Non-point Source Pollution: A Review of Policies, Practices and Regulations in Alberta and Selected Jurisdictions

April 2012

Prepared by

Green Planet Communications

Executive Summary

This report, *Non-point Source Pollution: A Review of Policies, Practices and Regulations in Alberta and Selected Jurisdictions,* was commissioned by the Alberta Water Council's Non-Point Source Pollution Project Team, to assist in Phase II of their work. The report reviews legislated requirements and voluntary best (or beneficial) management practices (BMPs) for addressing non-point source pollution (NPSP) in Alberta, three other Canadian provinces and selected jurisdictions in the U.S. and Europe for five major land uses: agriculture, urban, forestry, oil and gas, and recreation. The main objectives are to identify gaps and opportunities for reducing NPSP in Alberta and to learn from the experience of other jurisdictions. These jurisdictions were selected in discussion with the team and on the recommendation of people who are knowledgeable on the subject. The study objectives and methodology are outlined in Chapter 1.

Chapter 2 describes how NPSP is managed in Alberta. No single government department is responsible for NPSP in the province, so there is no systematic approach to addressing this issue. Good data, especially baseline data, are lacking in many areas and monitoring networks are generally not designed to answer questions related to loading and peak flows. Although all five major land uses were examined in this report, most attention was paid to agriculture, urban and forestry, as relatively little information was available on the extent of NPSP issues and their management for the conventional oil and gas sector (which is heavily regulated) and for recreation.

Raising producer awareness and encouraging the voluntary adoption of BMPs has been Alberta's main approach to managing NPSP from agriculture. A wide array of resources, programs and partnerships have been developed in support of this approach, including manuals and demonstration projects, cost-sharing mechanisms, and a variety of stewardship initiatives. Two studies now underway are expected to shed light on the environmental and economic effectiveness of BMPs in agricultural watersheds. Key pieces of legislation relevant to managing NPSP from agriculture include the *Agricultural Operation Practices Act,* which describes requirements for manure management, and the *Environmental Protection and Enhancement Act*, which regulates activities associated with pesticides.

NPSP management in urban areas was most closely examined for Calgary and Edmonton. A total loading management plan and a stormwater management strategy are major components of NPSP management in these cities, and both monitor stormwater quality. Municipalities typically manage stormwater using regulatory and policy tools (e.g., bylaws and formal plans) combined with a wide array of BMPs, including low impact development (LID) initiatives applied to new development and as retrofit projects. Erosion and sediment control guidelines are also essential features of urban NPSP management.

For the forest sector, the key policy tool for managing NPSP is the Timber Harvest Planning and Operating Ground Rules. These Ground Rules describe the requirements that licensees must meet as a condition of their harvest approval and include a number of mandatory requirements related to watershed protection and riparian lands, soils, habitat management and roads. The Alberta Government monitors compliance through planned and random audits and field inspections.

Like Alberta, none of the other Canadian provinces studied (British Columbia, Ontario and Saskatchewan) has a comprehensive integrated NPSP program and BMPs are used to varying degrees. Each jurisdiction has examples of instructional approaches, with both Ontario and Saskatchewan devoting considerable effort to source water protection strategies following a serious outbreak of waterborne disease in each province in 2000 and 2001 respectively. B.C., Ontario and Saskatchewan are reviewed in Chapter 3.

Of note in British Columbia, the comprehensive *Forest and Range Practices Act* governs the activities of forest and range licensees, and also enables penalties for activities (such as irresponsible off-roading) that damage sensitive sites. The Government has identified objectives and key resource values and forest companies develop strategies to meet these objectives, including objectives for soil, water and fish; the water objective, for example, includes maintaining or promoting healthy riparian and upland areas. The Government's Forest and Range Evaluation Program monitors activities on Crown land and their impacts to ensure that licensees are effectively meeting the established objectives.

Ontario's 36 Conservation Authorities play a key role in watershed management, oversee many NPSP-related initiatives in their regions, and have been actively involved in preparing watershed assessments and source protection plans. Ontario's *Nutrient Management Act* regulates what can and cannot be applied to land and describes standards and practices for management and application of nutrient-containing materials to avoid NPSP. A 2009 ban on cosmetic use of pesticides appears to have significantly reduced concentrations of three commonly used pesticides in sampled streams.

Saskatchewan's Long-Term Safe Drinking Water Strategy is the focal point for water management in that province. The Saskatchewan Watershed Authority, a Crown Corporation that was given greater responsibility after the 2001 incident in North Battleford, has a wide mandate for managing and protecting water, watersheds and related land resources. It undertakes watershed planning, conservation of wetlands, public awareness activities, and monitoring health of aquatic ecosystems. Like Alberta, Saskatchewan uses BMPs extensively to manage NPSP from agriculture. Saskatchewan is adopting a new legal framework for environmental management, including an Environmental Code that will define environmental outcomes and require the regulated community to decide how it will achieve compliance.

Chapter 4 looks at examples of NPSP management in the U.S. The federal *Clean Water Act* (CWA), which is implemented through the Environmental Protection Agency (EPA), sets regulatory requirements for NPSP (section 4.1.3). The EPA's Nonpoint Source Control Branch requires each state to comply and report on their NPSP program, including water quality monitoring and analysis. The CWA sets water quality standards for each class of designated water use (such as drinking water source, recreation use) and each state must have a water management plan to address NPSP and limit discharges to meet those standards. The Agency provides guidance on watershed planning, and the Nine Key Elements to be included in a Watershed Management Plan (Figure 4) provide a useful checklist of issues to be addressed when setting up a NPSP program. The EPA has produced manuals describing BMPs to reduce NPSP from agriculture, forestry and the built environment, as well as a toolkit on water quality trading. The U.S. Department of Agriculture also encourages the use of BMPs to reduce NPSP through its Clean Water Program, and provides some funding, but programs are voluntary (section 4.1.4).

While each state must comply with the CWA, states may also have their own legislation that augments federal requirements. In California (section 4.2), the *Porter-Cologne Water Quality Control Act* includes a discharge requirement for NPSP. Farmers can obtain a Conditional Waiver of Waste Discharge Requirements if they follow a water quality control plan, which usually includes monitoring and other enforceable requirements designed to meet water quality standards. The Irrigated Lands Regulatory Program, which is part of the State Water Resources Control Board's Nonpoint Source Control Program, is considered an effective example that uses the waiver approach. There are a number of success stories for irrigated lands and a similar approach is being considered for forestry lands in California. The State Water Resources Control Board recognizes the value of LID for reducing runoff from urban land and provides some funding for LID projects.

North Carolina's *Clean Water Responsibility and Environmentally Sound Policy Act* supplements federal legislation and sets out specific requirements for reducing nutrient levels in surface waters (section 4.3). The state's Division of Water Quality adopted basin-wide planning 20 years ago and implemented

programs to reduce nutrient levels from point and non-point sources in two major watersheds. In the Tar-Pamlico River Basin, for example, where NPSP is the most important nutrient source, the management strategy includes two agricultural rules to reduce nutrient use, three rules to protect buffer zones and a stormwater rule that applies to urban development. The nutrient management rule, which applies to agricultural land and to the commercial application of fertilizer on golf courses and lawns, requires operators to take state-sponsored nutrient management training or have a nutrient management plan. This comprehensive watershed approach, which is implemented through a Basin Oversight Committee and local advisory committees, is considered a success by the EPA, even though the nutrient levels in the estuary have not yet declined as expected, based on the implemented measures.

In Oregon, the focus is on the way in which the City of Portland implemented its highly-regarded LID program (section 4.4). The City first used BMPs to reduce stormwater runoff from municipal property, including road allowances, and extended the program to encourage private property owners to adopt LID. Brief reference is made to the Willamette Partnership, which is developing a legal framework for the trading of ecosystem services that might be applied to water quality.

