas of B.C. as well. These small farm units have some of the highest livestock densities found in the province. Operators of hobby farms have the same responsibilities as larger commercial operators to protect habitat and water quality.

Agriculture and Sensitive Habitats

Because many farms are in valley bottoms near waterways, good farming practices are vital to maintaining clean surface waters, and healthy fish and wildlife habitats.

Agriculture and Stewardship

Many stewardship efforts are being made on B.C. farms.

As with other agricultural enterprises, a combination of cooperative and individual stewardship efforts often yields the best results. Larger projects may require the joint efforts of neighbours to be successful.

Commodity and conservation groups offer producers a forum for the exchange of stewardship ideas and access to assistance.

Compliance with the Agriculture Waste Control Regulation and its' supporting Code of Agricultural Practice for Waste Management is increasing on B.C. farms.

These stewardship efforts are an important step towards reducing environmental impacts from farming.

Photo Credit: DFO

Stewardship practices can be as simple as fencing to protect sensitive streamside habitats.

Many opportunities for improvements remain.

While some improvements are being made by individual producers and organized groups of farmers, there are many more opportunities for positive changes.

The Stewardship Practices section of this guide discusses approaches that can be adopted, while maintaining or improving agricultural productivity. These ideas are similar to stewardship efforts being made in the forests, in urban areas, and by industry.

We are all neighbours who depend on one another for help from time to time.

The economic and social benefits we all enjoy in B.C. require a vibrant and healthy environment. This guide focuses on the things which you can do on your farm to help sustain the watershed which you and others rely upon.

Photo Credit: Ducks Unlimited

Individual producers, neighbours, and organized groups are making stewardship efforts on farms in B.C. to maintain healthy fish and wildlife habitats. Organized groups offer opportunities for the exchange of ideas and assistance.

Government agencies support community groups by developing educational materials, and providing technical support and equipment. Examples include the Streamkeepers program, and the Community Involvement program which are both part of DFO's Salmon Enhancement Program.

... but, can you afford to be a good steward?

In many cases not adopting stewardship practices can have a significant price. Making changes to adopt good stewardship practices may well have some upfront costs. Over time these changes can pay for themselves, for example:

- Cleaner water can lead to improved animal health, reduced transmission of crop and livestock diseases, and less wear on irrigation equipment;
- Protecting streams from sediments requires good soil conservation practices, which also result in reduced erosion of valuable farm land and productive soils;
- In most cases, good stewardship practices will increase the value of your property. Property values decline when there are evident problems such as loss of land due to denuded stream banks.

Stewardship offers many opportunities and challenges for farmers. This guide gives examples of what can be done, whether you run a small hobby farm or a large commercial operation.

Plants take up most of their water and nutrients from top soil. It takes between 200 and 1000 years to form 2.5 cm of topsoil, but in the Fraser Valley, this depth of topsoil can be lost to erosion in as little as 15 years. Eventually, erosion will cause the productivity of the land to decline.

Soil erosion also results in downstream sedimentation. The damage done by these sediments adds even greater costs to the obvious on-farm costs associated with soil loss.

Photo Credit: M. Crowe

Initially stewardship practices may seem expensive, but in most cases the cost of stewardship is offset by reduced maintenance costs and increased property values over time.

Photo Credit: P. Scales

Fences which have been installed along streams to protect riparian vegetation can also help to maintain farms as more diverse and comfortable places to live.

Watershed Features and Functions

Some knowledge about key watershed features and how they function is essential to understanding how to better care for the environment so that it can continue to support productive agriculture. While each watershed is unique in its combination of geology, climate, hydrology, and numerous other features, all watersheds share some general common features. This section of the guide describes the key general features of watersheds and how they function to support your farm, and provide healthy fish and wildlife habitats.

What is a watershed?

A watershed is a drainage basin and is defined by heights of land such as ridges and hills.

Healthy watersheds collect water which is received as precipitation, and slowly release it into streams. Streams may also receive water from groundwater sources. Streams flow into rivers, which eventually empty into the ocean.

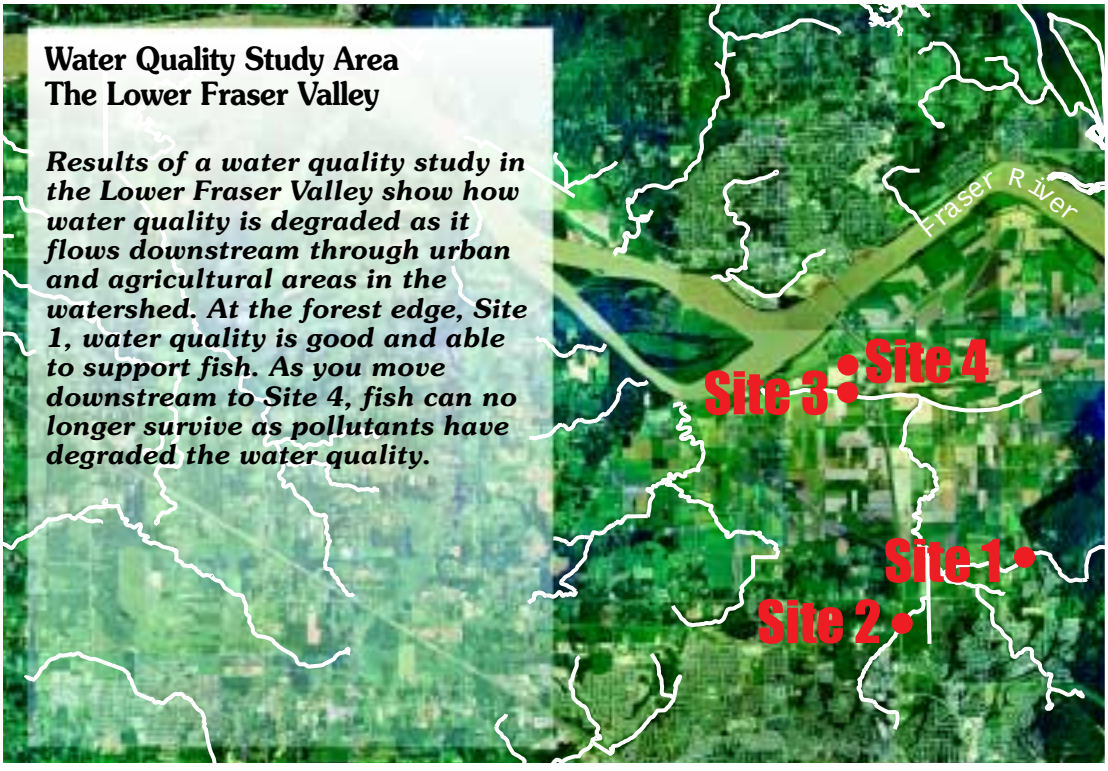
Watersheds also contain bodies of standing water such as lakes and wetlands.

Watersheds are constantly changing systems

Watersheds naturally undergo continuous changes, both seasonally and over the decades and centuries. Stream channels shift, unstable soils erode, and trees fall down.

Typically, the changes which result from human activities are very different and much broader in scope than naturally occurring changes in watersheds. When we cut forests, clear and cultivate land, create asphalt surfaces, build towns, remove stream-side (riparian) vegetation, alter drainage of the land, and withdraw water for irrigation, we cause rapid and often irreversible changes. Each of these changes will also affect downstream areas.

We all need to understand the possible implications of our actions on our watersheds, even if we do not have a stream in our own back yard.



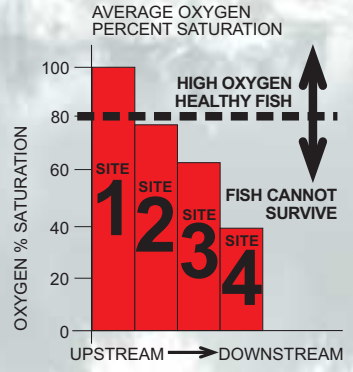
The graph shows what happens to dissolved oxygen levels in a stream, due to the accumulation of pollutants from agricultural runoff:

Site 1: *Water quality at the forest edge is good, with high levels of dissolved oxygen which can support fish. (98% saturation)*

Site 2: *Water quality has been slighly degraded by the urban area. Average dissolved oxygen levels are slightly below the 80% saturation level. (78%)*

Site 3: *(near mouth of stream): After passing through many kilometers of agricultural land, the average oxygen saturation is low (63%), making it difficult for fish to survive, creating a barrier which can prevent salmon from reaching their spawning grounds.*

Site 4: *(at the mouth of a tributary which drains intensively farmed land): Dissolved oxygen levels are extremely low and fish cannot survive here.*



The graph illustrates the decline in water quality along a stream. With these low levels of dissolved oxygen, fish cannot survive.

Streams and Rivers

Ecosystem
Living organisms and their non-living environment functioning as a unit.

Riparian
Relating to or located on the bank of a watercourse, such as a river, lake, stream, or a tidewater.

If the speed of a stream doubles, it will have four times more erosive power and can carry 64 times more soil!

From: 'Caring for the Green Zone'

Studies of a river in the B.C. interior show that between 1948 and 1995, channel widths have increased by three and a half times where streambank vegetation has been removed.

This erosion has resulted in large losses of prime agricultural land.

Streams and rivers drain water from the land. They contain a diversity of habitat features which support complex water and land-based **ecosystems**. Most streams, even those which are very small, which have been modified, or which go dry at times, provide valuable fish and wildlife habitat.

The work that streams do:

When water in a stream flows downhill, energy is released, and this energy is available to do work.

The "work" of a stream is to erode material from its bank or bed, and transport that material downstream. The amount of work that a stream can do depends upon the slope and flow of the stream, and the resistance of the stream bank and bed materials.

Physical Features of Streams:

Permanent streams flow year round.

Other streams can flow underground in places, or dry up during hot summer or frozen winter months. These seasonally wetted streams can be difficult to distinguish from permanent streams during wet months.

Meanders are the natural bends in a stream. Streams naturally wind, or meander, through the valley bottoms, because in doing their work they tend to find the path of least resistance.

Meanders reduce the slope of a stream and also slow down moving water with friction. Both of these factors reduce the amount of work - erosion - that a stream can do.

Meanders increase the amount of water which a stream can hold, which reduces the potential for flooding.

Side and Back Channels are parts of a stream which are removed from the main channel. They increase the amount of water which a stream can hold during high water periods, which reduces flooding.

Meanders, back channels, and side channels all contribute to the amount of water which is absorbed by the floodplain. This adds to the groundwater reserves which support plants, including farm crops, during dry summer months.

Watercourses which have been straightened, cleaned, or modified allow water to move more quickly. This means that the power to erode is greatly increased.

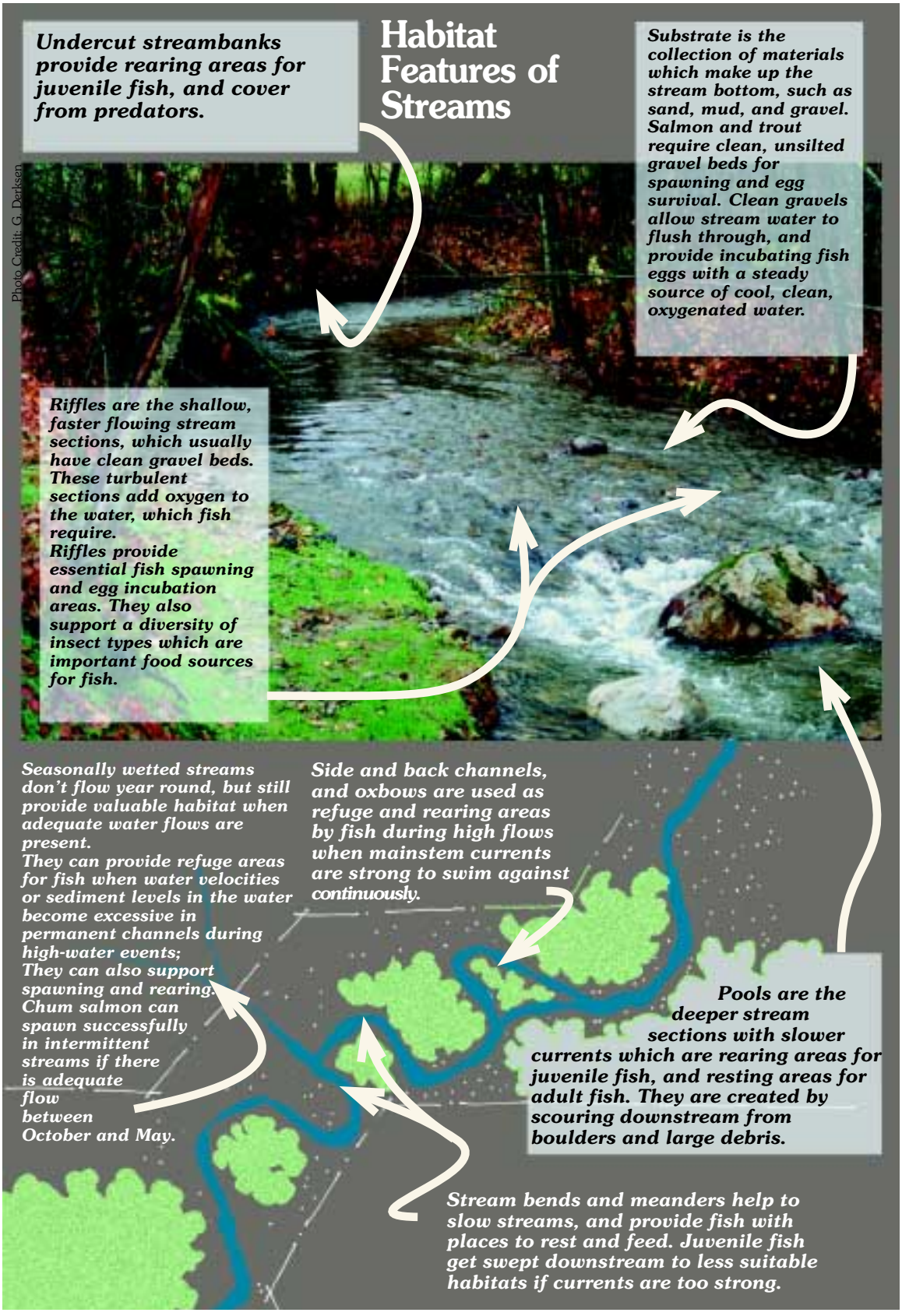
Stream Banks and Vegetation:

The stability of a stream bank depends on the soil type, and on the amount, and types of vegetation growing there, **riparian** vegetation.

Plants with extensive root systems hold stream banks together and resist erosion. Roots also create friction which slows a stream down and reduces its erosive power. Riparian vegetation is therefore very effective at protecting valuable farm land from erosion.

Streams with many trees and shrubs anchoring the banks are usually narrow and deep. Where riparian vegetation is lacking, stream banks erode, and streams become wider and shallower.

Riparian Zones are described in more detail on Pages 10 and 11.



Salmon and trout spend their egg and larval stages in the gravel of stream bottoms.

It is essential to keep gravel clear of fine sediment so that oxygenated water can reach the eggs, otherwise they will die.

The Fraser River is naturally muddy for most of the year, and is enormously important to salmon stocks. This may seem like a contradiction. Most salmon spawn in tributaries which have clearer water. The salmon which do spawn in the Fraser itself are restricted to areas where the current is fairly strong so that little sediment is deposited on top of gravel.

Riparian Areas

Riparian areas are the bands of land beside streams, rivers, wetlands, and other surface water bodies. They support lush plant growth, and stay green longer than other parts of a watershed. Riparian areas produce more forage than uplands, largely because the available water supports rapid plant growth. Riparian areas therefore contribute much more to the food chain relative to their size compared with upland areas, and are key to sustaining productive watersheds.

All plant root systems absorb nutrients from soils, so healthy riparian zones can help to protect streams by absorbing some of the excess nutrients which may leach from chemical fertilizers and manure spread on fields. High nutrient levels in streams can result in the growth of harmful amounts of algae, which damages fish habitat and degrades water quality.

A leave strip width of 15 m is generally recommended for all surface waters, except around very small and seasonally wetted streams or ditches with adjacent land uses which are unlikely to result in impacts.

A narrower leave strip may not be enough to protect stream banks from serious erosion and will be less effective at filtering runoff.