In Vermont (section 4.5), the Department of Environmental Conservation implements the state's *Water Pollution Control Act* but responsibility for NPSP from agricultural sources is delegated to the Agency of Agriculture. Farmers are required to implement Accepted Agricultural Practices that include manure management and buffer zones along stream banks. Medium-sized farms that operate under a General Permit must have nutrient management plans, while large farms are individually licensed. BMPs to reduce agricultural NPSP are encouraged through federal and state funding programs. Accepted Management Practices for forestry operations include some designed to protect water quality. Vermont has a new Green Infrastructure Program and the Vermont League of Cities and Towns developed a model LID stormwater management bylaw. A watershed approach, which was first adopted to reduce phosphorus discharges to Lake Champlain, has been extended to the whole state in the recently renamed Ecosystem Restoration Program. A number of projects in small watersheds have reduced nutrient or sediment loads and feature as EPA success stories.

In the State of Washington, the Department of Ecology is responsible for implementing the *Water Pollution Control Act* but 12 state agencies are involved in the *Watershed Planning Act* (section 4.6). Responsibility for addressing NPSP is split between several departments. The Department of Agriculture manages NPSP from most agricultural sources: there are many rules relating to the use of pesticides and fertilizers, and dairy farms and concentrated animal feeding operations are required to have nutrient management plans. The Department of Natural Resources is responsible for adherence to very detailed Forest Practice Rules, including those in the Forest Practices Watershed Analysis Manual. The shared responsibilities make it difficult for the Department of Ecology to implement or enforce measures to reduce NPSP in those sectors, which may have other priorities. However, the Department has been effective in local partnerships to reduce the impacts of ranching on water quality through the fencing and riparian buffers. With respect to urban NPSP, the City of Seattle has been a leader in the implementation of LID and the Puget Sound Partnership is very active, producing a LID manual and, with the University of Washington, giving training workshops to help professionals implement LID.

Wisconsin considers its agricultural and urban NPSP programs to be among the most progressive in the U.S. (section 4.7). The state's Priority Watershed and Lake Program addressed soil erosion and manure management at critical sites over a 30-year period by helping landowners implement BMPs. The more recent state-wide Runoff Management Rule limits the amount of phosphorus that is allowed to run off cropland and pasture and requires an uncultivated buffer next to water bodies. Counties take the lead in implementing the rule through their Land and Water Resource Management Plans. The Runoff Management Rule also applies to urban development, including roads, both during and post-construction. Some towns are encouraging LID. Milwaukee, for example, requires post development runoff to be at

least 10% less than pre-development flows. Implementation of BMPs in forestry is only mandatory in certified or registered forests, but the state evaluates their effectiveness through field examination of some harvest sites and monitoring of water quality.

Chapter 5 starts with a brief summary of the European Union's regulatory requirements followed by a review of the NPSP programs in three countries. The EU's Water Framework Directive requires each member country to adopt measures to reduce diffuse water pollution (as NPSP is called in Europe), including river basin management plans (section 5.1). The Nitrates Directive applies specifically to agricultural sources and requires mandatory measures to reduce nitrogen applications to the soil in vulnerable areas.

In England, the Environment Agency is responsible for managing NPSP, but works with the department responsible for agriculture and Natural England (section 5.2). As throughout the EU, farmers must keep their land in good agricultural and economic condition if they wish to receive any funding under the EU Single Payments Scheme. The Catchment Sensitive Farming Program focuses on measures to reduce NPSP in priority watersheds, but implementation varies between areas. The National Auditor has been highly critical of the Environment Agency's efforts to address diffuse water pollution, and his criticisms and recommendations provide good advice for those who are setting up a NPSP program.

One expert considers Scotland to be 10 years ahead of England in its NPSP program (section 5.3.2). Scotland's Environmental Protection Agency started with monitoring to characterize and quantify the impacts of diffuse water pollution and, when planning their program, tried to learn from experiences elsewhere, including the U.S. In 2005, a General Binding Rule was introduced to limit diffuse pollution from the built environment (including roads) and rules that apply to agriculture and forestry were added later. As with some rules in the U.S., General Binding Rules require compliance with certain practices, but do not require any special authorization. The Scottish EPA trained staff in several rural agencies to help raise awareness and undertake compliance monitoring. Sustainable Urban Drainage Systems, which are required to manage runoff from almost all new development except for single-dwelling homes, implement LID techniques.

As a result of the impacts of its highly intensive arable and livestock production, the Netherlands has very stringent rules for managing manure, fertilizers and many other non-point sources (section 5.4). There is a comprehensive water quality monitoring program and the data are used to update plans to reduce nutrient-rich runoff. The government funds research into ways to reduce the nutrient load from agriculture, especially in areas with nutrient-leaching soils. Even though the Dutch have a long tradition of being regulated, some farmers find the rules complex and onerous.

The final chapter, Chapter 6, extracts conclusions from the report findings. It draws on the experience of other jurisdictions to outline the key components of an effective NPSP program and identifies ways in which Alberta might approach a NPSP program of its own.

1. Introduction

The Alberta Water Council is a multi-stakeholder organization with representation from governments, industry and non-government organizations. The Council and its teams and committees operate by consensus. In 2009, a Council report[1] identified several priority areas for further work, including improving the understanding and management of non-point source pollution (NPSP). The Council subsequently established the Non-Point Source Pollution Project Team to examine the issue and develop recommendations on how to better manage the total non-point source contaminant loading in Alberta's watersheds to achieve *Water for Life* goals.

Drinking water, the production of livestock and crops, recreation, and a variety of industrial uses all rely on good quality water, as do healthy aquatic ecosystems and wildlife. Pollution from both point and non-point sources can reduce overall water quality. Point source pollution, such as discharge from a wastewater treatment plant, is generally well-understood and can be relatively easily measured and managed. NPSP, which is contamination that enters a water body from diffuse points of discharge and has no single point of origin,[2] is more complex and difficult to manage.

Non-point source pollutants can reach water bodies through surface runoff, atmospheric deposition and groundwater. Several key factors, including topography, soil texture, and weather and climate patterns, affect the movement of water through the landscape and play a major role in the extent to which NPSP becomes an issue. Almost any activity on the land base can be a potential source of NPSP.

To address this issue, the NPSP project team divided its work into three phases. The Phase I report, completed in November 2011, summarized the current state of knowledge in Alberta about the contribution of NPSP to the quality of Alberta's surface water, identified the major NPS contaminants, and provided a foundation for Phases II and III.[3] Phase II produced this report: *Non-point Source Pollution: A Review of Policies, Practices and Regulations in Alberta and Selected Jurisdictions.* Phase III will see the development of a final report and recommendations from the team to the Alberta Water Council, based on the information and conclusions from Phases I and II.

1.1 Objectives

The objectives for Phase II were to:

- Review existing public policies, practices and regulations in Alberta that are or could be applied to non-point sources of pollution.
- Review policies, practices and regulations in other jurisdictions to find innovative tools to manage non-point source pollution.
- Evaluate the state of implementation of policy, practices and regulatory tools for reducing or controlling non-point source pollution with a focus on Alberta, and identify the gaps and opportunities for improvement.

1.2 Methodology and Overview

The project technical team provided initial direction to the consultants, who then developed a draft table of contents for the Phase II report. The full project team also provided input to the draft table of contents prior to approving the proposed approach, and provided some contacts and possible sources of

[1] Alberta Water Council. 2009, *Recommended Projects to Advance the Goal of Healthy Aquatic Ecosystems.*
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[3] CPP Environmental Corp. 2011, *Current state of non-point source pollution: Knowledge, data and tools.* Report prepared by T. Charette and M. Trites for the Alberta Water Council, 153 pp.

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information. The consultants then built an initial list of potential resource people using leads from the team, their personal contacts and online research. The general approach involved online research, some literature searches, and phone calls and meetings with key resource people to obtain further clarification and details.

Building on the work done in Phase I and to the extent that information is available, the team agreed that five main land uses would be the focus of Phase II work: agriculture, urban, forestry, oil and gas, and recreation. To maintain a realistic scope for the project, the team agreed that research for Alberta would be limited to initiatives by the Government of Alberta and industry associations as appropriate, the two largest municipalities (Calgary and Edmonton), and selected regional watershed planning and stewardship bodies; the results appear in Chapter 2. The team also agreed that the Phase II work would examine in detail three Canadian provinces (Chapter 3), five US states[4] along with the US Environmental Protection Agency and the US Department of Agriculture (Chapter 4), and four European jurisdictions including the EU (Chapter 5). All individuals who provided information and comment to the consultants are listed in Appendix A.

Policy instruments and tools to address NPSP, include:

- "Sticks" in the form of regulation (such as land use, regulation of specific practices through permits, licences, and prohibitions),
- "Carrots" such as economic instruments in the form of subsidies, taxes and tax incentives, and
- "Sermons," which is the use of information or communication in the form of moral suasion, education and outreach.[5]

This report describes approaches and measures taken by various jurisdictions to reduce NPSP and relates success stories, where possible. It does not attempt to analyze the scientific efficacy of these measures, although such attempts can be found in the relevant literature.[6] Relevant regulatory and policy tools are noted and examples of best management practices and case studies are included, but specific management practices are not listed; rather, readers are directed to the various compilations referenced in this report.

[4] The City of Portland and Willamette Valley, Oregon were also examined.

[5] Bemelmans-Videc, M. *et al* (eds.) 1998, *Carrots, Sticks and Sermons: Policy Instruments and Their Evaluation*, London: Transaction Publishers; cited in Johns, Carolyn M. 2001. *Effective Policy Regimes for the Management of Non-point Source Water Pollution: Ontario and the US in Comparative Perspective*. This draft paper by Dr. Johns was prepared as a background document for the Walkerton Inquiry, https://ozone.scholarsportal.info/bitstream/1873/8143/1/10294253.pdf

[6] There is a large amount of literature on the effectiveness of different methods for reducing NPSP, such as buffer zones and wetlands. See, for example, references in Kay, P., A. C. Edwards and M. Foulger, "A Review of the Efficacy of Contemporary Agricultural Stewardship Measures for Ameliorating Water Pollution Problems of Key Concern to the UK Water Industry," Agricultural Systems, 2009, Vol. 99, Issues 2-3, February, pp. 67-75.

2. Managing Non-Point Source Pollution in Alberta

Alberta covers an area of 661,848 km^2, with a land base of 642,317 km^2;[7] its population of 3.8 million[8] is more than 80% urban.[9] Alberta has processes for approving, monitoring and ensuring compliance for point sources, with regulatory entities such as Alberta Environment and Water, the Natural Resources Conservation Board, and others having a clear mandate depending on the emissions source. However, like the sources themselves, mechanisms for managing non-point source pollution (NPSP) are much more dispersed; approvals are not required for many activities that could generate NPSP, and often more than one agency is involved in identifying potential problems and solutions. As a result, there is no one "home" in government or one systematic approach for dealing with NPSP. This issue stretches across many programs, legislation and regulations at different landscape levels and at different levels of policy development, all of which makes management and coordination more complex. On the other hand, sharing responsibility across several entities can lead to creative solutions that are specifically designed to address a concern.

Another challenge in managing NPSP in Alberta relates to the lack of good data in many areas, especially baseline data. The Phase I report for this project noted knowledge gaps, particularly with respect to data and the cumulative effects of NPSP from various activities. The lack of baseline data was a key observation of the Alberta Environmental Monitoring Panel in 2011[10] and was reiterated by a number of people who were interviewed for this report. Monitoring for NPSP is done on an *ad hoc* basis; as issues are identified, Government of Alberta departments tend to collaborate as required to monitor and assess the results.

Surface water is monitored in Alberta by various government, industry and stakeholder groups. To support these efforts, Alberta Environment and Water conducts water quality monitoring, reporting and evaluation throughout the province, including the 28 sites of the Long-Term River Network (LTRN), the River Water Quality Index, and lake monitoring. Monitoring networks for streams and wetlands are not as well developed. Work is also underway to develop ecological indicators and decision-support tools to assess cumulative effects in major watersheds, including the influences of point and non-point sources of contaminants. Nevertheless, controlling NPSP remains a challenge in the sense that no single agency or level of government is solely responsible for integrating land use activities into water quality protection strategies.[11] As well, most monitoring networks are not designed to answer loading questions; the LTRN, for example, takes monthly samples but may or may not catch peak flows, which is when most of the NPSP occurs.[12]

Against this backdrop, the rest of this chapter aims to "tell the story" of how NPSP is managed in Alberta.

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[7] Statistics Canada at http://www40.statcan.ca/l01/cst01/phys01-eng.htm.
[8] Statistics Canada at http://www40.statcan.gc.ca/l01/cst01/demo02a-eng.htm
[9] Statistics Canada at http://www40.statcan.gc.ca/l01/cst01/demo62j-eng.htm
[10] Alberta Environmental Monitoring Panel. June 2011, *A World Class Environmental Monitoring, Evaluation and Reporting System for Alberta*, http://environment.gov.ab.ca/info/library/8381.pdf
[11] Previous text in this paragraph is adapted from Alberta Environment and Water's online description of its Surface Water Quality Program, at http://www.environment.alberta.ca/01256.html
[12] Steph Neufeldt, Watershed Specialist, EPCOR Water Services, personal communication with Kim Sanderson, December 15, 2011.

2.1 Agriculture

Agriculture is a major land use in Alberta, with a total farm land area of just over 21 million ha, or about one-third of the total land area of the province; irrigation accounts for 675,000 ha, or 5% of the total cultivated land area.[13] [14]Alberta remains the largest beef producing province in Canada; dairy and poultry operations also contribute significantly to provincial agricultural production. In 2010, Alberta beef and dairy operations accounted for over 11 million head.[15]

As noted in the Phase I report, nutrients, pesticides and pathogens are the main constituents of NPSP from agriculture, along with sediment. These constituents enter watercourses largely as a result of erosion and runoff. Nutrients can originate with both manure and fertilizer, and excess nitrogen and phosphorus are both potential risks to surface water quality. Although Alberta does have several Acts and regulations that apply, or could apply, to potential NPSP from agriculture, the province and the industry have relied much more on Beneficial Management Practices (BMPs)[16] to address existing and potential NPSP.

2.1.1 Policy and Regulatory Tools

Most of the policy and regulatory tools that apply or could be applied to NPSP from agriculture are within provincial jurisdiction. These include the following Acts and their regulations, and Codes of Practice:

- *Agricultural Operation Practices Act*
- *Environmental Protection and Enhancement Act* (and the Environmental Code of Practice for Pesticides)
- Grazing Lease Stewardship Code of Practice
- *Animal Health Act*
- *Soil Conservation Act*
- *Water Act*

The federal *Fisheries Act* is also pertinent. It is discussed separately in section 3.1 because it applies to all internal Canadian waters inhabited by fish or with the potential to support fish.

Agricultural Operation Practices Act

The *Agricultural Operation Practices Act* (AOPA)[17] and its regulations are administered by Alberta Agriculture and Rural Development and enforced by the Natural Resources Conservation Board (NRCB). The regulations set environmental standards for the province's livestock industry. AOPA focuses particularly on confined feeding operations,[18] but applies to all livestock operations in terms of how they are required to manage manure. Such operations must follow the manure application and setback distances to protect surface water and groundwater resources. Seasonal feeding and bedding sites where livestock are fed and sheltered must also adhere to these regulations.