Riparian areas Provide:

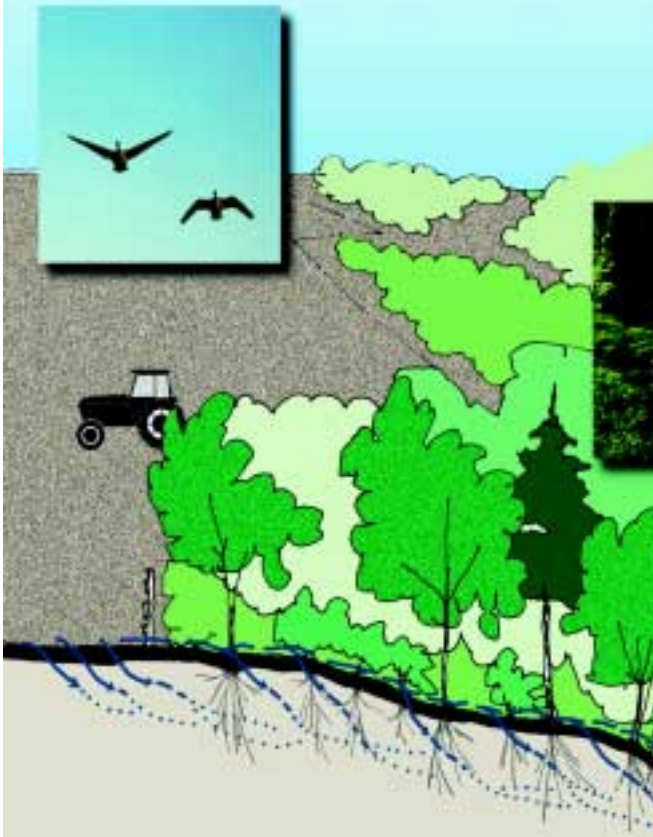
- **A diversity of plant species**, which in turn support a broad variety of bird and wildlife species which have differing needs for food supplies, nesting and denning sites, shelter from weather extremes, and places to hide from predators.

  Healthy riparian areas contain mature trees which provide nesting and perching sites for songbirds, and raptors such as red-tailed hawks and great horned owls. They also contain snags (standing dead or dying trees), which provide nesting sites for cavity-nesting birds. Snags serve as the main food source for woodpeckers.

  Many species of birds and wildlife are dependant upon riparian vegetation for successful completion of their life cycle. For example, the deciduous trees and shrubs which are found in riparian areas are a particularly important source of berries and seeds. Migrating songbirds rely heavily on riparian areas for these high-energy foods to fuel their flight to South America in the late summer months. If they don't get the food which they require they die, unable to complete their migration.

- **A buffer area** which physically protects the integrity of stream banks and minimizes disturbances to fish habitat. Riparian vegetation can also provide an effective wind break which reduces wind erosion of valuable exposed soils.

- **Corridors for wildlife**, by providing a sheltered route which connects larger habitats together. This allows animals to migrate from one area to another according to seasonal or life cycle requirements, with some level of protection. Many animals will avoid crossing large open areas which make them vulnerable to predators.



- **Filtering of surface runoff** which helps to keep surface waters clean. The trees, shrubs and grasses which grow in healthy riparian areas can be very effective at filtering eroded soil from runoff water. This helps to keep sediment on land where it belongs, and away from stream bottoms where it can smother spawning gravels.

- **Shelter and Cover** by contributing large woody debris such as stumps, logs, and root wads to streams. Large woody debris gives fish places to hide from predators, contributes to stream bank stability, and increases the instream habitat diversity. The diversity of resulting habitats will support a greater number of species and larger fish populations than are found in streams with less habitat features.

  Riparian vegetation also shelters streams from extreme weather conditions by moderating light, humidity, air movement and temperature. Vegetated riparian areas therefore provide important refuge areas for wildlife during extreme weather.

- **Shade and protection from solar radiation**, which helps to keep streams cool in the summer and minimizes daily temperature fluctuations. Fish are extremely sensitive to disruption of natural temperature conditions. Salmon and trout generally prefer water temperatures less than 16°C. Water temperatures greater than 20°C can be fatal to salmon and trout.

Photo Credit: M. Crowe

Treating riparian areas as 'leave strips' (simply leaving them alone) often provides the least cost and greatest benefit to agriculture and habitat alike.

Photo Credit: T. J. Brown

A recent study of several B.C. rivers showed that only 14% of vegetated bends eroded, while 67% of non-vegetated bends eroded during the same years.

- **An important food supply** for fish and wildlife. Riparian areas support rapid growth of vegetation which provides food sources for birds and wildlife. Riparian areas also contribute food to aquatic systems in two ways:

  1. Insects drop from overhanging vegetation into water, where they become fish food;

  2. Leaf litter and other organic matter falls into streams and becomes a source of food for aquatic insects, and ultimately fish.

  Because leaf litter and large wood debris are relatively slow to decompose they generally do not remove oxygen from water more quickly than it is replaced.

Radar records from weather stations show that the number of migratory songbirds is now about half what it was 20 years ago. These birds face many pressures, including here in B.C., where much of their riparian habitat has been lost. Protecting riparian vegetation can only help migratory bird populations.

Fish, amphibians, and wildlife all require clean water just as people and livestock do. Water pollution can increase the likelihood of fish, wildlife, and livestock succumbing to disease. Polluted water can also cause fish kills.

Lakes and Wetlands

Lakes

Healthy lakes have intact riparian areas the same as streams do.

Lakes usually also have aquatic vegetation in shallow waters along the lake shore which provides habitat and a food source to many species. This vegetation also helps to protect the shoreline from erosive wave action.

The productive fish spawning and rearing habitats in lakes tend to be in shallow water close to the shoreline. Juvenile fish will remain in these areas until they are big enough to survive in more open water.

People are usually careful around lakes because they rely on them, as a source of drinking water, or for recreation such as swimming, and fishing. We recognize these values and most of us take care avoid polluting or damaging these aquatic resources.

Wetlands

Wetlands are relatively small and shallow bodies of standing water compared with lakes. Like lakes and streams, they are surrounded by riparian areas where an abundance of water supports diverse and vigorous plant growth.

Wetlands contain vegetation which is distinct from that in neighbouring, freely drained areas. The four main types of wetlands are ponds, marshes, swamps, and bogs.

The importance of wetlands is often overlooked. In fact, some people view wetlands as negative features, and think of them as nothing more than breeding grounds for mosquitos!

Wetlands actually have many important roles in supporting productive watersheds.

Wetlands provide:

- Moderation of stream flows. Wetlands store large volumes of water during high precipitation, rapid thaws, or runoff events.

  When storage capacity of the floodplain is reduced by filling in wetlands and creating impervious surfaces, the threat of damaging floods increases.

Photo Credit: O. E. Langer

Wetlands are some of the most important aquatic resources we have. They provide habitat for 300 species of birds in Canada and many other plants and animals as well.

- Slow release of water into streams during dry summer months. This water contributes to stream flows when water from precipitation may be scarce;
- Natural water treatment systems. Wetlands function as biological filters and mechanical settling and filtering ponds which help to remove impurities from water;
- Habitat in Canada, for more than 300 species of birds, 55 of them waterfowl. More than 70 species of mammals, and countless other life-forms ranging from tiny invertebrates to plants and fish, also rely on wetland habitats;
- Drinking water for wildlife during dry months;
- Critical breeding areas, in the dry interior of B.C., for amphibians and reptiles such as frogs and salamanders which help keep insect populations under control;
- Essential breeding areas for water fowl such as geese and ducks
- Stopover sites, where migrating birds and wildlife can rest and take advantage of the diverse food sources.

Floodplains

Floodplains are the relatively flat, low-lying areas adjacent to streams. They are periodically flooded and modified when streams overtop their banks.

Stream channels will shift their courses from time to time, moving within the floodplain.

Most of B.C.'s finest crop production land is located on floodplains.

Natural Floodplains provide:

- Sediment deposition areas, which accumulate the fertile soils that support agriculture. When streams overtop their banks, flow velocities decrease as water moves over the floodplain, allowing sediments to settle out onto the floodplain.
- Water storage, by absorbing water during floods and rainfalls.

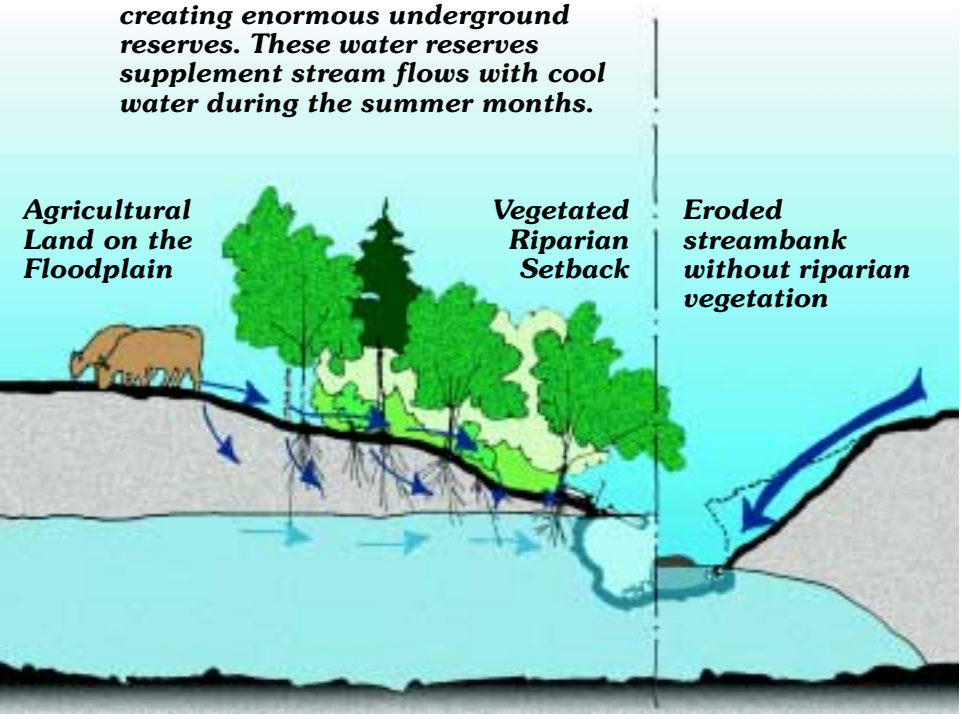
  Water which is absorbed by the floodplain raises the water table, and ultimately serves as a water supply to plants, including agricultural crops, during dry summer months.

  By developing impermeable surfaces such as roads and housing subdivisions, we reduce the amount of water which is absorbed by the floodplain, and increase the stream flows. This increases the risk of flooding further downstream in the watershed.
- Large expanses of habitat, which support diverse plant and animal communities.

  Some animal species migrate between upland areas and low elevation habitats to meet seasonal and life cycle requirements.

  Trees on the floodplains provide wind breaks for farm fields, and migratory corridors for wildlife moving between high and low elevation habitats. They also provide perching and nesting sites for many species of birds.
- High-water refuge areas for fish, during flood events.

Floodplains soak up and retain water creating enormous underground reserves. These water reserves supplement stream flows with cool water during the summer months.



On floodplains where vegetation has been removed, and drainage is improved to ensure water flows away rapidly, the opportunity for soils to soak up water is limited. The water table is lower and stream flows are affected during the dry summer months by the lack of groundwater inputs.

Groundwater

Permeable
Having openings through which water can pass.

Groundwater which is used today may have been rainfall on your property decades, or even centuries ago.

Groundwater is water that infiltrates through the ground and accumulates in underground water bodies called aquifers.

There are two types of aquifers:

Unconfined aquifers have only **permeable** materials overlying them. An example of this would be where soils have underlying loose gravel, so water can easily travel down from the surface of the soil.

Confined aquifers are covered with an impermeable layer of material, such as clay, which limits the penetration of water to and from the soils directly above.

Groundwater flows quickly through coarse sands and gravels, as much as several meters a day. On the other hand, groundwater flows much more slowly through heavy clay - maybe a meter in a thousand years.

Groundwater levels:

The water levels in aquifers rise and fall in response to water removal and infiltration.

Groundwater can resurface in wetlands and low-lying areas as springs, percolate into streams, or be pumped to the surface from wells.

Groundwater Quality:

Unconfined aquifers are especially vulnerable to pollution from land uses on the soils above.

Contaminants can easily filter down to reach an underconfined aquifer. Unfortunately, it can take decades or centuries for contaminated water in the aquifer to be replaced with clean water.

Groundwater provides:

A water supply to many wetlands, streams and wells during dry periods. Groundwater provides most of the late summer, fall, and winter flows in many streams.

Groundwater is an indirect source of irrigation water during the dry summer months in some areas of B.C.

Surface water temperatures are moderated when groundwater supplies water to a stream.

Groundwater temperatures are less variable than surface water temperatures. Groundwater tends to be cooler than surface water in the summer and warmer than surface water in the winter.

When you see water bubbling out of the ground like this, it is likely a spring fed by an unconfined aquifer. These aquifers are an important source of cool water for streams throughout the summer months. Aquifers rely heavily on gradual recharge from periodic flooding.

Photo Credit: G. Derksen

In some warm streams, cool groundwater inputs provide refuge areas, where fish gather to escape lethal hot summer temperatures.

The importance of these moderating effects has been documented in many streams including the Nicola River in the southern B.C. interior, where summer water temperatures may exceed 25°C.

Introducing Stewardship Practices for Farms

Small steps by individuals, including agricultural producers, provide an important contribution to healthy watersheds. Where communities are involved, a watershed-based approach to stewardship can involve coordination and planning for all land uses in a watershed.

This section of the Stewardship Guide provides ideas which can be applied on any farm. It gives suggestions on how to resolve problems which affect the success of your farm while addressing environmental issues at the same time, and also provides ideas for working with neighbours in your watershed.

Using this section

Chapters in this section are organized under several titles:

Main Issues - outlines how some historic agricultural practices have affected fish and wildlife. Understanding these problems should give farmers the background needed to find solutions that are best for their own operation. Approaches to solving common problems are introduced.

Additional Stewardship Actions - provides ideas for taking additional stewardship steps.

Challenges - identifies problems for which new solutions are needed. If you have a solution to a challenging problem, please share your successes by informing a peer advisor or contacting your producer group.

Conservation Check List - a check list is provided in each section to help you determine whether or not you face a stewardship challenge in your operation.

If you have several problems to face at once, consider contacting a peer advisor or MAFF for ideas on how best to address your circumstances.

For more information - this publication does not provide technical details so this section will guide you to other publications, many of which are available free of charge from government offices.

Photo Credit: L. Leach

Stewardship actions may include actions to help educate the public about the need to treat land resources with respect.

Photo Credit: L. Leach

Environmentally responsible farm practices are recognized by producer associations.

General Stewardship Strategies

There are a wide range of stewardship opportunities which may be applied to any land. This section introduces three major 'themes' of stewardship approaches.

The main objectives of stewardship are:

- *To take care of what we have, and*
- *To restore what we've already lost.*

Leaving riparian areas in their natural state, or restoring them, can protect streambanks from serious erosion and therefore potentially contribute to the value of your property.

Maintaining healthy riparian areas is also an excellent investment in the conservation of fish and wildlife habitat.

Three Major Themes

1) Prevent Water Pollution

Any substance that can be carried or dissolved by water can end up in waterways and wetlands. Stewardship practices include preventative measures which keep pollutants out of water.

Pollutants can be as common as:

- Soil;
- Nutrients from manure and fertilizer;
- Pesticides;
- Silage or wood-waste leachate;
- Milking parlour wastes;
- Fuel;
- Runoff from wet concrete.

Pollutants need to be controlled at the source, even when the source seems to be far removed from open water.

2) Protect Habitat

Priority must be given to conservation efforts so that impacts to fish and wildlife are not increased. Keep in mind that the costs of restoration can greatly exceed the costs of protecting and conserving these resources in the first place.

3) Restore Habitat

In many agricultural areas intensive land use has already degraded streams, wetlands, and their riparian corridors. Where riparian areas have been damaged, fencing and/or active restoration such as stabilizing stream banks and replanting is likely necessary.

Assistance for restoration activities may be available from government and/or non-government sources.

Contact the nearest DFO, MELP, or MAFF office for information about available assistance, and about local conservation groups that may be able to help you make changes.

How will stewardship affect your operation?

Some stewardship actions may already be part of your farm management. In many cases stewardship efforts will benefit you, by providing long term viability of your operation as demonstrated in following sections.

Stewardship actions will vary depending on:

- The type and intensity of agriculture;
- The risks of causing habitat damage and pollution;
- The sensitivity of the area.

Photo Credit: M. Crowe

Fencing to control livestock access to streams is a practical inexpensive way to protect habitat.

Photo Credit: M. Crowe

Where streams have been severely damaged, restoration protects are required to restore habitat. This photo shows stone placed to protect the banks and create riffles and pools in the stream.

Site Planning

The most efficient new or expanding operation will, through planning, put everything in the right place the first time, and avoid the cost of fixing problems later on.

Many farms were established long ago. With on-going operations, it helps to step back from what exists to consider what should be. Even for long-established operators it is useful to sketch - on a plan of your farm land - the factors that determine the capability and sensitivity of your land.