[13] Government of Alberta. 2011, *Agricultural Statistics Factsheet*, Agdex853, http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sdd12807

[14] Alberta's total area is 661,848 km^2, with a land base of 642,317 km^2. Source: Statistics Canada at http://www40.statcan.ca/l01/cst01/phys01-eng.htm.

[15] Government of Alberta. 2011, *Agricultural Statistics Factsheet*, Agdex853.

[16] The acronym BMPs can also stand for Best Management Practices. "BMPs" is used in this report to mean both "Beneficial" and "Best" Management Practices.

[17] Government of Alberta, *Agricultural Operation Practices Act*, http://www.qp.alberta.ca/570.cfm?frm_isbn=9780779751310&search_by=link

[18] Confined Feeding Operations are regulated by the NRCB and have very specific requirements that were not part of this review, except insofar as they must adhere to manure application requirements.

The manure spreading regulations include requirements for manure incorporation, soil nitrogen and salinity limits, setback distances, record keeping and soil testing. Specifically:[19]

- Manure must be incorporated within 48 hours when applied to cultivated land (except when applied to forages or direct-seeded crops, frozen or snow-covered land or unless an operation has a permit that specifies a different incorporation requirement). AOPA prohibits spreading of manure on snow-covered or frozen ground unless authorized by the NRCB on a case-by-case basis.
- The regulation sets soil nitrate-nitrogen and salinity limits according to various farming methods, soil groups, soil textures, and the depth to the water table. These limits may only be exceeded if a producer has a nutrient management plan approved by the NRCB. To ensure the salts in manure do not affect plant growth, the regulations specify that manure must not be applied to soils that have an electrical conductivity (salinity) greater than 4 deciSiemen per metre (dS/m) from the top 0 to 15 cm of soil. Manure should not be applied at levels that may increase the soil salinity (after manure is applied) by more than 1 dS/m from a soil depth of 0 to 15 cm.[20]
- Setback distances are required to reduce nuisance effects on neighbours and to minimize the risk of manure leaving the land on which it is applied and entering a common body of water. Manure must be applied at least:
    - 150 m away from a residence or other occupied building that the operator does not own if the manure will not be incorporated when spreading on forage or direct-seeded crops,
    - 30 m away from a water well,
    - 10 m away from a common body of water if subsurface injection is used,
    - 30 m away from a common body of water if manure is surface-applied,

    and incorporated within 48 hours of application, except when applied on forage, direct-seeded crops, frozen or snow-covered land. A person who applies manure on forage, direct-seeded crops, frozen or snow-covered land must meet the minimum setback distances for manure application, keeping in mind the average slope of the land near the common body of water.

The setback distances required are based on slope if the land slopes toward a common body of water, as noted in Table 1.

Table 1. Setback Distances Required for Manure Application on a Slope

Average slope within 90 metres of a common body of water	Setback distance required from the common body of water
4% or less	30 m
Greater than 4% to less than 6%	60 m
6% or greater, but less than 12 %	90 m
12% or greater	No application allowed

Producers using wintering sites are expected to minimize the risk of runoff by locating wintering sites and corrals 30 m or more from a common body of water. If the wintering sites or livestock corrals are closer than 30 m, one of the following options must be used to reduce runoff risks:

[19] The remaining text related to AOPA is adapted from three publications published by the Government of Alberta and the NRCB in 2007: *Manure Spreading Regulations*, Agdex 096-5; *Wintering Sites and Livestock Corrals*, Agdex 096-4; and *Manure Management Regulations for Cow/Calf Producers*, Agdex 096-6. All Agdex publications can be accessed via http://www.agriculture.alberta.ca/app21/infopage?start=true

[20] For details on nitrate-nitrogen limits in specific soil groups and types, see *The Standard: Manure Management Regulations for Cow/Calf Producers*, March 2007, Agdex 096-6.

- An interceptor (e.g., berm or ditch) must be constructed between the site and the water to divert runoff away from the water, or
- Manure and bedding accumulated at the site must be moved to an appropriate manure storage facility or area before runoff occurs.

If the NRCB receives a complaint, it can inspect a livestock facility. NRCB inspectors typically look at potential risks to the environment or problems related to manure handling, storage and application. If a problem is found, inspectors will work with operators to resolve the situation. When determining the appropriate enforcement response, inspectors will consider the significance of any non-compliance as well as the risk to the environment and the operator's willingness to address the issue voluntarily.

Environmental Protection and Enhancement Act

The *Environmental Protection and Enhancement Act* (EPEA)[21] is very wide-ranging and covers any activity that could adversely affect the environment. For example, if manure is applied at a rate or in a location where it could cause environmental damage, an environmental protection order could be issued by Alberta Environment and Water under EPEA. Such orders are not usually punitive; rather they require that a plan be developed and implemented to deal with the release.

EPEA also regulates the sale, use, application, handling, storage, transport and disposal of pesticides. EPEA regulations specify:

- Use of pesticides according to the directions specified on the label.
- Transportation and disposal of pesticides in a way that ensures they will not contaminate food or water.
- Storage of pesticides in their original containers or in other containers that are clearly marked.
- Responsibility of the user for cleanup and decontamination in case of accidental spills.
- Washing of pesticide-contaminated material or sprayers is prohibited within 30 m of an open water body or on a public waterworks system.
- Pesticide storage is not allowed within 30 m of an open water body.
- No person shall use, apply handle, transport, store or dispose of a pesticide or operate any equipment involving the use, handling, transportation, storage handling or disposal of pesticides in a manner that is or is likely to cause an adverse effect.[22]

A Special Use Approval permit is required from Alberta Environment and Water to apply or store pesticides or wash equipment used to apply pesticides in, on or within 30 m of an open body of water. This does not include sloughs or ponds less than 4 ha in area, providing they are completely surrounded by private land with no drainage off the land.

The Environmental Code of Practice for Pesticides[23] further notes that:

- Herbicides must not be deposited within 30 horizontal metres of an open body of water unless the herbicide application is conducted by ground application equipment only.
- Herbicides must not be deposited on areas that have slumped, been washed out or are subject to soil erosion into the water body.

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[21] Government of Alberta, *Environmental Protection and Enhancement Act*, http://www.qp.alberta.ca/570.cfm?frm_isbn=9780779755240&search_by=link

[22] Alberta Agriculture and Rural Development and Agriculture and Agri-Food Canada/Prairie Farm Rehabilitation Administration. 2004, *Beneficial Management Practices: Environmental Manual for Crop Producers in Alberta* - Alberta Legislation, Agdex 100/25-,1 http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex9450.

[23] Government of Alberta. 2010, *Environmental Code of Practice for Pesticides*, effective May 12, 2010, http://www.qp.alberta.ca/574.cfm?page=PESTICIDE.cfm&leg_type=Codes&isbncln=9780779749676

- An applicator must not locate outdoor field pesticide mixing and loading sites within 30 horizontal metres of an open body of water, unless specific conditions are met.

Alberta Environment and Water investigates potential contraventions of provincial pesticide regulations.

EPEA also empowers the government to prevent and control the release of substances into the environment, and to ensure prompt control and clean up.