Main Issues

1. Know Your Land, Know Your Watershed.

Good planning can prevent or reverse damage to fish and wildlife habitat, and water quality. It can also make farming your land more financially and personally rewarding.

Identify the following features on a plan of your farm:

Native vegetation - document wooded areas, native riparian areas, wetlands, and rare or sensitive habitats like garry oak meadows on Vancouver Island, interior grasslands, native prairie, or old growth forest. Carefully consider the agricultural capability of the underlying land before removing native vegetation.

Wetlands and watercourses - Identify these natural sources of clean water. Clearly distinguish between wet land, which can be managed by drainage and tillage, and wetlands, which should be conserved.

Note the width and condition of riparian areas around wetlands and watercourses.

Natural habitats - Note existing wildlife habitats, such as areas which are used by moose, deer, birds of prey, waterfowl, and other species.

Wherever possible accommodate continuity between natural areas, to provide migration corridors for wildlife.

Topography - watch for erosion prone areas: steep or long, uninterrupted slopes. Soils on ridges which are lighter in colour than surrounding areas may be a sign of erosion.

Soil Types - it is important to know the soil types on your farm in order to identify prime production areas and areas with the greatest erosion potential such as sandy or silty soils.

Marginal lands - Lands which are excessively steep, dry or have shallow, stony, or poorly drained soils may bring marginal returns. Carefully consider both the development and ongoing management costs of marginal lands to ensure they will be worth putting into production before disturbing a natural system. Lands that are marginal for farming are often important wildlife habitat.

Climate - you can't alter the climate, but you can plan for it, and for how it affects your land. Note prevailing wind directions, frost pockets, and any other weather and climate information that may affect your plans.

Photo Credit: B. John

This livestock operation has been renovated with fencing to restrict livestock access to the shoreline to a single well-defined access point. Damage to vegetation along the stream caused by previous uncontrolled access still needs to be addressed.

A well thought out plan can:

- *Help identify issues which need to be addressed before they become big, expensive problems;*
- *Help to secure financing from financial institutions that are beginning to request environmental assessments to accompany loan applications.*

Carefully consider the costs and benefits of bringing fragile or marginal lands into production before removing natural vegetation.

Intensive agriculture often degrades fragile or marginal land resulting in reduced productivity and low economic returns over time.

Each fenceline represents a loss in crop production.

Can some upland fencelines be removed to increase field area, to compensate for establishing protective fencing around sensitive habitat or fragile land?

Can water storage or sediment control ponds be located in field corners, to minimize impacts on your land base?

2. Planning for Field or Range Production

Use your farm plan to keep the 'big picture' of your land's capability in mind. To incorporate conservation efforts into the management of your farm follow these steps:

Evaluate prime production areas, identify natural areas to remain, and areas which require restoration in a farm improvement plan

Streams and wetlands should generally be conserved with vegetated riparian buffers at least 15 metres (50 feet) wide on each side of the watercourse in order to guard against erosion, and to protect these important habitats.

Narrower buffers are better than no buffers but may be appropriate only for small grassed gullies and streams wetted for just a few weeks each year.

Develop a livestock management plan

This plan should identify preferred distribution, density, feeding and watering areas, and relationships to crop production and rotation.

Plan a soil conservation and erosion control strategy

Soil conservation plans may include crop rotation, tillage options, nutrient management, cover cropping, and windbreaks (See Pages 29-32).

Plan pesticide and herbicide applications

Allow for a pesticide-free zone around all surface waters including ditches which flow through the treated area. This pesticide-free zone should generally be at least 10 m wide to protect surface waters from toxic chemicals.

Plans should include an additional application-free zone to capture spray drift. In sensitive zones, noxious weeds can be addressed with spot applications from a backpack sprayer.

Plan irrigation systems

During low flows, water stored from high flow periods provides a secure source of irrigation water, and also helps to protect the minimum instream flows required by fish.

If the landscape provides a choice, use a warmer water source for irrigation and leave cool water for fish. See Pages 37-38. for more details.

Fenceline and field layouts

Design field layouts to accommodate your new operational and conservation plan. Be sure to coordinate riparian and other habitat leave areas with fenceline layouts.

Identify access routes to fields and rangeland

Access routes should be well set back from riparian areas and sensitive habitats. Vehicles and livestock can be very destructive to sensitive habitats.

Construct drainage and finish of roads so they will support intended uses without causing erosion.

Where stream crossings are necessary bridges should be used instead of culverts, and their number should be minimized to avoid disruption of the stream bank. Bridges should be designed and located to avoid impacts to streams. (see Pages 45-48).

Fording streams with vehicles and equipment damages habitat and may be an offense under the Federal *Fisheries Act*.

Photo Credit: M. Crowe

Site plans should include bridge crossings where access across streams and rivers is required.

3. Planning for Buildings and Storage

Buildings include residences, barns, sheds, greenhouses, and other shelters and storage facilities. When considering improvements to existing facilities, or new buildings and storage areas:

- Plan access routes, buildings and storage areas to be located away from streams and wetlands. Setbacks should be a minimum of 15 m from the natural stream or wetland boundaries or top of bank, whichever is greater.
- Confined livestock areas should be located at least 30 m back from surface waters and domestic water sources.
- Manure storage structures should also be located a minimum of 30 m away from domestic water supplies.
- Storage sites for petroleum, pesticides, and other chemicals should be located a minimum of 30 m from any well, 15 m away from watercourses, and be equipped to contain a spill.
- Plan drainage to keep surface runoff away from buildings, storage areas, and any other contaminant sources, and avoid direct runoff to streams. Keep clean water clean.
- Avoid generating runoff during construction by scheduling projects for dry months. Control drainage of water around construction sites and use silt fences (hay bales can work), sediment detention ponds, revegetation, gravel access pads, or other erosion control techniques as necessary to keep sediment out of water (see the Land Development Guidelines for details).

Riparian fencing will help to protect stream vegetation and stabilize streambanks. Where vegetation has already been lost, or stream banks are eroding, stream restoration works may benefit your farm. Consult with environmental regulators to find out what assistance is available.

Additional Stewardship Actions

- Get out during the **worst** weather conditions to identify problems as they occur.
- Share ideas and learn from others: get a peer review of your farm from a fellow producer.
- Establish priorities for improvements and implement them one step at a time.
- Monitor the results of your actions and discuss successes with your commodity group.
- Evaluate whether or not you are being impacted by upstream activities. If so, try working with your neighbours and/or local government to find solutions together.
- Consider whether your agricultural activities are helping or hindering downstream users - try to be the kind of neighbour you like to have!

Challenges

- Funding your improvements.
- Accessing information and expertise.
- Existing farms: how to deal with structures in place which do not have adequate setbacks.
- Obtaining cooperation from upstream neighbours (including urban neighbours and municipal governments) who may be causing impacts to the watershed which affect your farm.

Tip: Use riparian vegetation as a natural buffer to reduce impacts of existing buildings which are within 15 m of a stream or wetland. A healthy riparian area will help to remove contaminants from runoff, and prevent erosion near your buildings.

As little as 1 litre of petroleum product can make 1 million litres of water undrinkable.

Agricultural runoff contains many substances which are decomposing. The decomposition process consumes oxygen. If agricultural runoff reaches a watercourse it can deplete the available oxygen. Without oxygen fish will quickly die.

Conservation Checklist

	Yes	No	Notes
1. Are you not in compliance with the *Code of Agricultural Practice for Waste Management*?	☐	☐	
2. Do you lack a plan of your farm layout?	☐	☐	
3. Are you experiencing losses of land to stream bank erosion?	☐	☐	
4. Is your riparian vegetation being damaged by livestock, tillage, or machinery access?	☐	☐	
5. Are land uses in the upper watershed leading to increased flooding on your farm? If so, somebody else has a stewardship problem which you should bring to their attention?	☐	☐	
6. Are your costs of farming marginal lands greater than returns?	☐	☐	
7. Could a spill of petroleum or chemicals from storage areas on your farm reach a waterway or groundwater?	☐	☐	
8. Is field productivity dropping due to erosion of top soils?	☐	☐	

Reminder: a "YES" answer indicates that actions are necessary to address a conservation problem.

Photo Credit: MAFF

Photo Credit: MAFF

For More Information

1. Land Development Guidelines for the Protection of Aquatic Habitat, DFO and MELP.
2. Stream Stewardship: A Guide for Planners and Developers, DFO and MELP.
3. Section 7 (Water Act) Users Guide to Changes in and About a Stream, MELP.

Livestock Management

Grazing patterns, livestock numbers and distribution, and manure management all have implications for soils, water quality, and fish and wildlife habitat. Small changes in your operation can have major benefits for your farm, for streams and wetlands, and for other producers downstream from you in the watershed.

Main Issues

Good livestock management will minimize livestock health problems, and also protect water quality and sensitive habitats.

1. Managing Livestock Handling and Feeding Areas.

Remember the following provisions of the Code for Agricultural Waste Management when managing these areas:

a) Confined Livestock Areas

Confined livestock areas include feedlots, paddocks, corrals, exercise yards and holding areas.

- Confined livestock areas must be located at least 30m (100 ft.) from the high-water mark of any watercourse or wetland. Livestock within these areas cannot have access to natural watercourses or riparian areas.
- Contaminated runoff from confined livestock areas must be contained and managed as manure - it must not reach surface or ground waters where it can cause pollution.

Photo Credit: MAFF

Small changes in livestock management can have benefits like reducing livestock health problems while improving water quality and protecting sensitive habitats.

- All clean runoff should be diverted away from livestock areas - this will minimize the generation of contaminated runoff, make manure management easier, and keep livestock pens more dry.

b) Seasonal Feeding Areas

Seasonal feeding areas support livestock feeding operations for part of the year, and also produce a crop.

Address the following issues within seasonal feeding areas (some of these recommendations are not addressed by the Code):

Runoff Management

- Runoff should be managed in the same way as described for confined livestock areas.
- Ensure that runoff from calving areas and seasonal feeding areas does not reach surface waters.

Animal watering

- Off-stream livestock waterers should be used wherever possible, particularly on sites with large numbers of livestock.
- Where access to natural watercourses is needed, it should be restricted to locations where developed access has been established.
- An improved surface, such as gravel or cobble, combined with fencing in the immediate vicinity will limit use of the entire stream bank, minimize loitering in the stream, localize impacts, and allow cleanup if and when required.

Livestock shelter

- Maintain groves of trees, or provide some shade such as a roofed shelter beyond the riparian zone to draw livestock from sensitive areas.

Livestock may drink up to 60 litres of water each, per day. If left unmanaged, livestock are attracted to riparian areas for water, shelter, and forage, resulting in high animal densities near water. Good livestock management is required to prevent loitering and reduce impacts to sensitive streams and wetlands.

Livestock exert about 10 times the weight per unit area as a D9 Cat. Sensitive stream banks can't withstand this for long.

From "Caring for the Green Zone".

Solar-powered electric fencing can reduce costs associated with maintaining livestock barriers in sensitive areas.

Management of range lands is addressed through the Forest Practices Code (FPC). Producers should follow MOF guidelines for managing livestock on crown range.

Grazing and Feeding

- Control grazing in the riparian area to prevent damage to streambanks, particularly during wet weather when they are most vulnerable to trampling.
- Manage grazing to ensure enough riparian vegetation remains to stabilize stream banks. A healthy riparian area contains lots of young plants.
- Place additional feed at new locations regularly so manure is evenly distributed within the feeding area. Locate feeding sites where ground slopes away from watercourses.
- Additional feed should be placed at least 30 m from waterways and wetlands - further away where ground is frozen.
- Locate all feed supplements such as salt and mineral blocks well back from streams to reduce loitering near the riparian zone. On crown range land comply with conditions specified in your Range Use Plan which is required under the Forest Practices Code.
- Where livestock access to the riparian area remains a problem despite making these efforts, consider using low cost electric fencing.

Photo Credit: DFO

Fencing to restrict livestock access can protect livestock, water quality, and sensitive habitats.

2. Feed Handling

Runoff or leachate from feed storage sites or waste feed can introduce large amounts of nutrients and organic matter to watercourses. This runoff can be toxic to fish and can deplete the oxygen from surface waters resulting in the death of aquatic organisms.

When handling feed

- Contain and store any seepage from silage storage and apply to crop land only in accordance with *Code of Agricultural Practice for Waste Management*, or handle with manure.

3. Off-Stream Livestock Watering

Livestock diseases are more readily transmitted when their drinking water becomes contaminated with animal wastes. Also, when drinking water becomes polluted with silt, manure, and algae, livestock will drink less and as a result will produce less milk and beef.

Establishing off-stream watering facilities will help draw animals away from sensitive riparian areas.

Several innovative livestock watering systems are available which do not require electric power:

- Sling pumps (water current powered);
- Water harvesting (storing rainwater);
- Cattle-operated nose pumps;
- Solar-powered pumps;
- Windmills;
- Gravity-fed systems.

They all provide cost-effective alternatives to conventional livestock watering systems.

Maintain livestock waterers to prevent leakage and overflow, which can generate contaminated runoff.

Keep manure out of water, and keep water out of manure.

Additional Stewardship Actions

- Restrict the access of your livestock to riparian areas with fencing, and by taking steps to draw them away from sensitive areas;
- Encourage your upstream neighbour to match your standards for protecting the riparian area and water quality - for the health of your livestock and the stream;
- Make sure your colleagues are all aware of these five good reasons to restrict livestock access to riparian areas:

1. Studies show that keeping livestock out of riparian areas results in better weight gains, as animals spend more time feeding, and less time loitering in overgrazed areas.
2. Fencing protects livestock from drowning in streams during high flow periods.
3. Less loitering in muddy streams results in a lower incidence of foot rot.
4. Livestock loitering in or near streams will result in degraded water quality - which is bad for livestock and for fish.
5. By protecting stream banks from damaging hoofs, you protect your land from erosion.

Challenges

- Addressing tax disincentives which could discourage protection of riparian leave strips and other sensitive habitats (i.e. removing ALR land from production).

Photo Credit: M. Crowe

Nose pumps can be placed back from riparian vegetation so that cattle are able to pump water on demand without trampling streamside vegetation.

Photo Credit: M. Crowe

Water can be pumped reliably to off-stream watering facilities using solar energy.

Photo Credit: M. Crowe

Using a sling pump water can be pumped to off stream watering facilities. The sling pump uses the power provided by the moving water.

Tip: flexible fencing (for areas of high snow fall) can withstand conditions which would cause conventional fences to collapse.

Conservation Checklist

	Yes	No	Notes
1. Is contaminated runoff from livestock areas reaching surface waters at any time of the year?	☐	☐	
2. Do livestock have uncontrolled access to watercourses?	☐	☐	
3. Is there evidence of livestock damage to riparian vegetation, such as an absence of young plants, trampling, or any related stream bank erosion?	☐	☐	
4. Is there runoff or leaching from feed storage areas?	☐	☐	
5. Are streams showing signs of excessive algal growth?	☐	☐	

If the answer to any of these questions is "YES" you should take actions now to address the problem, before it becomes bigger.

For More Information

1. BC Livestock Watering Manual - MAFF
2. Why Keep Livestock Out of Watercourses? - MAFF
3. Sources for Livestock Water - MAFF
4. Innovative Livestock Watering Options - MAFF
5. Improved Cattle Access to Water Using Geogrids - MAFF
6. Water Pumping Using Solar Energy (Photovoltaics) - MAFF
7. B.C. Agricultural Fencing Handbook (1996) - MAFF
8. Alternative Livestock Watering Facilities - Interior Wetlands Program/Ducks Unlimited
9. Livestock Grazing on Western Riparian Areas - E. Chaney, USEPA, 1993

Photo Credit: B. Locken

Is there evidence of livestock damage to riparian vegetation, such as an absence of young plants, trampling, or any related stream bank erosion?

Photo Credit: L. Nikl

Are streams showing signs of excessive algal growth? This is an extreme example of what can happen when too many nutrients reach a stream.

Waste Management

The proper management of waste products such as manure, wood waste, milking center effluent, and dead animals prevents pollution of air, soil and water. Producers are responsible for ensuring that the environment is protected from contamination by agricultural wastes.

Main Issues

Manure, a resource or a waste?

Manure is a valuable source of nutrients when properly managed. It promotes crop production, and is a good soil conditioner.

When improperly managed, manure can be very damaging to the environment.