Grazing Lease Stewardship Code of Practice[24]

Public rangelands play an important role in watershed functions. Riparian areas are often sources of succulent forage, water and shade and require special attention to prevent damage. The *Public Lands Act* and its regulations, administered by Alberta Sustainable Resource Development, lay out the requirements associated with grazing leases, and the Grazing Lease Stewardship Code of Practice describes the roles and responsibilities of leaseholders. Grazing leaseholders are required to apply sustainable grazing practices that flow from four key rangeland management principles, one of which is particularly relevant to preventing NPSP; that is, avoid grazing during vulnerable periods. Leaseholders are expected to consult with the rangeland agrologist and apply specific practices as required when rangelands are considered vulnerable (e.g., during early spring); these practices include:

- Manage grazing on stream banks during vulnerable periods to prevent permanent trampling damage.
- Minimize dormant season browsing (if approved for the lease) to encourage woody plant regeneration in riparian areas.
- Manage grazing on riparian sites during vulnerable periods to prevent permanent trampling damage.

Range health is monitored through a rating system that addresses five indicators of range health, one of which is site stability: Is the site maintained or is the ecological site subject to accelerated erosion? Riparian health is also assessed by rating riparian plant communities using indicators appropriate for those systems. Rangeland agrologists inspect and rate range health on leases and discuss management with leaseholders. Management agreements and tenure conditions help leaseholders meet their stewardship commitments and include a peer review process when stewardship commitments are not achieved. Grazing leaseholders are required to "invest in management practices that result in stable range and riparian health. . . Grazing leaseholders have a particularly crucial responsibility to address any riparian area management issues on their grazing lease" (p. 9).

Animal Health Act[25]

This Act is the responsibility of Alberta Agriculture and Rural Development. It includes the *Destruction and Disposal of Dead Animals Regulation,* which has requirements for distance from a water body. For natural disposal (scavenging), the site must be 500 m from wells, waterways and high water marks of lakes, and 25 m from the edge of a coulee, major cut or embankment. For burial or composting, the pit or site must be 100 m from wells, waterways and high water marks of lakes, and 25 m from the edge of a coulee, major cut or embankment. The bottom of a burial pit must be at least one metre above the seasonal high water table.

[24] The text in this section is adapted from the *Grazing Lease Stewardship Code of Practice*, published by Alberta Sustainable Resource Development, December 14, 2007; http://www.srd.alberta.ca/LandsForests/GrazingRangeManagement/GrazingLeaseStewardshipCodeOfPractice.aspx

[25] Government of Alberta, *Animal Health Act*, http://www.qp.alberta.ca/570.cfm?frm_isbn=9780779751402&search_by=link

Soil Conservation Act

The *Soil Conservation Act*[26] applies to all landholders and requires them to prevent soil loss or deterioration, or to stop it from continuing if it is already occurring. It is administered by Alberta Agriculture and Rural Development and enforced by local authorities (municipalities). When agricultural practices cause or are likely to cause soil degradation, a soil conservation officer acting on behalf of the local municipality may serve notice to the landholder advising that remedial action is required within a specified time. The landholder may appeal the notice, but if the appeal fails, the landholder must comply with the notice. "If the remedial action is not done within the specified time, the soil conservation officer and/or others under the officer's direction may enter the property and perform the required work. The cost of this work may be collected by a tax on the property. Any person obstructing the officer or failing to comply with the notice is subject to a fine of up to $5,000" (p. 150).[27]

Water Act[28]

The *Water Act* requires approval from Alberta Environment and Water for any project or activity that, among other things, could cause:

- Siltation of water,
- Erosion of any bed or shore of a water body, or
- An effect on the aquatic environment.

2.1.2 Use and Implementation of BMPs

Alberta Agriculture and Rural Development (ARD) has worked extensively with Agriculture and Agri-Food Canada, with producer organizations and with groups such as the Alberta Riparian Habitat Management Society (commonly referred to as "Cows and Fish") to develop and produce BMP manuals for the main agricultural commodity types. These agencies along with local authorities work closely with producers to identify situations where BMPs could be used to address various on-farm environmental issues, assist producers with implementation, and advise them of cost-sharing opportunities.

Raising producer awareness and encouraging the widespread voluntary adoption of BMPs has been Alberta's preferred approach for managing NPSP from agriculture for more than 20 years. This proactive approach offers strong extension support and cost-sharing mechanisms, but is backed up by enforcement if needed. However, the main barriers to BMP adoption and implementation are: the amount of time needed to put the measure in place (e.g., rotational grazing, fencing), cost of implementing change, and lack of knowledge and understanding of the issue.[29]

In developing its series of BMP manuals, ARD defined a BMP as "any management practice that reduces or eliminates an environmental risk. BMPs are site-specific practices that take into consideration legislation, practicality and operational needs for a specific operation."[30] ARD, with partnership funding

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[26] Government of Alberta. *Soil Conservation Act*, http://www.qp.alberta.ca/570.cfm?frm_isbn=9780779753468&search_by=link

[27] Text in this paragraph adapted from Alberta Agriculture and Rural Development and Agriculture and Agri-Food Canada/Prairie Farm Rehabilitation Administration. 2004, *Beneficial Management Practices: Environmental Manual for Crop Producers in Alberta*, Agdex 100/25-1, http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex9450

[28] Government of Alberta. *Water Act*, http://www.qp.alberta.ca/570.cfm?frm_isbn=9780779754366&search_by=link

[29] Dale Chrapko, Program Manager, Agri-Environmental Programs Section (Growing Forward), Alberta Agriculture and Rural Development, personal communication with Kim Sanderson, December 13, 2011.

[30] Alberta Agriculture and Rural Development. 2010, *Beneficial Management Practices – Environmental Manual for Livestock Producers in Alberta*, p. 3.

from Agriculture and Agri-Food Canada/Prairie Farm Rehabilitation Administration, produced four manuals in the BMP series that cover all aspects of environmental risk for a farm operation, including NPSP.[31] Detailed BMP environmental manuals were developed for Alberta Farmsteads (Agdex 090-1), Crop Producers (Agdex 100/25-1), Cow/Calf Producers (Agdex 420/28-2), and Livestock Producers (Agdex 400/28-2). All manuals are available by searching online at http://www.agriculture.alberta.ca/app21/infopage?start=true.

These manuals describe in detail how to manage potential sources of NPSP; for example, the manual for livestock producers devotes one chapter to surface water management, examining runon and runoff flows, their risks and various management options including catchbasins, vegetated filter strips and constructed wetlands. ARD's website provides access to factsheets and guides on diverse topics that could help prevent NPSP from agriculture, such as the use of pasture water systems for livestock, pasture pipeline design, and many others. Agriculture and Agri-Food Canada has also published a *Field Manual on Buffer Design for the Canadian Prairies.*[32] It is intended for use by agricultural practitioners and identifies appropriate BMPs, including vegetated buffers, to reduce the loss of nutrients.

A study done in 2007 for the Crop Nutrients Council examined what the economic benefit would need to be to encourage Canadian agricultural producers to adopt BMPs, specifically those related to crop nutrients.[33] The study concluded that most of the selected BMPs, including soil testing, minimum tillage, no tillage, and nutrient management planning, improved profitability for the representative farms. The profitability of farms using variable rate fertilization depended on the crop grown and the province. In all cases, the models suggested that buffer strips reduced expected net revenue. The study also found that funding was available for all the BMPs evaluated except soil testing (unless obtained through the development of a nutrient management program), but most respondents were not accessing these funding programs. Results of the survey done as part of the study suggest that the greatest barriers to adoption were cost and not understanding the need for the BMP.

The Canadian Fertilizer Institute is working with others to help improve agricultural productivity and minimize environmental impacts by encouraging adopting of the 4R Nutrient Stewardship System. The 4R system is a BMP with four pillars for fertilizer application: Right Source @ Right Rate, Right Time, Right Place®.[34] Better management and application practices can reduce NPSP by reducing the loss of nitrogen and phosphorus from fields. A research project now underway in Alberta is investigating the benefits of 4R nutrient management on barley, canola and wheat. Sites around Alberta, representing a range of soil and climate variables, are being used to evaluate the performance of nitrogen fertilizer options based on the 4R nutrient management system. Once completed, the results will be used to update provincial nitrogen fertilizer management recommendations and the Alberta Farm Fertilizer Information and Recommendations Manager software.[35]

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[31] Alberta Environmentally Sustainable Agriculture Program and the Alberta Beef Producers also contributed funding to one or more manuals.