Here are six good reasons for keeping manure out of water:

1. Manure can be a source of pathogens (bacteria, viruses, and other organisms which cause disease). Water which is contaminated with manure can be a vehicle for spreading disease to livestock on other farms and to people.
2. Water which is contaminated with manure will be unpalatable to livestock.
3. Excess nutrients (nitrogen and phosphorus) from manure cause accelerated algal growth which damages fish habitat and depletes dissolved oxygen. Death of fish and other aquatic organisms can result.
4. The organic matter in manure consumes oxygen from water as it decomposes. The resulting low dissolved oxygen levels can kill fish.
5. Manure runoff contains high levels of ammonia, which is toxic to fish.
6. When more nutrients (nitrates) are applied to land over an unconfined aquifer than crop plants can take up, nutrient leaching occurs. Over a period of years nitrate concentrations will reach toxic levels in groundwater, making the water undrinkable.

Each of these six types of impacts have been documented in numerous places in B.C. It is time to change practices!

If the amount of manure generated on your farm is greater than what can be used effectively as a fertilizer by your crops, then another destination must be found for the excess manure.

The benefits of good manure management include:

- Less money spent on chemical fertilizers;
- Healthy waterways, wetlands and groundwater.

The key to good manure management is a nutrient management plan, which addresses the following:

Appropriate Manure Storage

- Construct manure storage facilities to prevent escape of manure or manure leachate to surface and ground water.
- Ensure capacity is large enough to store manure until it can be effectively used as a fertilizer. Plan some extra capacity to accommodate early falls and late springs.
- Allow capacity for storing contaminated runoff from livestock handling areas, as well as rainfall, and milking center wastes if needed.
- Cover manure storage to maximize capacity. You won't need such a large facility if it is not collecting rainwater.
- Locate storage well back from watercourses and water supplies - 30 m minimum from any source of domestic water, and 15 m minimum from any watercourse or lake. Greater distances are preferred.
- If storing liquid manure, secondary containment (such as a berm) is suggested for storage facilities which are near a watercourse or lake.

High potassium levels in soil can lead to elevated levels of potassium in forage, which causes health problems in livestock.

Minimize the amount of feed which you import to your farm, as potassium from feed will end up in manure, and then be spread on your soil.

It has been estimated that more effective use of manure as a fertilizer in the Lower Fraser Valley could save producers about $12 million each year on fertilizer costs. This would also reduce the total loadings of nutrients to the environment.

When 1 litre of milk gets into a stream and decomposes it uses up all the oxygen in 10,000 litres of water. Fish need oxygen in the water to live.

Runoff from manure spread on snow was sampled where it entered a B.C. creek. The ammonia concentration was about six times higher than the concentration which is toxic to fish.

Tip: Separating solids from manure will leave a liquid fraction that contains all of the nutrients needed to fertilize crops.

Solids can be composted to produce a major ingredient for potting soil mixes. (Contact Agriculture and Agri-Food Canada - PARC)

Manure Application

Manure applications must be planned and timed so that:

- The amount and timing of nutrient applications match soil conditions and optimize crop uptake;
- There is no runoff or excessive leaching to any body of water. Avoid applications during seasons of intense rainfall and do not apply manure to snow, frozen ground, or saturated soils;
- Manure should not be applied within the 15 m riparian leave area of any permanently wetted water body.

Excess Manure

If the amount of nutrients in the manure generated on your farm exceeds what you can appropriately use as a fertilizer:

- Investigate the carefully balanced feeds which enhance nutrient uptake by livestock and reduce the nutrient levels in manure;
- Arrange for appropriate off-farm disposal (i.e. composting and selling, or finding another user) of any remaining excesses.

Photo Credit: B. Scott

Cover wood waste storage, to reduce pollution caused by leaching.

2. Milking Parlor Wastes

Milking center wastes contain nutrients, organic matter, detergents, and disinfectants. Proper disposal is essential to preventing pollution.

- Milking center wastes should be collected and stored for application to crop land. These wastes can be stored separately or added to manure storage if manure is handled as a liquid.
- Direct discharge of milking center wastes to watercourses is not allowed.
- Subsurface disposal through a tile field is not reliable and would require a Waste Management Permit from MELP.

3. Woodwaste

Leachate from woodwaste can be extremely toxic to fish, and can deplete oxygen levels in surface waters. Even after several years, woodwaste can release harmful leachate.

Leachate can be generated whenever woodwaste comes into contact with water. Treatment of leachate can be difficult and technologies are unproven. Preventing leachate from forming is easier than dealing with treatment.

To reduce the problems associated with woodwaste

- Minimize the amount of woodwaste used. Woodwastes cannot be used for landfill and should be avoided as a material for road construction.
- Maintain a 30 m buffer zone between woodwaste deposits and domestic water supplies and watercourses.
- Store woodwastes in dry locations which are not subject to runoff or flooding.
- Keep woodwastes covered, particularly in areas with high precipitation.
- Do not use chemically treated woodwaste - it can introduce highly toxic chemicals to your soils.
- Producers using more than 50 cubic metres (65 cubic yards) of woodwaste material per year are requested to submit "Wood Waste Discharge Information Sheets" to MELP.

4. Dead Animal Disposal

Dead farm animals should be disposed of at rendering plants or by other means identified in the *Code of Agricultural Practice for Waste Management*.

If burial pits must be used they:

- **Must** be located at least 30 m from any source of domestic water or any body of surface water;
- They **must not** contain more than 700 kg of dead animal;
- **Must** be at least one meter above the groundwater table;
- **Must not** be subject to seepage or flooding;
- **Must** allow for cover with at least 1 m of soil.

5. Other Waste Materials

Other wastes which can be generated on a farm or ranch - such as pesticide containers, farm medical wastes, and domestic waste - need to be handled properly.

To prevent problems

- Avoid burying any waste materials.
- Never put medical wastes in manure or compost. Unwanted or expired medical supplies should be returned to suppliers or contact MELP for advice on proper disposal.
- For disposing of pesticides and containers see pages 34-35. **Do not burn pesticide containers as this is illegal.**
- Proper disposal in an approved landfill is the best alternative if reuse or recycling is not an option**.**
- Only certain materials can be burned, and in some areas burning is not permitted at all. *Contact MELP, BC Ministry of Forests and your local government for details on burning regulations***.**
- Establish a manure-free zone around watercourses to protect water quality and reduce transmission of animal diseases between farms.

Additional Stewardship Actions

- Try to balance livestock numbers with your forage land base to reduce reliance on purchased feeds. This can protect you from fluctuating feed prices, and minimize accumulation of undesirable substances, (e.g. potassium) in soils.
- Recycle nutrient solutions in greenhouses to reduce water use and the discharge of wastes to the environment, and to lower fertilizer costs. Researchers are developing ways to remove compounds which accumulate in the recycled solution and which can be harmful to crops, so that further benefits can be gained from recycled solutions.

Challenges

- Managing manure properly when the weather brings much longer winters or rainy seasons than usual.
- Properly managing manure when livestock numbers are large relative to the size of your land base.
- Increasing the market for composts produced from manure.

Runoff from spent mushroom compost in south coastal B.C., which was draining into a stream, was found to contain extremely high concentrations of ammonia. Even when diluted 100-fold the runoff still killed fish.

Generally, if water is cool, flowing, and looks clean, it will probably support a fish population.

New Ideas

New technologies which make it feasible to apply manure as a fertilizer on growing crops without leaf burning and foliage contamination:

- The sleighfoot applicator deposits manure in bands on soil beneath the leaf canopy. Trials completed by the Dairy Producer's Conservation Group show that farmers can expect a 10-15% yield advantage in their crop in comparison with splashplate manure application.
- Portable solid-liquid manure separators make it feasible to apply only the liquid portion to an established crop. Studies on grassland show that total nitrogen uptake is almost double the uptake from whole manure.

Contact BCFA for information on new technology and equipment, and new farming approaches. They may be aware of alternatives which could work on your farm.

Conservation Checklist

	Yes	No	Notes
1. Is an up-to-date nutrient management plan still on your "to do" list ?	☐	☐	
2. Are you applying nutrients before testing soil nutrient levels?	☐	☐	
3. Are you spreading manure without knowing its nutrient content ?	☐	☐	
4. Is there any runoff or seepage from manure or compost storage areas ?	☐	☐	
5. Is manure spread on snow, ice, or on bare ground in the fall or winter?	☐	☐	
6. Are milking center wastes not collected, stored and applied to crop land?	☐	☐	
7. Is leachate forming at any wood waste storage or former disposal site?	☐	☐	
8. Are pesticide containers disposed of on the farm?	☐	☐	
9. Are there unwanted pesticide concentrates on the farm?	☐	☐	
10. Are dead animals or other waste materials burned or buried on the farm?	☐	☐	
11. Can greenhouse nutrient solutions reach streams or groundwater?	☐	☐	

Remember, a "YES" answer indicates a need for stewardship action.

For More Information

1. Obtain the appropriate B.C. MAFF Environmental Guidelines document:

   Guidelines are available for the following industries:

   Beef, Berry, Dairy, Field Vegetable Producers, Greenhouse Growers, Horse Owners, Mushroom, Nursery and Turf, and Tree Fruit and Grape Producers.

2. The News Spreader - Dairy Producers' Conservation Group Newsletter.
3. Stockman Grass Farmer - a monthly paper.
4. Fall and Winter Manure Management Strategy Information Sheets for the Fraser Valley, and Okanagan/Shuswap areas. MELP.

Photo Credit: J. Nener

Soil Management and Conservation

Conserving soil is fundamental to productive agriculture. Soils develop slowly, but can be easily harmed by human activity, causing decreased crop production, higher management costs, and impacts on the aquatic environment. Many steps taken to protect soils can also benefit water quality and fish habitat.

Main Issues

1. Soil Fertility and Nutrient Management

Good crop productivity depends on delivery of the right amount of the right nutrients, at the right time to meet crop needs.

Every farm should implement a well designed nutrient management plan which:

- Includes regular soil nutrient testing;
- Accounts for the nutrients which are applied when manure is spread;
- Monitors crop tissue nutrient levels with plant tissue testing;
- Coordinates the amount and timing of nutrient applications with crop requirements;
- Utilizes manure (or other organic material) to maintain a good level of soil organic matter which will improve soil structure and productivity.

Photo Credit: PARC (Agassiz)

Italian ryegrass was planted between corn rows in spring, and grows rapidly in the fall after the corn is harvested. The ryegrass captures residual nutrients and provides a protective cover to the soil over winter months. It also produces 3 to 4 t/ha. of top quality feed that can be grazed or ensiled before the end of April.
(From *Growing Ideas* 1995 Vol. 2 No. 1 Agriculture and Agri-Food Canada - PARC)

Rainfall and irrigation water can carry nutrients and oxygen-consuming substances from fertilizer into nearby watercourses. As with manure, chemical fertilizers should not be spread within the 15 m buffer zones of streams, ditches or wetlands. A well vegetated buffer zone around the watercourse will help to absorb nutrients and protect water quality.

Photo Credit: Locken

Crop production must be set back from watercourses. Without a buffer the effects of soil erosion, and nutrient runoff can be direct and devastating to a stream.

Accounting for the nutrients which are applied when manure is spread can dramatically reduce the money spent on inorganic fertilizers.

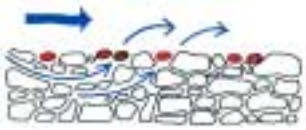
Some B.C. producers have achieved reductions of up to 100% of inorganic fertilizer use with significant cost savings and no decline in yield.

A study of flooding and erosion in B.C.'s interior showed that devegetated river bends were almost 30 times more likely to experience major bank erosion than vegetated river bends during flood events.

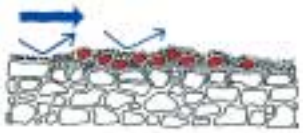
Plants return organic matter to the soil, which increases water and nutrient holding capacity. Some types of organic material can hold nine times their own weight in water.

Stream water normally percolates through clean gravels in the stream bed delivering oxygen to fish eggs which are incubating there.

Sediment smothers fish eggs by filling the spaces between stones in the stream bed. This prevents stream water from percolating into gravels, and cuts off the supply of oxygenated water to fish eggs.



Clean Spawning Bed



Sediment Covered Spawning Bed

2. Soil Erosion

The right soil conservation practices - which reduce the risk of erosion - can vary from site to site, depending on soils, climate, topography, and cropping systems.

Soil erosion decreases crop yields and property values, and increases land management costs. It also introduces sediment, and soil-bound contaminants into aquatic habitats.

To minimize erosion:

- Maintain or restore a zone of permanent riparian vegetation, preferably trees, shrubs, and grasses along watercourses. Their roots will help to hold the stream bank together.
- Till and plant along the contours of sloping fields to reduce downhill movement of soils and water.
- Consider using conservation tillage. This involves leaving at least 30% of the soil surface covered by crop residue after seeding, which protects soils from the erosive forces of rainfall, runoff, and wind.
- Further minimize winter bare soils by leaving crop residues, planting winter cover crops, and planting cover crops between crop rows where appropriate.
- Use crop rotation and the addition of organic matter to maintain soil structure so that water infiltrates easily rather than running off.
- Try using grass swales or terraces to break long slopes into shorter segments. This will decrease the velocity of surface runoff.
- Protect drainage structures and subsurface drain outlets from erosion.
- Use trees and natural fencerows as windbreaks where wind erosion is a problem; riparian vegetation can provide an effective wind break.
- Permanently grass waterways that carry surface flow across fields.

3. Soil Compaction

Soil compaction is a very common degradation process occurring on B.C. agricultural land. It usually results from inappropriately timed tillage and heavy machinery traffic. Livestock can also create compaction problems in pasture areas.

Compacted soils increase the risk of overland flow, which causes erosion and can carry nutrients and other contaminants from fields directly to water courses.

Compaction can also damage or destroy vegetation, and can make revegetation efforts very difficult.

To minimize compaction:

- Keep machinery and livestock away from wet fields.
- Use cropping and tillage practices which enhance soil structure and stability of soil aggregates.
- Avoid subsoiling on an annual basis, and in general when the moisture content of the soil profile is above field capacity.

A well designed drainage plan will include ditches designed to accomodate flows without the requirement to clean frequently.

3. Soil Moisture

Soils which are very wet or very dry have lower productivity and are more susceptible to degradation processes such as erosion and compaction.

Poorly drained soils

Poorly drained soils have low bearing strength and can be easily damaged by tillage and traffic. They also produce more surface runoff, warm more slowly in the spring, and create conditions which make crops more susceptible to disease and insect problems.

To improve poorly drained soils (not wetlands!):

- Install a properly designed drainage system which addresses conditions in surface and subsurface soils, topography, drainage from adjacent areas, and climate;
- Encourage soil organisms which improve soil porosity, through the addition of organic amendments or growth of cover crops - worms will thrive with good drainage;
- If areas of wet soils are not manageable consider taking them out of production and returning them to a more natural state.

Coarse-textured soils:

Coarse-textured soils have low water retention capacities and higher irrigation needs. This is because larger soil pore spaces are less able to hold water. These same conditions increase nutrient leaching from the soil, and the potential to contaminate groundwater.

When managing coarse-textured soils:

- Improve water and nutrient holding capacities by increasing the soil organic matter content. Compost and manure are excellent soil amendments;
- Maintain crop residue to shade the soil and reduce evaporation from the soil surface;
- Apply smaller amounts of water more frequently, so water is available to plants as needed;
- Fertilizer application must be managed to eliminate loss of excess nutrients, as any excess may simply leach away and be lost to the crop - polluting watercourses and groundwater.

Photo Credit: S. Cannings

Areas with extremely wet soil should be removed from production and returned to a more natural state.

Additional Stewardship Actions

- Erosion control blankets and geotextiles can be used to address erosion problems.
- New tillage and subsoiling techniques can be used to minimize soil compaction and exposure of bare soils.
- If you need to import nutrients to your farm, consider using a neighbour's excess manure (in the appropriate amounts) - it may save you money and help to solve a neighbour's problem of excess nutrients.

Challenges

- Managing poorly drained soils.

Conservation Checklist

	Yes	No	Notes
1. Are there signs of soil erosion on your property, such as muddy water draining your property or stream bank slumping?	☐	☐	
2. Are fields tilled right up to the edge of any stream or ditch?	☐	☐	
3. Do you apply nutrients to your soils without abiding by a nutrient management plan which includes regular soil and plant tissue nutrient analysis?	☐	☐	
4. Do you have bare soils on your land over winter months, or between crop rows in the summer?	☐	☐	
5. Would you rather drink from the stream at the upstream end of your land than the downstream end?	☐	☐	

Remember, a "YES" answer means there is a need for stewardship action.

Photo Credit: O. E. Langer

If riparian vegetation is healthy, regenerating, and diverse, including grasses, trees, and shrubs, it is likely protecting you from erosion.

For More Information

1. BC Agricultural Drainage Manual, MAFF
2. Land Development Guidelines, MELP, DFO
3. Soil Management Handbook for the Lower Fraser Valley, MAFF
4. Soil Management Handbook for the Okanagan and Similkameen Valleys, MAFF
5. Conservation Tillage Handbook - Peace River Soil Conservation Association.