[32] Franz, B. *et al*. 2011, *Field Manual on Buffer Design for the Canadian Prairies*, http://www4.agr.gc.ca/AAFC-AAC/display-afficher.do?id=1308065640348&lang=eng

[33] George Morris Centre. 2007, *An Economic Evaluation of Beneficial Management Practices for Crop Nutrients in Canadian Agriculture*, prepared for the Crop Nutrients Council, http://www.georgemorris.org/aspx/Public/Utils/DbFileViewerPopup.aspx?FileID=269

[34] Canadian Fertilizer Institute website, http://www.cfi.ca/whatwedo/nutrients/. See also http://www.nutrientstewardship.com/

[35] *Agri-News*, Nov. 28, 2011, http://www1.agric.gov.ab.ca/$department/newslett.nsf/all/agnw18758

Examples of Partners

Cows and Fish

Cows and Fish is a voluntary stewardship program that works with various groups and agencies, landowners and managers on both private and public land to improve and protect the health of riparian areas. Healthy riparian areas act as filters to keep sediments and pollutants out of adjoining watercourses. Cows and Fish has produced a number of resources, including tools for assessing riparian health, tools for riparian management, and examples of good stewardship practices. Among other things, the program works with cattle producers to set up demonstration sites that provide practical, local examples of riparian management options and illustrate to other producers and communities the costs and benefits associated with certain management techniques. In 2010, Cows and Fish evaluated 151 sites for riparian health, for a total of over 2,200 sites since 1997. A significant focus of their work is workshops and training sessions to resource managers to improve extension program delivery.[36]

Ducks Unlimited Canada

Wetlands and their surrounding grasslands reduce the effects of flooding, erosion and sedimentation; recharge local groundwater and aquifers; filter nutrients, pesticides and pathogens from the water; maintain shorelines; and provide important wildlife habitat. They can thus play an important role in helping to reduce and mitigate NPSP. Wetland restoration is a recognized BMP and is a key component of the Environmental Farm Plan process. Ducks Unlimited Canada (DUC) works closely with federal and provincial agencies, private landowners, grazing leaseholders, and irrigation districts to help conserve natural and agricultural lands and restore wetlands; over 1800 projects are underway in Alberta. DUC provides producers with education, assistance and support in developing and implementing wetlands preservation and restoration projects.[37] See Figure 1 for more information on the importance of wetlands in managing NPSP.

Land Stewardship Centre

The Land Stewardship Centre (LSC) works directly with landowners and land managers to improve stewardship practices, supports grass-roots community stewardship efforts, and encourages the development of practices and policies that support sustainable resource use. The LSC has developed various programs, tools and information resources to help people become better stewards, many of which focus on the rural environment. The Centre has an extensive online resource centre with information, news and resources related to environmental stewardship, including many that pertain to water quality and NPSP.[38]

[36] Cows and Fish website, http://www.cowsandfish.org/
[37] Ducks Unlimited Canada website, http://www.ducks.ca/province/ab/index.html
[38] The LSC's online resource centre is located at http://www.landstewardship.org/resources/explore/

Funding Mechanisms and Approaches

Over the years, ARD has provided funding alone and in partnership with Agriculture and Agri-Food Canada to assist producers in identifying and implementing BMPs that can reduce NPSP.

Environmental Farm Plans

Agriculture and Agri-Food Canada supported the initial development of Environmental Farm Plans (EFPs) over a four-year period. By taking advantage of financial support to develop EFPs, producers can assess their environmental risks, including potential management issues related to NPSP, and develop mitigation plans. EFPs are now coordinated through ARD and recent data show that over 12,000 producers have participated in this initiative.[39] EFPs are meant to be regularly updated and are required for some program funding. A future driver for EFPs could emerge if commodity groups require an EFP to be in place as part of their branding and marketing initiatives.

Growing Forward

Growing Forward is a joint federal-provincial initiative that, among other things, aims to help producers more effectively manage risk. The initiative provides support in more than 20 program areas, including the development of stewardship plans. There are three Stewardship Plan programs: Integrated Crop Management, Grazing and Winter Feeding Management, and Manure Management. Producers develop a work plan that identifies mitigating actions that will address their highest environmental risks and will reduce or minimize their impact on the environment. Producers can apply for grant funding for projects that will help them achieve actions identified in their work plan. Approved projects are funded on a 50:50 cost-shared basis to a maximum amount per applicant, depending on the program.[40]

Agricultural Service Board Grant Program

This program is supported by ARD and administered by Alberta Municipal Affairs. It supports Agricultural Service Boards in developing and delivering environmental extension programming and administration of legislative requirements under the *Agricultural Service Board Act*. It enables the hiring of qualified staff directed at environmental programming and implementation of the *Agricultural Service Board Act*. The budget allocation for 2011/12 was $12.2-million.[41]

Agriculture Opportunity Fund[42]

The Agriculture Opportunity Fund is also supported by ARD and provides funding assistance to eligible organizations to enable them, through partnership with others, to promote long-term sustainability of the agricultural industry and rural communities in their areas. The focus is on growth, environment, economic development and sound extension methodology. “Environment” is one of the Fund’s three main program areas, with the intent of achieving enhanced awareness, understanding and implementation of environmentally beneficial agricultural practices and the importance of responsible stewardship of land, air, water and biodiversity. Recipients are required to submit annual reports.

Monitoring BMP Implementation and Effectiveness

It is difficult to quantify both the extent of implementation of BMPs to manage NPSP and their overall effectiveness. Many producers have taken advantage of support programs to voluntarily identify and implement BMPs and ARD does field inspections to ensure funding was used properly and the BMP was actually adopted. ARD also tracks its extension activities, but it is possible that projects may be counted in more than one program.

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[39] Alberta Environmental Farm Plan website, http://www.albertaefp.com/
[40] Growing Forward website, http://www.growingforward.alberta.ca/index.htm
[41] Agriculture Service Board Grant Program, http://www.municipalaffairs.alberta.ca/municipalgrants-ministry.cfm
[42] Agriculture Opportunity Fund, http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/webdoc7493

Every three years, ARD surveys 500 farmers in the five provincial agricultural regions to track changes in awareness of, attitudes toward and adoption of environmentally sustainable agriculture practices in Alberta. The most recent survey was done in 2010 and assessed changes since the previous survey in 2007.[43] An overall trend in the 2010 survey suggests that environmentally sustainable agriculture is increasingly becoming part of mainstream agriculture. Two key findings are relevant to the NPSP project, but it is difficult to know how these numbers actually translate to on-the-ground changes:

- There were strong gains in several water quality practices that could prevent or mitigate NPSP; these included the use of vegetative buffer strips along the edges of water bodies (13% increase), avoiding draining or filling natural wetlands (13% increase), providing off-site watering systems to keep livestock out of water bodies (12% increase), and the use of grassed waterways (10% increase).
- There was increased adoption of some manure management practices, but overall awareness and understanding of the requirements of AOPA continue to lag. Despite ongoing extension efforts, only 41% of respondents said they were aware of the management standards in AOPA that apply to their operations.

Despite documented efforts to implement BMPs, a big question remains as to how effective these efforts are at actually reducing or preventing NPSP. Intuitively, it seems that many BMPs would positively affect NPSP to water bodies, but performance measures and clear correlations between BMP implementation and improved water quality have yet to be developed. Two evaluation projects described at the end of section 2.1.3 are examining the relationship between BMPs and surface water quality, and will help strengthen the links between science and policy.