Pest Management

Main Issues

Pesticides can provide benefits to producers and consumers alike, but can also have negative effects if they enter goundwater or surface waterways. There are ways to reduce both pesticide use, and the risks of pesticide use, while maintaining crop productivity.

1. Integrated Pest Management (IPM)

Managing agricultural pests is critical to successful farm management. Many producers have already adopted sophisticated integrated pest management (IPM) techniques, which help to reduce the overall use of pesticides while maintaining farm profitability.

Some pesticides are powerful poisons which can harm people, livestock, fish, wildlife and crops, and require careful management. They may be directly lethal to non-target organisms, or may injure in ways which ultimately result in death.

Considerable progress has been made in the past decade with developing techniques to adequately manage pests while reducing the use of chemical pesticides.

IPM uses a combination of the following methods to control pests:

- Cultural (e.g., crop rotation which reduces impacts from crop-specific pests, and companion crops which can be used to out-compete weeds between crop rows);
- Physical (e.g., sticky traps);
- Chemical (e.g., pheromones, biocides);
- Biological (e.g. predator insects).

Practicing IPM involves:

- Regular checks for pest problems.
- Correct identification of the pest and a decision as to whether or not pest control is necessary.
- Consideration of all of the methods available for pest control and choice of the least toxic method, or a combination of methods, which will achieve the required crop protection.

Benefits of IPM Include:

- Reduced exposure of workers to toxic chemicals.
- Minimized escape of chemical pesticides to the aquatic environment.
- Reduced chances of pests developing a chemical resistance.
- Reduced pest management costs when properly implemented.

A 1992 study determined that dollar savings to B.C. growers under Integrated Pest Management programs ranged from $59 to $494 per hectare in 1991. Generally these programs reduced insecticide costs by at least enough to cover the pest monitoring costs.

As of 1994, about 8% of berry land and 17% of vegetable crops in the Lower Fraser Valley were managed under IPM programs. Participating producers reduced pesticide use for insect control by over 50%.

2. Pesticide Use

If alternatives are considered but it is concluded that pesticides must be used, minimize the potential for impacts by:

A) Selecting a product which will protect your crop and has the following features:

- **Low solubility** - reduces the amount of chemical which will dissolve and potentially contaminate water;
- **High adsorption** - strong binding with soil particles will reduce the potential for leaching;
- **Rapid degradation** - the faster a chemical breaks down the less likely it is to be washed into surface or ground waters;
- **Low toxicity** - of the pesticide and its breakdown products to non-target organisms.

B) Having the appropriate training:

- Successful completion of the "Pesticide Applicator Course for Agricultural Producers" is mandatory for anyone handling restricted pesticides (Pesticide Control Act). The Workers' Compensation Board (WCB) regulations also require certification for individuals handling pesticides classed as either moderately or very toxic;
- Growers should stay current with the latest information on different chemicals and alternate approaches to pest management.

3. Pesticide Handling Reminders

Most of the pesticides which reach the aquatic environment are there because of poor handling practices leading to spray drift, runoff, leaching, misapplication, or accidental spills.

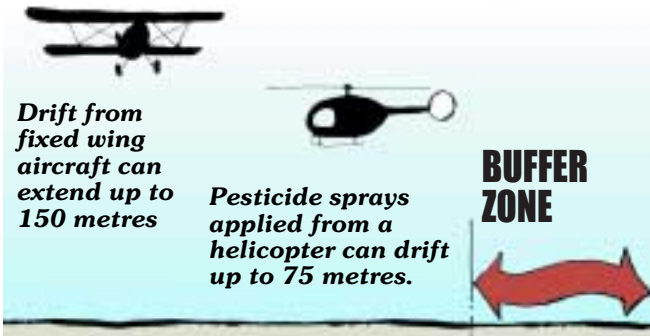
To minimize the amount of pesticides which reach the aquatic environment:

- Follow label instructions for proper storage and application.
- Maintain and calibrate application equipment properly - this is essential to ensuring that appropriate amounts are applied.
- Handle and store the minimum amounts of pesticides.
- Prepare only the required amount of pesticide from concentrate.
- Ensure that setbacks for mixing and storage of pesticides are consistent with the Pesticide Control Program and/or Forest Practices Code Community Watershed Guidelines.
- In general, pesticide storage and mixing sites should be located 30 m or more from domestic water sources and wells, and at least 15 m from watercourses.
- Do not fill sprayers directly from streams or wetlands.

4. Riparian Pesticide-Free Zones and Buffers

To protect riparian vegetation, and prevent pesticides from entering the aquatic environment:

- Establish a 10 m minimum pesticide-free zone around all water bodies, wells, and water sources, including ditches which flow into fish-bearing waters. Consider marking the edges of this zone prior to applying pesticides.



Setbacks are required to ensure that drift from spray applications do not get into the pesticide free (riparian) zone

- Provide additional setbacks beyond the pesticide-free zone to allow for spray drift.
- Avoid pesticide application when wind or breeze will cause spray drift.

Setbacks will vary according to equipment used and weather conditions.

Drifts can commonly travel 5 m from ground-based spray booms or backpack sprayers during calm conditions, 75 m from helicopters, and 150 m from fixed wing aircraft applications. Buffers in excess of these distances should be provided.

5. Pesticide Containers

Pesticide containers can be the source of powerful poisons if not handled properly, therefore:

- Rinse containers according to the Special Waste Regulation of the Waste Management Act and apply rinse water to treated crop land.
- Crush or puncture containers so they will not be inappropriately re-used.
- Dispose of containers as directed on label or in an approved landfill.
- Call MAFF or MELP to enquire about recycling of pesticide containers - new options are currently being developed.
- Do not burn pesticide containers on your land - this practice is illegal.

6. Unwanted Pesticides:

To avoid unnecessary expenditures and disposal, carefully plan pesticide use so that there are no excess mixtures or concentrates. If you have unwanted pesticides:

- Try to return unopened containers to the manufacturer or dealer.
- Excess spray mixtures and equipment rinse water should be applied to fine textured soils away from any watercourses, existing or future wells, in an area not subject to flooding, and where there will be no harm done to current or future crops.
- Contact MELP for further advice.

Additional Stewardship Actions

Use technologies which more effectively deliver pesticides to target plants, such as:

- Shroud sprayers;
- Electrostatic spraying systems which deliver charged droplets that are attracted to leaf surfaces. These are becoming more affordable and available.

Progress is being made on new Integrated Pest Management tools and techniques.

Challenges

- More affordable drift-reducing application technology needs to be developed.
- Training of workers needs to be more responsive to barriers of language, seasonal availability, and the need for regular upgrading.

The Workers' Compensation Board has regulations for Occupational Health and Safety in Agriculture, requiring employers to maintain a record of pesticide applications.

Conservation Checklist

	Yes	No	Notes
1. Do you always use chemicals, to the exclusion of other pest control methods?	☐	☐	
2. Do you spray without accurately identifying the pest type, or the severity of the problem?	☐	☐	
3. Does anyone handle dangerous chemical pesticides on your farm without completing the appropriate "Pesticide Applicator Course for Agricultural Producers"?	☐	☐	
4. Is lack of good housekeeping on your farm creating pest breeding sites (Note: riparian vegetation supports bird species which are effective insect predators)?	☐	☐	
5. Has it been more than a year since your pesticide application equipment was last maintained or calibrated?	☐	☐	
6. Could an accidental spill of chemical pesticides get into groundwater or surface water?	☐	☐	
7. Do you dispose of pesticide containers on the farm?	☐	☐	

Remember: a "YES" answer indicates a need for stewardship action!

For More Information

1. Forest Practices Code: Community Watershed Guidelines, MOF
2. Pesticide Applicator Course for Agricultural Producers, offered by MELP. Contact the nearest MELP office for more information
3. Handbook for Pesticide Applicators and Dispensers, available from MELP
4. General information on pests and pesticide use is contained in the Environmental Guidelines series produced by the MAFF and BCFA, available from MAFF.

Irrigation

Proper design and operation of irrigation systems is critical for both crop production and the aquatic environment. In agricultural areas, irrigation often removes a large proportion of summer stream flows. Many streams in the B.C. interior naturally have very low summer flows, so withdrawals for irrigation have the potential to create real problems.

Main Issues

1. System Selection, Design and Operation

Water use can be minimized by using a well managed system designed by irrigation experts. Crops, soils, slope, energy requirements, wind patterns, method of application, and water source all must be considered when selecting what type of system to use.

For System Selection:

- Select an irrigation system with the most efficient application method (i.e. least evaporation) that will suit the soil, crop type, anticipated weather, soil moisture content, and your needs.
- Consider trickle irrigation systems - they allow for efficient use of water.
- If instream works are unavoidable, they must be completed according to DFO and MELP requirements (see pages 45-48).

For Water Intakes and Pumping:

- Remember that a water license is normally required to withdraw water for irrigation purposes from any surface water source in British Columbia.
- Screen the intakes of your irrigation system. When water is pumped from surface waters without fish screens, small fish enter the irrigation system and are needlessly destroyed. They can also block the irrigation system. Refer to *Freshwater Intake End-of-Pipe Fish Screen Guideline* available from DFO.
- Consider electrical pumps which are clean, inexpensive to operate, and eliminate the chance of contamination from fuel spills.
- Ensure that pumps are well supported and do not cause damage to stream banks.
- Storage dams, diversion structures, and intakes must be designed and constructed to allow fish passage and minimize impacts to natural systems, (see pages 45-48).

Photo Credit: MAFF

Careful monitoring of irrigation requirements with tensiometers helps to reduce water usage, lower costs, and minimize impacts to fish habitat.

*The **Fisheries Act** states that every water intake, ditch, or channel which conducts water away from Canadian fisheries waters must be screened to prevent the passage of fish into the intake or ditch, and to prevent impingement of fish on the screen.*

2. Irrigation Supply Water

Taking irrigation water from streams, especially during summer low flow conditions, can have a major impact on aquatic habitat. To minimize these impacts:

- Minimize water use by carefully monitoring soil moisture, weather, crop needs and growth stage, and schedule irrigation accordingly. This will also reduce energy costs for pumping water.
- Minimize peak withdrawal rates by operating the irrigation system on a 24 hour basis. This will also help to reduce fluctuations in stream flows.
- Take irrigation water from large or warmer streams if possible. Leave cool water for fish.
- Consult DFO or MELP biologists to learn which is your most 'fish friendly' water source.
- Contact the Water Management Branch of MELP to make any necessary changes to water licenses.

Ditches as a Water Supply

Fish inevitably enter constructed irrigation channels and ditches. To minimize harm to fish:

- Avoid causing rapid fluctuations in water levels - fish can be stranded when water is rapidly removed.
- Create barriers to prevent fish from entering new ditches which are not already fish habitat. Lift stations are good barriers to prevent fish from entering constructed channels.

3. Irrigation Drainage Water

Drainage from irrigation systems can carry large amounts of sediment and chemicals into watercourses. To minimize the potential for impacts:

- Operate the system so it does not cause any surface runoff or erosion;
- Use good management practices to minimize the chemicals in drainage water.

4. Chemical or Nutrient Application

The application of fertilizers or pesticides through an irrigation system may reduce costs and make application easier, but it presents a risk for backflow of chemicals into the water supply.

When irrigation systems are used for chemical or nutrient applications:

- They must include an approved backflow prevention device, which must be tested by a certified tester before each irrigation season;
- Apply chemicals only if irrigation application is specified on the label;
- Be sure that spray drift does not enter pesticide free zones when applying chemicals (see Page 35).

Additional Stewardship Actions

- Water recycling (utilizing "gray" water from treatment plants or industry, suitable for some agricultural applications).

Challenges

- Many streams, particularly in B.C.'s interior, are over-licensed for water use. Better irrigation management is required to ensure that use is optimized so that all users, including fish, have enough water.

Ditches & Drainage

Drainage works are often required to sustain profitable crop production. Saturated root systems and ponded water reduce crop growth, and high water tables restrict the agricultural potential of the land by limiting the range of crops that can be grown. Effective drainage is usually achieved by using a combination of surface and subsurface drainage systems.

Drainage systems have a significant potential to impact fish and fish habitat if they are not properly designed, constructed, and maintained. They also present unique stewardship opportunities when good practices are employed.

Photo Credit: MOF

Under many conditions, the water quality and habitat characteristics of ditches allow them to be utilized by fish.

Juvenile fish migrate into ditches, using them as rearing and off-channel habitats.

As a result, some ditches are very valuable fish habitat and must be treated as such.

Ditches - for Drainage and Habitat

Ditches are constructed to provide irrigation water to crops or to remove excess water from agricultural land. The term "ditch" includes a variety of open drainage works ranging from shallow, and often dry furrows, to deep, and permanently wetted canals.

What appears to be a ditch may actually be a length of stream which has been straightened and constrained, resulting in considerable damage to fish and wildlife habitat.

Ditches present two types of concerns for fish and fish habitat:

- Direct impacts, occurring in the ditch where fish and/or fish habitat are supported.
- Downstream impacts, typically related to sediment or water quality problems.

Types of Ditches

The three common types of ditches and their general relationships to fish are:

1. Surface Drainage Ditches

- These are small excavations which are wetted only for short periods (hours to days) following precipitation.
- These are not considered to be fish habitat and do not support aquatic vegetation.

Potential problems are downstream and result from introduction of sediment and water of poor quality.

Photo Credit: MOF

2. Wetted Ditches

- These are larger watercourses with permanent banks, and can support aquatic vegetation;
- These may be permanently or intermittently wetted;
- These may support fish or fish habitats for all or part of the year;
- These are significant to fish even when they do not contain fish because they carry large amounts of water to streams which do contain fish.

These ditches should be managed the same way as natural streams

3. Channelized Streams

- These are pre-existing permanent watercourses which have been diverted, dredged, straightened or dyked.
- Channelizing has resulted in large, permanent losses of habitat, and has greatly impaired many formerly productive streams through elimination of habitat features such as pools, riffles, and riparian vegetation.

Photo Credits: O. E. Langer

Despite impacts, many existing channelized stretches of stream still provide some rearing and spawning habitat for fish, and provide migration corridors for salmon and trout. They must therefore be managed with the same care as natural streams.

*The **Fisheries Act** applies to all habitat that directly or indirectly supports fish including waters that contain fish, waters that pass food and nutrients to fish, and related riparian areas. Fish do not have to be present in a ditch for it to be considered as fish habitat.*

Even if fish are not present in a ditch, the drainage water usually flows into streams containing fish, and unless precautions are taken, impacts to fish usually result. Some fish populations have been severely damaged by agricultural drainage.

1. Ditches as a Water Supply

Because of fish habitat values, all works involving the maintenance of existing ditches and installation of new "wetted ditches" require permission from DFO and/or MELP. You will find it easier to obtain approvals for proposed works if you follow the suggestions below, and in the "Working Near Water" section (Pages 45-48).

Refer to the DFO *Freshwater Intake End-Of-Pipe Fish Screen Guideline* for information on how to effectively screen fish from small water intakes.

2. Ditch Maintenance

Sedimentation and overgrown vegetation are the primary factors which reduce the capacity of ditches to carry water, and result in ditch cleaning efforts. The following ideas will help to reduce the need for ditch cleaning:

Reduce Sedimentation and Erosion

Sediment in ditches means that erosion is taking place somewhere. Dealing with this problem at its source will save valuable soils and also reduce the need to clean out ditches.

If the sediment source is upstream of your property:

- Talk to the appropriate landowner about resolving or reducing the problem;
- Install sediment traps at the upstream end of your property, and additional traps at locations where sediment accumulates. Removing sediment from the traps can maintain the flow capacity of ditches without extensive cleaning.

If the erosion is occuring on your property, consider the following:

- Establish a vegetated buffer strip along ditches to minimize erosion of ditch banks, and capture sediment from surface runoff before it gets into the ditch;
- Clean out sections of the ditch which consistently fill in over time.

Inlet and Outlet Controls

Inlets to and outlets from drainage facilities can be the source of significant erosion.

To prevent erosion:

- Install riprap or protective drop structures if a change in grade occurs where ditches or sub-drainage outlets enter natural watercourses;
- Install blind inlets in areas where standing water from fields enters sub-drainage systems.

Ditch capacity

- If you are cleaning a ditch, increase its capacity so that vegetation does not have to be removed in the future in order to maintain water carrying capacity.
- Mow vegetation during the dry season to gain capacity.

Photo Credit: V. Lalonde

Surface drainage ditches should be sized to accommodate flows after vegetation has been established in the ditch, and with infrequent maintenance.