2.1.3 Monitoring NPSP and Assessing Management Outcomes

Several major surveys and studies have been done to monitor and assess the impact of agriculture on surface water quality in Alberta. Much of this work has been done in southern Alberta where agricultural activities are most intense, and some of these studies are described below. The data collection process and methodology are described in detail in the background materials for each project. ARD does not monitor water quality on an ongoing basis. If an issue is identified, partnerships are typically formed to fund the monitoring and ARD provides analysis.

The Provincial Stream Survey was conducted under the Canada-Alberta Environmentally Sustainable Agriculture (CAESA) agreement to determine if there were relationships between the agricultural intensity in the drainage basins and water quality of streams. In 1995 and 1996, water quality was monitored in 27 streams with differing levels of agricultural intensity. The study observed higher peak, median, and flow-weighted mean concentrations of total and dissolved nutrients and more frequent pesticide detections in streams draining high agricultural intensity watersheds. The Alberta Environmentally Sustainable Agriculture (AESA) Program was initiated in 1998 following cessation of CAESA. The **AESA Stream Survey** assessed temporal and spatial patterns in water quality in watersheds with agricultural activity. Data were collected in 23 diverse watersheds from 1999 to 2006 to evaluate water quality and quantity. This study confirmed the impact of agricultural activities on surface water quality in Alberta, echoing the findings of the CAESA study.[44]

[43] Alberta Agriculture and Rural Development, *2010 Environmentally Sustainable Agriculture Tracking Survey Report*, http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/aesa6467

[44] Lorenz, K., *et al*. 2008, *Assessment of Environmental Sustainability in Alberta's Agricultural Watersheds Project, Volume 3: AESA Water Quality Monitoring Project*, http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/irr12914

From 1999 to 2006, ARD and the Oldman Watershed Council monitored water quality and flows in two agricultural watersheds in southern Alberta, the **Battersea Drain and Lower Little Bow River**.[45] Water flows in these watersheds are controlled, in part, by irrigation demand. The existing network of monitoring sites was used to evaluate five BMPs established in the watersheds. Results showed that BMPs that targeted point sources of contamination were the most effective. Water quality improvements in fecal contaminant loads and concentration were measured for BMPs that limited or excluded livestock access to waterways. Nutrient reductions were more difficult to quantify, suggesting that either BMPs may not be effective at reducing nutrients or more likely, that BMPs need to be applied on the landscape more extensively or monitored for a longer period of time to detect nutrient changes.

Also in southern Alberta, the **Oldman River Basin Water Quality Initiative (ORBWQI)** saw water samples collected along the length of the Oldman River from 1998 to 2003.[46] The study is described in more detail in section 2.6.3; it showed that non-point sources play a major role in the quality of the Oldman River and its tributaries, and agriculture is not the only land use that affects water quality in the basin.

In 2006 and 2007, ARD undertook a study to assess **water quality in Alberta's irrigation districts**. Irrigation water was monitored at about 80 sites in 11 irrigation districts.[47] Sampling sites were chosen to capture water as it moved through the infrastructure of each irrigation district, from the source water to return flows. Samples were analyzed for a suite of nutrient, metal, major ion, salinity, pesticide, and bacterial indicators. The study found that water quality for irrigation was generally good or excellent and guidelines for nutrients and metals were met most of the time, but pesticides were detected in most samples and herbicide guidelines for irrigation were often exceeded. Salinity and major ions were not a concern for most districts.

In 2006, Alberta Environment (and Water) undertook a pilot study to evaluate the practicality of aquatic ecosystem monitoring in small agricultural streams in Alberta.[48] Researchers looked at three streams from the AESA network in different ecoregions that are farmed with different levels of intensity. Biological communities and sediments were sampled and field data and observations were noted for basic water quality parameters and site characteristics. The study found differences in biological communities among streams that were linked to the degree of eutrophication, physical habitat characteristics and disturbance. More work is needed to determine background or reference conditions that could be used to depict healthy conditions for each ecoregion. This would then enable health assessments of streams affected by various types of activity (agriculture, forestry, urban development, mining, etc.).

Collecting surface water quality data is a necessary first step in developing strategies to manage NPSP and determine which BMPs will give the best results. At present, there is little scientific data to demonstrate the environmental and economic effectiveness of BMPs. Two evaluation studies now underway are expected to shed some light on which BMPs are most effective at reducing or preventing NPSP.

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[45] Alberta Agriculture and Food and Oldman Watershed Council. *Beneficial Management Practice Evaluation in the Battersea Drain and Lower Little Bow River Watersheds*, 2007, http://oldmanbasin.org/pdfs/bmp_eval_2007.pdf

[46] Description of this program is adapted from Saffran, K.A. 2005, *Oldman River Basin Water Quality Initiative: Surface Water Quality Summary Report, April 1998-March 2003*, http://www.oldmanbasin.org/pdfs/orbwqi_swq_98-03.pdf

[47] For details, see Little, J. *et al*. 2010, *Assessment of Water Quality in Alberta's Irrigation Districts. Second Edition.* AARD, Lethbridge, 181 pages, http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/irr13000

[48] Anderson, A.-M. *et. al*. 2009, *Pilot Study to Evaluate the Practicality of Aquatic Ecosystem Monitoring in Small Agricultural Streams in Alberta*, Alberta Environment, http://www.environment.gov.ab.ca/info/library/8140.pdf

In 2004, Agriculture and Agri-Food Canada initiated the **Watershed Evaluation of Beneficial Management Practices** project to measure the economic and water quality impacts of selected agricultural BMPs at nine small watershed sites across Canada.[49] By assessing BMPs at the watershed scale, researchers can better understand their performance by evaluating the combined effects of soils, topography, local climate, and land use. This research is being done on working farms to ensure applicability to the agricultural landscape. The project is funded until 2013. BMPs were selected to match the unique conditions of each watershed, as well as to reflect local and regional BMP interests. The Lower Little Bow River Watershed[50] was chosen for testing in Alberta, and four BMPs are being evaluated: cattle exclusion fencing (and off-stream watering), off-stream watering without fencing, nutrient input/management (commercial fertilizer and manure), and buffer strips. To date, more than half of the BMP tests (13 of 22) reduced surface water contamination by nutrients or sediment, although in many cases, the results have yet to be quantified. Some BMPs were found to have both positive and negative environmental effects.

In 2007, ARD and its partners implemented the **Nutrient Beneficial Management Practices Evaluation Project, 2007-2012**. This six-year study is scientifically evaluating BMPs in two watersheds: Whelp Creek near Lacombe in central Alberta, and Indianfarm Creek near Pincher Creek in southwestern Alberta.[51] Two field sites are also part of the study, in the Lower Little Bow River and Battersea Drain watersheds east of Picture Butte. The selected sites will be evaluated before and after BMP implementation through the monitoring of surface water quality and quantity, soil nutrient status, riparian health, and rangeland health. Land cover, land use and economic data will also be collected and used in the overall assessment. Based on the collected data, a computer model will then be used to predict the environmental and economic effectiveness of BMPs in all agricultural watersheds in the province. The study is evaluating six nutrient management BMPs, three livestock management BMPs, and one alteration of infrastructure BMP.

2.1.4 Other Initiatives

Phosphorus is an essential plant nutrient and application of manure at appropriate rates can benefit crops. However, over-application can cause phosphorus to accumulate in soil and potentially contaminate surface water,[52] as this nutrient is known to contribute to eutrophication. AOPA has soil limits for manure application based on nitrogen, but shifting to a phosphorus-based system may be needed.