3. Minimize the Need for New Ditches

Because of the potential for negative impacts on fish habitat, the construction of new wetted ditches will be subject to intensive review by environmental regulators. The construction of new ditches should be avoided where possible. Consider the following suggestions to minimize the need for new drainage.

Drainage System Planning

A drainage expert may have specific ideas about how to reduce the amount of ditching required to adequately drain your land.

Upstream Stormwater Management

Upland developments can disrupt drainage patterns for low lying agricultural areas leading to increased flooding. These changes can result in the need for more drainage capacity. Others in the agricultural community may share your interest in convincing local governments to include adequate stormwater detention facilities with new developments upstream of agricultural land. Work together, and consult the *Land Development Guidelines* and *Stream Stewardship: A Guide for Planners and Developers* for more information.

Stormwater Detention

Minimizing disturbance to wetlands, woods and seasonally flooded areas will retain natural stormwater storage capacity.

Developing stormwater detention ponds can reduce ditch capacity requirements, improve water quality, and possibly provide a source of irrigation water.

Subsurface Drainage

Many shallow field ditches can be replaced by subsurface drainage. Subsurface drainage can increase agricultural productivity and reduce surface runoff, decreasing the loadings of sediment and nutrients to waterways.

4. Design and Location of Ditches

The proper design of ditches and drainage systems can reduce long-term maintenance costs and minimize impacts on the environment.

For details on ditch design, installation and maintenance, consult the B.C. Agricultural Drainage Manual.

For Shallow Field Ditches:

- Design the outfall of shallow field ditches to flow into vegetated buffers, which filter sediment prior to the water entering streams or wetted ditches.
- Provide check dams, blind inlets or clean-outs to trap sediment.

For Wetted Ditches:

- Wetted ditches should be located along field edges where interference with other land uses is minimized, and where there is sufficient grade to drain the land effectively.
- Ditch systems should be designed to minimize the amount of ditching required, and the related cost of construction and maintenance.

Ditch Capacity & Design

- Ditch capacity should accommodate the required flows with some growth of vegetation.
- Fish-bearing ditches should have more of a 'V' shaped bottom than a broad, flat 'U-shaped' bottom. This cross-section will create a narrower channel bottom, with deeper water, so fish are less likely to become stranded. Ditch banks should have a relatively gentle slope to minimize erosion.

Less frequent ditch cleaning means less work for land owners, and less habitat disruption for fish and wildlife.

Establish sediment control ponds so that cleaning efforts can be focussed on a small area. Settled materials can be recovered and applied to fields to augment topsoil.

Hog fuel, corn cobs or any other decomposable material are not acceptable as a binding material. These materials do not work effectively and often cause water quality problems.

5. Maintaining Riparian Vegetation

Routine farm activities such as spreading manure, fertilizers, and pesticides have the same impacts on water quality in ditches as they do in natural streams.

Channelizing of streams and similar instream works are normally no longer permitted by fisheries agencies because they are very destructive to fish habitat.

For wetted ditches and existing channelized streams

- A strip of trees and shrubs along ditches will reduce impacts of farm activities on water quality, if it is wide enough, by filtering sediments and absorbing nutrients.
- Riparian vegetation along streams or ditches will provide shade to help moderate the water temperatures. Shade is most critical along south and west-facing banks.
- The width of the buffer strip which separates agricultural activities from wetted ditches and streams should reflect the intensity and nature of adjacent land uses.
- Areas subject to intensive livestock activities, manure spreading, pesticide use, or frequent cultivation, should have wider buffer strips (minimum 15 m) along streams than fields which are not tilled and do not receive applications of manure, fertilizer, or pesticides.
- Livestock cause the same problems for ditches as they do for streams. Fencing to exclude livestock will reduce slumping and erosion of banks, improve water quality, and provide safer conditions for livestock.

For shallow field ditches

- Having woody riparian vegetation is desirable, but not always practical.

Photo Credit: Ducks Unlimited

The boardwalk out to this intake provides easy access for maintenance with minimum damage to the wetland area.

Photo Credit: O.E. Langer

Ditch maintenance costs can be reduced, and fish habitat protected by planning ditches which are maintained from one side only

6. Constructed Ponds

Constructing water storage ponds can have many benefits. Discuss the potential for benefits to your farm with a consulting engineer, or agrologist.

Ponds should be developed away from the stream channel. In all cases ponds must be designed to withstand flood flows.

Ponds can be designed for any combination of functions:

- **Sediment control:** to collect surface runoff and allow sediment to settle out before water is discharged. The sediment pond will require routine cleaning, however downstream ditches will require much less cleaning - a benefit to you and aquatic life;
- **Detention ponds:** store water in high flow periods and release it slowly in low flow periods. This reduces flooding and helps support base flows for fish, irrigation, and other downstream water uses in dry months;
- **Irrigation Storage Ponds:** to store water for irrigation.

7. Ditch or Pond Construction

Construction and maintenance of "wetted" ditches and ponds must be conducted in accordance with specifications from DFO or MELP. These agencies will provide information on how to complete drainage works while protecting fish, wildlife, and their habitats. Some of the typical requirements are identified in the section "Working Near Water" (Pages 45-48).

Additional Stewardship Actions

To minimize impacts of ditch cleaning on water quality and habitat:

- Perform maintenance on one side of the ditch only, and establish a vegetated "leave" area on the opposite bank. There are several working examples of this approach in the Lower Fraser Valley.
- Vegetated "leave" areas on the south or west ditch banks will provide the most shade to help keep water temperatures cool.
- Ditch cleaning is subject to restrictions from regulatory agencies to protect habitat and water quality.
- Ditch maintenance provides opportunities for habitat improvements, and in some cases this may be a requirement for approvals for ditch maintenance.

Challenges

- Resolving perceived conflicts between needs for drainage and needs for fish.
- An expedient approval system is required for ditch maintenance and construction activities.

Conservation Checklist

	Yes	No	Notes
1. Do your instream works or structures impede fish passage at any time of year?	☐	☐	
2. Can fish enter your irrigation system?	☐	☐	
3. Are there signs that your irrigation system is creating surface runoff?	☐	☐	
4. Do you irrigate without testing and recording soil moisture levels?	☐	☐	
5. Do you obtain irrigation water from a surface water source without a water license?	☐	☐	
6. Do you apply chemicals or nutrients through your irrigation system, without certainty that your backflow prevention is working?	☐	☐	
7. Does your source of irrigation water go dry anywhere during summer months?	☐	☐	
8. Do you undertake extensive and frequent ditch cleaning and maintenance works?	☐	☐	
9. Can manure runoff and other farm wastes be washed into your ditches?	☐	☐	
10. Do your ditches lack a riparian zone that supports grasses, shrubs, and trees?	☐	☐	
11. Are you planning to construct a new ditch in an area with fish-bearing streams?	☐	☐	
12. Do you experience increased flooding due to developments upstream of you in your watershed?	☐	☐	

Remember: a "YES" answer indicates a need for stewardship action!

For More Information

1. B.C. Sprinkler Irrigation Manual, IIABC
2. B.C. Trickle Irrigation Manual, MAFF
3. Chemigation Guidelines for British Columbia, MAFF
4. Freshwater Intake End of Pipe Fish Screen Guideline, DFO
5. B.C. Agricultural Drainage Manual, MAFF
6. Freshwater Intake End-Of-Pipe Fish Screen Guideline, DFO
7. Land Development Guidelines, MELP, DFO
8. Stream Stewardship: A Guide for Planners and Developers, MELP, DFO
9. The Streamkeepers Handbook: a Practical Guide to Stream and Wetland Care.

Working Near Water

This section outlines the agency approvals required for the types of instream work that is often proposed to improve agricultural operations. It also describes some ways to enhance fish and wildlife habitat.

Work conducted in streams, side channels, wetlands, or riparian areas, will be carefully controlled by DFO and MELP because of the potential for damage to fish habitat. Agricultural operations should be planned to avoid work in and about streams and wetlands. If this work cannot be avoided, good planning and lots of lead time will help you obtain the environmental approvals required for working near water.

Agricultural producers should contact MELP and refer to the Users Guide for Works and Changes In and About a Stream for a summary of the Section 7 Regulation under B.C.'s ***Water Act****. The Regulation provides for expedient approvals of minor works in and about a stream.*

Main Issues

1. Key Approvals

If you must undertake work, either in the riparian zone or instream, there are two Acts in particular which will regulate the project - the provincial *Water Act* and the federal *Fisheries Act.*

The *Water Act*

In part, the Section 7 Regulation under the B.C. *Water Act* addresses:

- Works that do not involve any diversion of water, that may be completed within a short period of time, and that have little impact on the environment.

The Section 7 Regulation requires:

- Protection of water quality during works, including prevention of sediment or other compounds from entering a stream;
- Written notification of proposed works in and about a stream be given to MELP at least 45 days prior to proposed commencement date of work, for most works, including:
  - installation of culverts, bridges, or fish screens;
  - restoration or maintenance of ditch or stream channels;
  - cutting of annual vegetation;
  - erosion protection; or
  - fish habitat restoration.

Photo Credit: P. Scales

Environmental regulations help to ensure that work near waterways is undertaken with protection for waterways in place, and at the correct time of the year so that disruption to fish is minimized.

- That specific construction standards be met, which will often be supplemented with conditions from MELP, for habitat protection during construction.

Works that do not require notification or authorization under the *Water Act* include: installation of drain tile outlets, and installation, repair or maintenance of fences which are not in the stream channel.

The *Fisheries Act*

Under the *Fisheries Act* it is illegal to carry on any work that results in the harmful alteration, disruption or destruction of fish habitat, or to deposit a deleterious substance into waters without authorization from the Minister of Fisheries and Oceans.

2. Common Conditions of Approval for Works Near Water

Conditions which may be specified by DFO and/or MELP often include, but are not limited to the following:

- Construction works may only be performed within timing "windows". Windows are established to minimize risks to fish and vary depending upon the area of the province and the fish species present. Get the necessary applications in early, several months before planned works, to avoid missing the timing window(s) in your area;
- A specified minimum instream flow of water may be required while activities or works are constructed;
- Add to, or remove materials, sediment or debris from the watercourse;
- Retain and protect natural materials and vegetation in order to protect habitat and stream channel stability;
- Restore stream or riparian habitats associated with the construction site;
- Control sediment during construction;
- Isolate the construction site from flowing water to prevent sediment or other pollutants from entering watercourses;
- Use silt fences, straw check dams, or other sediment traps to control runoff from excavations, stockpiles or spoil sites until revegetation is complete;
- Plan works so that vegetation will re-establish at the construction site before the wet season.

Photo Credit: M. Crowe

Plant material is grown from cuttings, to be used for a habitat restoration project.

3. Project Management

Where instream works that affect fish habitat are unavoidable, additional ingredients for success include:

Professional help

- Professionals with skills in biology and engineering can help determine proper siting and design of instream works.
- Professionals can develop a project plan, ensuring that agency requirements are addressed in the application for approval, and see that work is completed according to accepted environmental standards.

Environmental monitoring

- For major projects, producers will be required to provide a qualified environmental monitor on-site, to guide construction workers on legal requirements and stewardship practices.

Photo Credit: M. Crowe

Saplings have been planted along the stream. Plastic sleeves help to protect the young plants from animal damage.

4. Agricultural Works in and about Streams

Stream crossings

- Clear span bridges are preferred.
- Choose locations carefully and design to minimize impacts. Fording streams with farm vehicles is not acceptable.

Culverts - must be sized to handle flood flows, and allow fish passage. For large culverts, keeping of natural stream substrates is preferred.

Outlet pools - may be required to promote fish passage and avoid scouring.

Water intakes - must have fish screens.

Drainage outfalls - must be armoured to prevent scouring of erodible soil.

Dams and structures - must provide fish access, including fish ladders if necessary.

Beaver dams - Consult local MELP/DFO staff for guidance and necessary permits prior to removing beaver dams. Any efforts to remove dams should be part of an overall beaver management plan. Poor removal techniques can create many problems including loss of fish habitat, and downstream flooding or erosion of farm land.

Photo Credit: M. Sheng

Both DFO and MELP are looking for opportunities to work with local producers and community groups to restore or improve fish habitat.

5. Habitat Restoration

Where fish habitat is impacted by work in or near a stream, mitigation or compensation will likely be required. Some of the habitat improvements which may be considered include:

- Riparian fencing and planting;
- Gravel cleaning and placement;
- Side-channel creation;
- Off-channel pond development;
- Removal of obstructions;
- Marsh creation;
- Riparian planting along ditches.

Other Habitat Restoration Opportunities

Fish spawning and rearing habitats can be restored in channelized streams by rebuilding the pool-riffle structures in the channel, and re-establishing riparian vegetation.

If your property borders a channelized stream, consider some habitat enhancement opportunities. Consult the nearest DFO or MELP office for their advice on how to make the existing channelized stream more fish-friendly.

Both DFO and MELP are looking for opportunities to work with local producers and community groups to restore impacted streams and to improve ditches. Contact these agencies to see if they can assist with: revegetation around watercourses on your property, side-channel enhancement, or development of over-wintering pools for fish.

Additional Stewardship Actions

- Biotechnical slope protection.
- Harvestable hedgerows can be established to restore damaged riparian zones with harvestable crops which have wildlife and conservation value e.g. filbert trees, berries, and grasses. These approaches should not, however, involve the removal of intact native riparian zones, or use of pesticides.

Conservation Checklist

	Yes	No	Notes
1. Do you notify MELP less than 45 days in advance of your intended project?	☐	☐	
2. Have you planned your project without knowledge of the 'Operating Windows for Fisheries Sensitive Zones' (i.e. timing windows) that apply to your watercourse or wetland?	☐	☐	
3. Do you undertake works in or near surface waters without prior approval from DFO and/or MELP?	☐	☐	

Remember: A "YES" answer indicates a need for stewardship actions.

Challenges

- Increasing awareness of habitat values, so that this knowledge will be included as part of all decision-making processes.

For More Information

1. Section 7 (Water Act) Users Guide to Changes in and About a Stream, MELP
2. Land Development Guidelines for the Protection of Aquatic Habitat, DFO and MELP
3. Policy for the Management of Fish Habitat, DFO
4. Stream Stewardship: A Guide for Planners and Developers, DFO and MELP.

Project Profiles

There are numerous examples of stewardship projects which have been successfully undertaken in B.C. and Alberta, and most involve cooperation between people with very different areas of expertise. The following examples of stewardship projects illustrate the range of technical assistance and support that is available to producers. They also demonstrate the results and advantages of working together for producers, agency representatives, conservation organizations, and for the environment.

The Greenfields Project

The Fraser Delta is a major stopover and overwintering area for 1.5 million birds migrating on the Pacific Flyway. The fertile soils and favourable climate of the area also make the Fraser Delta a highly productive agricultural area.

The Greenfields Project was initiated in 1990 to address damage to winter cover crops caused by heavy grazing from water fowl. Farmers were not receiving the benefits of their good soil conservation practices.

Project description:

Research was done to determine the extent of the grazing, and to develop strategies that maintain wildlife habitat and promote soil conservation. On-farm programs were developed to provide direct benefits to producers who continued to plant winter cover crops.

A communications program was also developed to improve understanding between farmers, wildlife agencies and the public. Improved communication led to a better understanding of the collective needs of farmers, waterfowl, and wildlife.

Project Successes:

Farmers are continuing to plant cover crops - a good soil conservation practice which also benefits wildlife, especially water fowl which spend the winter months in the delta area.

In 1995, a total of 2,442 acres of winter cover crops were supported and monitored by the program, with 29 farmers cultivating between 5 and 255 acres each.

The D.F.W.T. has also set up new programs for establishing grassland set-asides and hedgerows. These stewardship practices can harbour beneficial shrews, insects, and birds that may help to reduce the outbreak of agricultural pests.

Participants:

The project was initiated by partners in the Pacific Coast Joint Venture, and was supported by the Canadian Wildlife Service and Ducks Unlimited Canada. The Delta Farmland and Wildlife Trust (D.F.W.T.) took over administration of the program in 1995. The D.F.W.T. is a non-profit organization which is supported by people with fish and wildlife interests.

" ... farmers thought that the most important message contained in the communication materials was to ensure a future for wildlife, we must also ensure a future for farmers."

81% of farmers who participated in the program and responded to a survey indicated their belief that both farmers and wildlife/ waterfowl benefit from the Greenfields covercrop program.

Greenfields Project Fact Sheet, Feb. 1996.

Salmon River Watershed Management Partnership

Langley, B.C.

The Salmon River watershed supports a population of Salish Suckers which are now considered to be an endangered species in B.C. It also supports cutthroat trout, steelhead, and a large run of coho salmon.

Agricultural and urban development are increasing both in intensity and geographic scope, threatening these fish populations, and the aquifer which residents rely upon for drinking water.

Project Description:

A large project was initiated to examine the state of the watershed, and to identify the environmentally sensitive areas for planning purposes. A community involvement program including education and stream bank restoration was also initiated.

Project Successes:

The Township of Langley, along with federal, and provincial agencies have developed cooperative working relationships. Many residents have become more aware of their natural resources and how to better care for them.

Tree planting programs have been initiated to restore eroding stream banks. Youth tree-planting teams have put in many hours in exchange for a learning experience and an opportunity to contribute to the watershed. Though plantings are relatively new, they are taking well and erosion problems are already reduced. Additional erosion control projects involving tree revetments have been completed with the cooperation of property owners.

Fencing has been installed on farm land to restrict cattle access to the Salmon River and tributary streams. Improved cattle crossings have been developed which protect stream banks and discourage cattle from loitering in and near the stream.

Farmers, fish, wildlife, and the community at large have all benefited from these efforts.

Photo Credit: DFO

Citizens, local farmers and volunteer community groups participated in educational programs and streambank restoration.

Participants:

A wide range of people have participated in this project including many citizens and local farmers, volunteer community groups, the Township of Langley, First Nations, a range of federal and provincial agencies, and several academic institutions.

The program was initially funded by the federal Green Plan. In recent years, the local community group has been very successful at raising funds and is now largely independent of government funding.

Shuswap, B.C.

Similar to the Langley Salmon River Project, this is an ambitious undertaking which addresses issues at a watershed scale. In the Shuswap there is development pressure from agriculture, urban development, and forest harvesting.

A large loss of riparian vegetation and withdrawal of water from the Salmon River have resulted in high summer water temperatures which are lethal to salmonids. Riparian losses and land use practices have also resulted in very unstable river banks, and excessive erosion.

The Salmon River now supports only a very small run of sockeye salmon in contrast with the huge run which used to spawn there.

Project Description:

The project began when the municipal council established a committee to examine environmental concerns in the Salmon Arm area. Committee members soon recognized the need to address issues in a watershed context, rather than just a site-by-site basis. A community round table was established to provide a forum for communication and action within the watershed.

Volunteers wanting to help the struggling salmon population in the river were active in bringing together DFO's Salmon Enhancement Program with farmers who were experiencing severe erosion problems. Other producers became involved with the round table because of concerns about possible shortages of irrigation water.

Project Successes:

A number of stream bank restoration projects were completed to address problems of severely eroding stream banks. Some farmers already have relatively lush growths of willows and red osier dogwood re-established along river banks, which is greatly reducing their losses of land to erosion, and is a positive step forward in improving the stream environment for fish.

Participants:

Participants included agency staff from DFO, DOE, and MELP, ranchers, Ducks Unlimited, and numerous tireless volunteers from the Salmon Arm area.

Eroding streambanks pose problems for landowners. In this example the banks were regraded and protected with rip rap and geotextiles. Riparian vegetation is encouraged with the help of cattle exclusion fencing.

Dennis Lapierre is a sheep producer on the Salmon River. He says,

"There are three reasons why I participated in a riparian restoration project on my property:

As a new owner of this farm, I was shocked to see how much of our hayfield was being washed downstream during the spring runoff. I could see the day when we would have no hayfield at all.

After getting involved in the Salmon River Roundtable, I learned that excessive erosion was just one of an interconnected set of problems caused by incorrect resource utilization. Reduced fish populations and deteriorating water quality were two other consequences.

Because on my farm there were things I could do to help the problem, and there were government agencies willing to help me do it, I did it.

Photo Credits: M. Crowe

It will be a wonderful reward if, as a result of these efforts, my family will be able to see the river improve over time, and the habitat restore itself to some sort of natural balance."

Nicola River Demonstration Project

Project Description:

The Nicola River meanders through the dry Southern Interior of B.C., where it has created a fertile floodplain and productive, marshy oxbows. This river corridor supports more than 250 species of wildlife and fish, more than 10,000 people, and some of the most productive ranches in the province.

Over several decades, various activities have caused extensive damage to the riparian zone. Cottonwood trees were logged and their undergrowth of shrubs and grasses were heavily grazed, resulting in the loss of cover, food, and nesting or breeding areas for many species of birds and other wildlife, particularly where riparian zones of oxbows were damaged. The river banks began to erode, and bank slumping became common. Both water quality and valuable fish spawning and rearing habitats began to suffer.

In 1993 a program was initiated to address the fisheries, wildlife, and agricultural concerns along a 14 kilometer stretch of the river.

Oxbows which had been cut off from the river channel were reconnected, to provide salmon fry with access to rearing and resting areas and to promote the growth of marshy vegetation which supports many species. In addition, excess woody debris which had accumulated in many oxbows was removed, making more habitat available for small mammals, reptiles, and waterfowl. Sinuous channels were excavated within several overgrown marshes to increase water flow, providing habitat for breeding pairs of ducks.

Fourteen kilometers of new fencing was installed to control the access of livestock to the river, and to establish pastures which enable ranchers to better control the timing and intensity of grazing. Willows and cottonwoods were planted to help speed up the regeneration of native vegetation along the streambank.

What was Achieved:

An enormous amount of work was completed over a relatively short period of time by enthusiastic participants, in addition to the projects described above. While all of the improvements are recent, recovery of marshes and riparian zones is already visible. Stream banks are stabilizing, and losses of agricultural land to erosion are declining in the project area. It will be several years before the new cottonwoods are tall enough to effectively shade the Nicola River, but eventually they will help to keep summer water temperatures from reaching recent lethal highs of 29°C.

Participants

Partners included several ranch owners, Ducks Unlimited, the DFO, MAFF, MELP, local school children, and others.

Project Description:

Dogpound Creek originates in the Rocky Mountain Foothills near Cochrane, Alberta.

Prior to the 1950s, Dogpound Creek supported one of Alberta's finest brown and brook trout sport fisheries. These species have freshwater habitat requirements similar to Pacific salmonids. Through the 1960s and 1970s, land clearing and livestock grazing intensified along the creek. Removal of the overhanging vegetation in the riparian zone resulted in higher water temperatures, and erosion of the streambanks increased siltation of spawning beds. Habitat degradation caused the fish populations to decline.

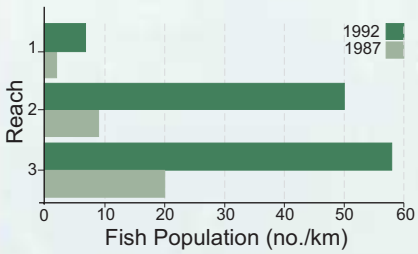
Project Successes:

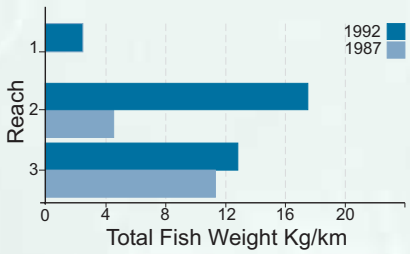
In 1985, the Alberta Fish and Wildlife Division started a habitat restoration project along Dogpound Creek, which included stream bank fencing, bank stabilization and tree and shrub planting.

Changes in habitat quality and numbers of brown trout were monitored after the restoration project began. The graphs show changes in fish numbers and total fish weight per km. of stream between 1988, shortly after restoration began, and 1992, after a recovery period.

Study results show there has been a large increase in fish numbers following stream bank fencing, beaver management, and tree and shrub planting, especially in the upper areas of the creek. There were large increases in both total trout weight (measured as grams of fish per kilometer) and the number of fish per kilometer of creek.

The increase in fish numbers is partly due to a decrease in water temperature during the warmest time of the summer, and an increase in the amount of dissolved oxygen in the water. Reduced sedimentation of stream substrates and improved access to traditional spawning areas which resulted from beaver dam removal have also helped fish populations to recover. Improved conditions and an increase in the amount of suitable habitat available allow more fish to survive.





As riparian vegetation continues to grow and streambanks are stabilized, greater improvements to the quality of fish habitat can be expected in the future. In addition, land will be protected from ongoing losses to erosion, and bird habitats will also be enhanced.

The Roles and Successes Of Agricultural Organizations

Agricultural organizations can have a significant role in pursuing sustainability of the industry and the environment. Agriculture organizations are ideally suited to participate in activities such as:

- Advocacy for agricultural and environmental sustainability;
- Encouraging policy-makers to address emerging areas of concern;
- Pursuing technical solutions to problems.

These organizations can support the efforts of individual producers to implement environmentally sustainable agriculture, and to develop and maintain high environmental standards. A few of these organizations are profiled below:

Agricultural Environmental Protection Council (AEPC)

The AEPC links volunteer peer advisors with farmers who are the subject of a nuisance or pollution complaint.

Peer producers/advisors review the complaint, and help find solutions to challenges faced by individual producers. They also ensure that the person issuing the complaint is advised of the plan which is developed to address the problem.

One of the challenges faced by volunteer programs of this type is that being a volunteer can take a lot of time.

B.C. Cattlemen's Association Enviralert Program:

The Enviralert Program links volunteer peer advisors with ranchers who are facing challenges with meeting requirements of the *Code for Agricultural Waste Management*, or who simply want advice on how to improve their operation.

The Cattlemen's Association further encourages sustainable practices with their Environmental Stewardship Award, which is issued each year to a rancher who has incorporated an outstanding commitment to environmental stewardship into their operation.

B. C. Horse Council Producers' Sustainable Farming Group

Their Environmental Protection Practices project aims to encourage the horse industry to implement more environmentally responsible waste management practices.

Hog Producers' Sustainable Farming Group

This group has been examining ways hog producers can dispose of hog wastes in an environmentally sustainable manner.

Studies have included:

- Cover cropping and utilizing hog manure as a soil amendment at a ball and burlap nursery;
- Using composted hog and poultry manure as a replacement for peat nursery container growing medium

Dairy Producer's Conservation Group Relay Cropping Initiative

The Dairy Producer's Conservation Group was established in 1990 to "encourage the development, evaluation, transfer and adoption of conservation farming practices that sustain soil and water productivity over the long term."

This group has made great progress in developing new manure management and soil conservation techniques, and in exploring new equipment opportunities. It also actively informs producers about new approaches which can benefit both producers and the environment.

One practice promoted by the group is Relay Cropping - the planting of a second crop such as Italian ryegrass between rows of corn in spring, when corn is at the 6-9 leaf stage. The relay crop is then well established by the fall when the corn crop is removed. The benefits which can come from a relay crop include:

- The second crop may be ploughed under to increase organic matter content of the soil;
- A vigorous, high quality forage crop the following spring;
- The second crop serves as a cover crop to protect soils during the fall and winter months;
- Absorption of "excess" nutrients from the soil after corn is removed, which reduces nutrient leaching to surface and ground water.

Successes:

Field test results from 1995 show promising results:

- Up to triple the fall biomass yield of fall planted cover crops was obtained;
- Double the fall nitrogen recovery of fall planted cover crops.

Keys to success include effective weed control and uniform germination and establishment.

Participants:

In 1996, numerous producers collectively planted at least 300 acres of relay crops in the South Coastal Region of B.C.

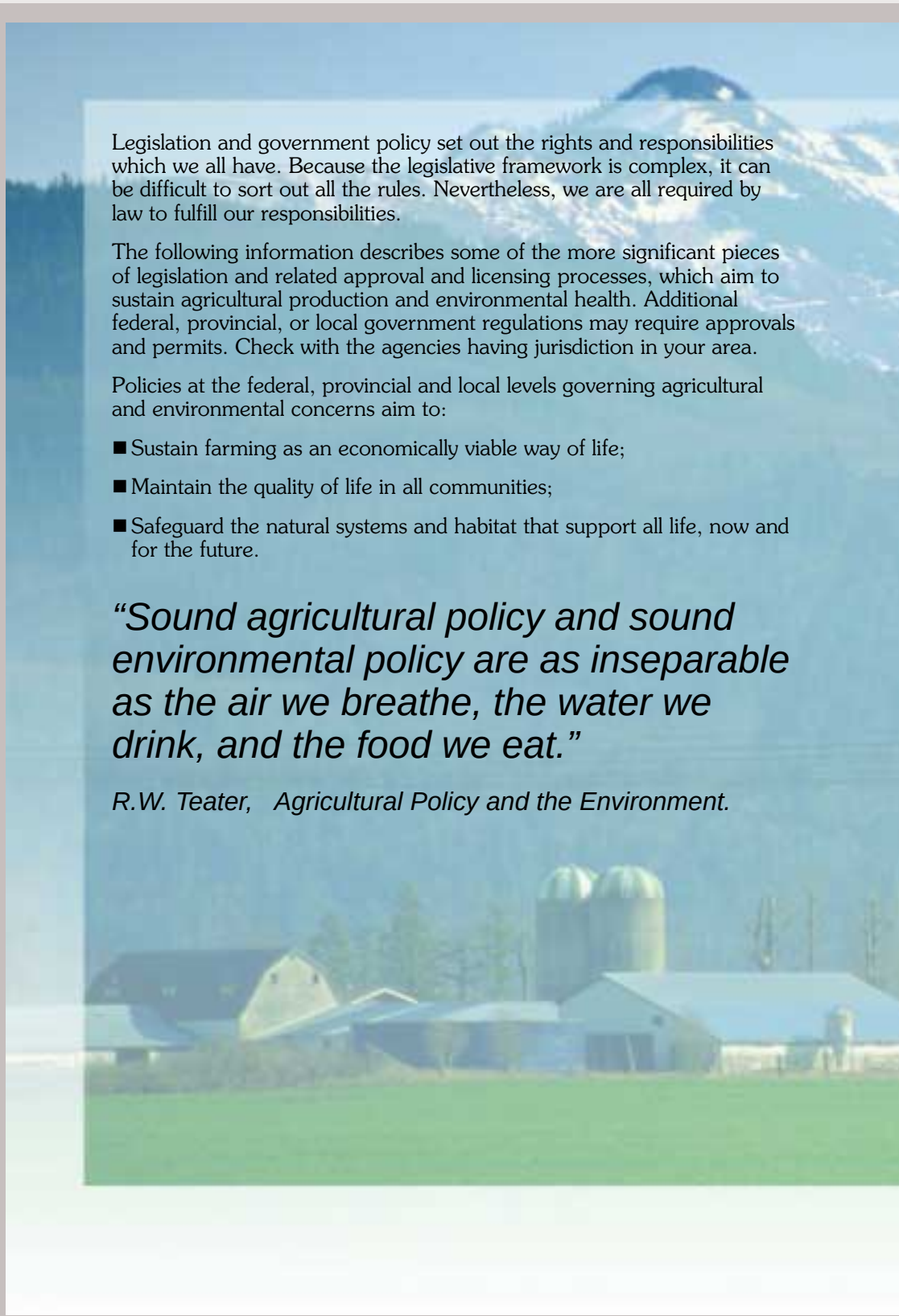
"Numerous tributaries in the Lower Fraser Valley are spawning grounds for Coho and other species of salmon. When the health of these streams is protected, everyone wins."

The News Spreader, Dairy Conservation Group Newsletter Dec. 1995.

Photo Credit: PARC (Agassiz)

Legislation and Policy

Legislation and government policy alone cannot achieve stewardship goals. However, achieving compliance with existing legislation is an important first step in protecting the environment and yourself.



Legislation and government policy set out the rights and responsibilities which we all have. Because the legislative framework is complex, it can be difficult to sort out all the rules. Nevertheless, we are all required by law to fulfill our responsibilities.

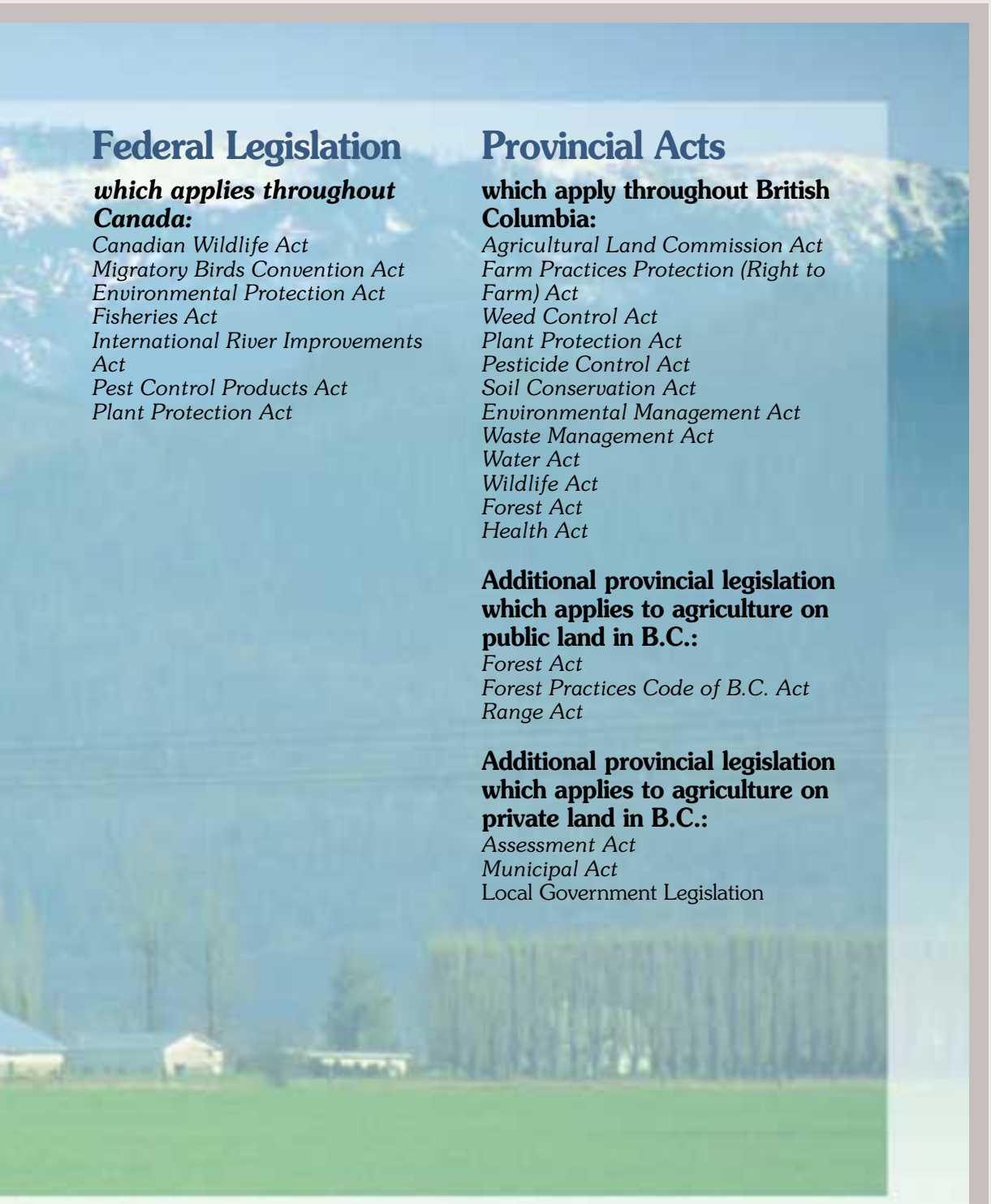
The following information describes some of the more significant pieces of legislation and related approval and licensing processes, which aim to sustain agricultural production and environmental health. Additional federal, provincial, or local government regulations may require approvals and permits. Check with the agencies having jurisdiction in your area.

Policies at the federal, provincial and local levels governing agricultural and environmental concerns aim to:

- Sustain farming as an economically viable way of life;
- Maintain the quality of life in all communities;
- Safeguard the natural systems and habitat that support all life, now and for the future.

"Sound agricultural policy and sound environmental policy are as inseparable as the air we breathe, the water we drink, and the food we eat."

R.W. Teater, Agricultural Policy and the Environment.



Federal Legislation

which applies throughout Canada:

Canadian Wildlife Act
Migratory Birds Convention Act
Environmental Protection Act
Fisheries Act
International River Improvements Act
Pest Control Products Act
Plant Protection Act

Provincial Acts

which apply throughout British Columbia:

Agricultural Land Commission Act
Farm Practices Protection (Right to Farm) Act
Weed Control Act
Plant Protection Act
Pesticide Control Act
Soil Conservation Act
Environmental Management Act
Waste Management Act
Water Act
Wildlife Act
Forest Act
Health Act

Additional provincial legislation which applies to agriculture on public land in B.C.:

Forest Act
Forest Practices Code of B.C. Act
Range Act

Additional provincial legislation which applies to agriculture on private land in B.C.:

Assessment Act
Municipal Act
Local Government Legislation

Rights and Responsibilities

A brief summary is provided here of key pieces of legislation and approval processes which are relevant to all farms. Understanding the laws and associated approval processes will help you to avoid risks of conflict with the law. By operating in compliance with existing environmental legislation, you protect your operation, yourself, and the environment.

*The revised Section 7 Regulations under the **Water Act** set detailed standards for working in and about a stream, and are an example of federal and provincial agencies working together to clarify and streamline administrative processes.* *See Pages 45-48 for more information.*

Senior Government Environmental Approvals

The federal DFO and provincial MELP have interrelated jurisdictions with respect to fish and fish habitat. The DFO is responsible under the *Fisheries Act* for all fish species and their habitats, and manages most anadromous and saltwater species. MELP administers regulations which protect freshwater fish species. Approvals are therefore required from both governments for actions which may affect fish habitat.

The Approval Process

When projects have the potential to affect fish or fish habitat, proponents are required to contact DFO and MELP for environmental approvals.

For projects affecting fish habitat (including riparian zones) consider the following:

- Review the *Land Development Guidelines for Protection of Aquatic Habitat*, which was jointly published by DFO and MELP. This is a technical guide which outlines the requirements for land development to meet fish habitat objectives. It, and related publications, can be obtained from DFO and MELP offices;
- Consult early - months before you wish to begin your project is best;
- Provide a clear explanation of your proposed works, including factors such as timing of works, to MELP and DFO agencies.

Once DFO and MELP staff have reviewed your proposal, they may provide comment, identify potential concerns, negotiate compensation, or give approval in principle to the project, as appropriate.

Federal Government

DFO's mandate focuses upon the protection of fish and fish habitat, and is implemented through the *Fisheries Act*. Environment Canada (DOE) assists in protecting fish habitat by taking a lead role in administering the pollution prevention provisions of the *Fisheries Act*.

Referrals and Approvals

are required for all works that have the potential to impact fish or fish habitat. Examples of such works include:

- Any instream works;
- Alteration to the riparian zone;
- The discharge of a deleterious substance into fish habitat.

A description of your intended works should be provided to the nearest of the DFO Habitat and Enhancement offices, presently located in Nanaimo, Kamloops, Prince George, Prince Rupert, and New Westminster.

Charges may be laid under the *Fisheries Act* for harmful alteration, disruption, or destruction of fish habitat. Charges may be related to:

- Alteration of fish habitat, which includes the ocean, estuary, rivers, streams, lakes and wetlands, ditches, and other intermittent streams which may provide fish habitat;
- Alteration of adjacent stream habitat on which fish may depend directly or indirectly;
- Allowing the deposition of deleterious substances, such as sediment, manure or a wide range of other pollutants, into fish-bearing waters.

Provincial Government:

MELP has jurisdiction on private lands over freshwater fish, wildlife, water use, waste management, and floodplain management.

Notification or Approval is required for all projects which affect watercourses (including ditches), whether fish-bearing or not.

The following outlines some of the provincial approval requirements applicable to agricultural operations:

Works with potential impacts on fish habitat Regional MELP Fish and Wildlife staff will review applications or proposals for projects that may affect fish habitat.

Agricultural waste management - the *Code of Agricultural Practice for Waste Management* specifies generally accepted waste management practices for all commodities. Operations which are unable to satisfy the requirements of the *Code* must obtain a permit for waste disposal under the *Waste Management Act*. Applications for waste discharges will be reviewed by MELP Regional Environmental Protection Divisions.

Failure to comply with the *Code*, discharge of waste without a permit, or permit non-compliance may result in issuance of a Pollution Abatement Order or charges being laid under the *Waste Management Act*.

Water use - use of surface water requires a license. Applications for water use or stream diversion will be reviewed by MELP Regional Water Management staff. At present, a water license is not required for groundwater use, however groundwater legislation is being developed.

Environmental management -under the *Environmental Management Act,* administered by MELP, producers planning a large construction project may be required to obtain an environmental impact assessment before proceeding. An operation which is having or is likely to have a detrimental effect on the environment may be served with an environmental protection order under this act, requiring whatever work is necessary to prevent damage to the environment.

Wildlife -the *Wildlife Act,* administered by MELP Wildlife Branch, regulates harassment, trapping, poisoning, shooting, and other actions harmful to wildlife, including small mammals and deer.

Pesticide control -licensing and certification is mandatory under the *Pesticide Control Act* for anyone using "restricted use" pesticides, for the sale of pesticides, and for applicators who apply pesticides as a service.

Pesticide use permits are required for application of pesticides to public land, and application to private land used for forestry, transportation or public utilities.

Pesticide use permit applications are reviewed by regional interagency committees. Submit applications to the Regional Office of the Pesticide Management Program (MELP).

Pesticides labeled "for agricultural or commercial use" may be used for agricultural purposes on private land, in accordance with label directions and applicable regulations, without a permit.

Soil removal/deposition - Under the *Soil Conservation Act*, the removal or deposit of soil or fill within the ALR requires a letter of approval from the Agricultural Land Commission and a permit from the local government. Minor exemptions from approval requirements are identified under the *Soil Conservation Act*, provided that activities are conducted in accordance with good farm management practices.

Charges may be laid for failure to comply with any of these Acts. Provincial Conservation Officers may also lay charges under the *Fisheries Act*.

Local Government

The *Municipal Act*, administered by Ministry of Municipal Affairs allows local governments to regulate land use through the Official Community Plan, Zoning and Development Permit processes, within the framework of current federal and provincial regulations.

Bylaws and Regulations

Each local government establishes procedures and bylaws tailored to specific circumstances, therefore regulations vary from one community to another.

Due to the special status of lands in the Agricultural Land Reserve (under the *Agricultural Land Commission Act*), and the Forest Land Reserve (under the *Forest Land Reserve Act*), local government does not designate land use in these areas. However, aspects of use such as building setbacks, permitting requirements, and the keeping of animals can be regulated on ALR lands.

*The new **Farm Practices Protection (Right to Farm) Act**, administered by the Ministry of Agriculture Fisheries and Food, further protects the rights of producers operating in accordance with normal agricultural practices within the ALR or upon lands where farm use is allowed under the **Municipal Act**.*

The legislation aims to:

-create a more active and supportive role in planning for agriculture at the local government level - as a part of Official Community Plans, and zoning and bylaw processes;

-improve the level of understanding between urban and rural residents, and help reduce potential conflicts and nuisance complaints;

-provide a clear understanding of normal, accepted farm practices, through "codes of practice" that meet producers needs and are fair to neighbours.

For More Information

Suggested Readings

Agricultural Composting Handbook, (factsheet: 382.505-1). B.C. Ministry of Agriculture, Fisheries and Food, 1993.

Agricultural Crops Grown Under Integrated Pest Management Programs in British Columbia, B.C. Ministry of Environment, Lands, and Parks, 1992.

B.C. Agricultural Drainage Manual, B.C. Ministry of Agriculture, Fisheries and Food, 1997.

B.C. Livestock Watering Manual, B.C. Ministry of Agriculture, Fisheries and Food, 1990.

B.C. Sprinkler Irrigation Manual, Irrigation Industry Association of B.C.; B.C. Ministry of Agriculture, Fisheries and Food, 1989.

B.C. Trickle Irrigation Manual, B.C. Ministry of Agriculture, Fisheries and Food, In Preparation.

Best Management Practices (series):

A First Look, Farm Forestry and Habitat Management, Field Crop Production, Horticultural Crops, Livestock and Poultry Waste Management, Nutrient Management, Soil Management, Water Management, all by Agriculture Canada, Ontario Federation of Agriculture, Ontario Ministry of Agriculture and Food.

Bird Control for Agricultural Lands in British Columbia, B.C. Ministry of Agriculture, Fisheries and Food, 1979.

Caring for The Green Zone: Riparian Areas and Grazing Management. Produced by "The Cows and Fish Project", Alberta, 1995, (403-381-5281)

Chemigation Guidelines for British Columbia, B.C. Ministry of Agriculture, Fisheries and Food, 1993.

Consulting Services for Best Agricultural Waste Management Plans, (factsheet: 301.00S2). B.C. Ministry of Agriculture, Fisheries and Food, 1993.

Control of Insect and Related Pests of Livestock and Poultry in British Columbia, Ministry of Agriculture, Fisheries and Food, 1993.

Creating Your Own Environmental Farm Plan in South Coastal BC, Marina Gibson, A.I.T., Dairy Producers' Conservation Group, 1994.

Deer Farm Perimeter Fence, (factsheet 316.130-1). B.C. Ministry of Agriculture, Fisheries and Food, 1995.

Environmental Guidelines for Producers In British Columbia (series): **Beef, Berry, Dairy, Hog, Mushroom, and Poultry Producers, Greenhouse Growers, Horse Owners, Nursery & Turf Industry, Tree Fruit & Grape Producers** all by B.C. Ministry of Agriculture, Fisheries and Food, 1992-1995.

Freshwater Intake End of Pipe Fish Screen Guideline, Department of Fisheries and Oceans.

Guidelines to Prevent Damage to Fish and Fish Habitat from Transportation, Storage, Use and Disposal of Woodwaste in British Columbia, Department of Fisheries and Oceans, Environment Canada.

Handbook for Pesticide Applicators and Dispensers, B.C. Ministry of Environment, Lands and Parks.

Improved Cattle Access to Water Using Geogrids, B.C. Ministry of Agriculture, Fisheries and Food, 1992.

Landscaped Buffer Specifications, Agricultural Land Commission, Burnaby 1993.

Land Development Guidelines for the Protection of Aquatic Habitat, Ministry of Environment, Lands and Parks, Department of Fisheries and Oceans, 1992.

Pesticide Applicator Course for Agricultural Producers, Open Learning Agency, Richmond, British Columbia.

Soil Management Handbook for the Lower Fraser Valley - 2nd Edition, B.C. Ministry of Agriculture, Fisheries and Food, 1991.

More Suggested Reading

Soil Management Handbook for the Okanagan and Similkameen Valleys - 2nd Edition. B.C. Ministry of Agriculture, Fisheries and Food.

The Best Management Practices (BMP) Series is available from Ontario. It is a collection of full-colour booklets from 36 to 150 pages long, and some titles have related videos, CD-ROMs and/or slide sets. Titles include:
Farm Forestry and Habitat Management
Field Crop Production
Fish and Wildlife Habitat Management
Integrated Pest Management

No-Till: Making it Work. Order from Ontario Federation of Agriculture, Attn: Manager, BMP, 40 Eglington Ave. E., 5th flr., Toronto, Ontario, M4P 3B1. Phone: (416) 485-3333; fax (416) 485-9027.

The Stewardship Series

The Stewardship Series is a group of B.C. publications describing stewardship activities for various audiences. The series is funded by federal and provincial governments in partnership with non-government organizations on a project-by-project basis. Current publications include:

Stream Stewardship: A Guide for Planners and Developers. Department of Fisheries and Oceans, Province of B.C., 1994. Phone (604) 666-3545

Stewardship 94: Proceedings from a conference held March 3-5, 1994 on revisiting the land ethic and caring for the land. Nora Layard and Loralee Delbrouck (Eds.), 1994. $15. Phone (604) 387-9369

Water Stewardship: A Guide for Teachers, Students and Community Groups. Ministry of Environment, Lands and Parks, 1994. $20. Phone 1-800-387-9853

The Streamkeepers Handbook: a Practical Guide to Stream and Wetland Care. G. Taccogna and K. Munro (Eds.). Department of Fisheries and Oceans, 1995. $30. Phone (604) 666-3545

Community Stewardship: A Guide to Establishing Your Own Group. Fraser River Management Program, 1995. Phone (604) 660-1177

Naturescape British Columbia: Caring for Wildlife Habitat at Home. Ministry of Environment, Lands and Parks, 1995. Phone 1-800-387-9853

Stewardship Options for Private Landowners in British Columbia. Ministry of Environment, Lands, and Parks, 1996. Phone 1-800-387-9853.

Community Greenways: Linking Communities to Country and People to Nature. Department of Fisheries and Oceans, Province of B.C. 1996. Phone (250) 356-6124.

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I support the principles of watershed stewardship. All agriculture, and the general public in B.C., should consider this as a guide to becoming better stewards of the land which we live work, and play on.

Don Livingston,
Dairy Farmer & AEPC Chair

In recent years we have greatly increased our understanding of how to protect the environment, which we are dependent upon, while fostering viable ranching operations. Agricultural practices that maintain healthy and productive ecosystems are good business. This guide introduces new stewardship ideas which we can use to safeguard our land and water, and• fish and wildlife resources. Most producers would find useful information in this guide.

Lorne Leach, Executive Director,
B.C. Cattlemen's Association

BRITISH COLUMBIA CATTLEMEN'S ASSOCIATION