The livestock industry (Intensive Livestock Working Group) is taking the lead in developing a long-term Phosphorus Strategy to help minimize its impact on surface water quality, ensure it has the social license to continue operations, and can grow as market conditions allow. A sub watershed-scale pilot project is being proposed in support of the industry-led Phosphorus Strategy. The next steps are to establish a study watershed and finalize funding support to move forward for implementation in 2013. Partners in this industry-led project include ARD and the NRCB.[53]

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[49] Text about this project adapted from Agriculture and Agri-Food Canada's online description at http://www4.agr.gc.ca/AAFC-AAC/display-afficher.do?id=1296246973332&lang=eng

[50] Water quality in the Lower Little Bow River had been previously monitored to determine if irrigation return flows were having a significant impact on river water quality and to examine relationships between land use and water quality in this watershed. See Little, J.L. *et al.* 2003, "Land Use and Water Quality Relationships in the Lower Little Bow River Watershed, Alberta, Canada," in *Water Qual. Res. J. Canada*. 38(4):563-584.

[51] Text about this project adapted from online description at http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/epw11955. Progress reports are also available at this site.

[52] See Olson, B.M. and B.A. Paterson. "Implications of Moving to a Phosphorus Based System for Manure Application," http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/epw9889

[53] Ron Axelson, Executive Director, Intensive Livestock Working Group, personal communication with Kim Sanderson, February 22, 2012.

NPSP from agriculture has been implicated as a significant contributor to phosphorus loadings in the Bow River. A Phosphorus Management Plan for the Bow is expected to be developed in 2012-2013 and may create regional ambient water quality objectives with limits and triggers using a cumulative effects management approach.

Private landowners play an important role in conserving natural landscapes and can help to prevent NPSP and preserve ecological integrity by managing their land with conservation goals in mind. This can be particularly important as a source water protection tool. Landowners can work with land trusts to conserve their land through land donations, land purchases, a combination of land donation and land purchase, or through a Conservation Easement. Through its Ecological Gifts Program, the Government of Canada has eliminated capital gains tax for all certified ecological gift donations.[54]

2.2 Urban

The Phase I work for this project found that "of all human activities, large urban developments in the Bow and North Saskatchewan River basins seem to have the most direct effect on mainstem water quality, primarily because urban centres typically cluster around mainstems and many stormwater outfalls directly discharge to them. Urban development, through stormwater runoff, is also affecting the water quality and ecosystem health of streams. This runoff exports relatively important NPS pollutant loads of total suspended solids (TSS), metals, nutrients, salts, pesticides, and fecal coliforms."[55]

The project team agreed that discussion of how urban NPSP is managed in Alberta would focus on the two major cities of Calgary and Edmonton. Together, these two cities comprise about 50% of Alberta's population[56] on a total of 1427 km^2, or 0.2% of the total provincial land base. Neither city has a NPSP management strategy or framework *per se*, but stormwater management is clearly a major focus.

Cities require approvals from Alberta Environment and Water (AEW) to operate their wastewater treatment plant, wastewater collection system, and stormwater drainage systems. These approvals include conditions that can affect NPSP, such as a requirement to have a **total loading management plan** (TLMP) and a stormwater management strategy. Municipalities typically use a mix of approaches to address NPSP, but the TLMPs consider non-point source releases in addition to loadings from wastewater treatment plants, with the objective of ensuring that total emissions to the river do not have significant adverse impacts on the aquatic ecosystem. As noted in Calgary's TLMP, "An overriding principle behind total loading management is that it is a planning approach, rather than a regulatory approach. As such, the total loading objectives are not regulatory limits, but are values the City will use to manage its pollutant loadings to the Bow River. In practice, the loading objectives are more idealistic than regulatory values tend to be, and include margins of safety."[57]

[54] See the Alberta Land Trust Alliance website at http://www.landtrusts-alberta.ca/guide.php?PHPSESSID=st6hjso5kcge0etl1vglb14t80 for more information.
[55] CPP Environmental Corp. 2011, *Current state of non-point source pollution: Knowledge, data, and tools,* Report prepared by T. Charette and M. Trites for the Alberta Water Council, 153 pp, p. i.
[56] Statistics Canada data from 2006 indicate the two cities comprised just over 52% of provincial population. Since then, other data from the cities and the province using differing years, suggest that percentage has declined slightly to just under 50%.
[57] City of Calgary, Water Services. *2008 Calgary Total Loading Management Plan,* p.3.

2.3 Forestry

In 1948, Alberta was divided into two main areas for the purpose of land management: the Green Area, which is public land, and the White Area, most of which is privately owned. These two areas respectively cover about 58% and 42% of the province's land base.[142] The Government of Alberta (GoA) regulates public land use for a variety of activities, including timber production. Alberta's forests cover 27,718,000 ha,[143] and forestry operations are a dominant use in the Green Area.

The GoA has sub-divided the Green Area into Forest Management Units (FMUs), which are forested public lands designated under the *Forests Act* as administrative units to manage timber. The GoA allocates the right to harvest timber in the FMUs to companies and individuals through a forest tenure system, which includes Forest Management Agreements (FMAs).[144] FMAs are the dominant form of forest tenure; they cover nearly one-third of Alberta's land base[145] and are negotiated with the company and authorized as Orders-in-Council. Between May 1, 2009 and April 30, 2010, FMUs within FMAs included about 23.1 million ha or 66% of the Green Area.

FMA holders are required to create a Forest Management Plan (FMP) for their defined forest area, and these plans must be approved by the Minister of Alberta Sustainable Resource Development (SRD). FMPs (also referred to as Detailed Forest Management Plans) are technical documents that describe forest management objectives, strategies and commitments, and identify intended methods of cutting, reforesting, and managing timber resources in the FMA. They look beyond sustained timber yield to, among other things, recognize other resource values and uses. SRD is responsible for forest management planning on the 4.3 million ha of non-FMA FMUs with timber dispositions.[146] Timber Harvest Planning and Operating Ground Rules provide direction to forest companies and government for planning, implementing and monitoring timber harvesting operations on timber dispositions.

The Phase I report for this project notes that forest harvesting and its associated activities represent important potential sources of NPSP. Runoff can potentially result from land disturbance, increased sedimentation from road construction and use, and the use of herbicides. Several policy and regulatory tools are used to manage NPSP in the forestry sector.

2.3.1 Policy and Regulatory Tools

The provincial *Forests Act* provides the legislative framework for administering forest lands (allocation of timber, annual allowable cut, etc.) and for forest management planning but is not directly relevant to NPSP. The main policy and regulatory tools that apply or could apply to NPSP from forestry include:

- Timber Harvest Planning and Operating Ground Rules
- Alberta Forest Management Planning Standard
- *Environmental Protection and Enhancement Act*

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[142] Alberta Sustainable Resource Development. Fall 2010, *Sustainable Forest Management Current Facts and Statistics,* http://www.srd.alberta.ca/LandsForests/ForestManagement/ForestManagementFactsStatistics/documents/GeneralBoundary-CurrentFactsAndStatistics-2010.pdf

[143] Statistics Canada, http://www40.statcan.gc.ca/l01/cst01/envi34a-eng.htm

[144] The other tenure types are a Timber Quota and a Timber Permit. Timber quotas and FMAs are 20-year renewable agreements.

[145] See https://www.landuse.alberta.ca/Planning/WhyLandusePlanning/UnderstandingLandUseAlberta/Pages/default.aspx

[146] Much of the text in this paragraph is adapted from *Sustainable Forest Management Current Facts and Statistics*. Fall 2010. Alberta Sustainable Resource Development. For more information on FMPs, see also http://srd.alberta.ca/LandsForests/ForestManagement/ForestManagementPlans/Default.aspx

- Herbicide Reference Manual (2004)
- *Public Lands Act*
- *Water Act* (and the Environmental Code of Practice for Watercourse Crossings)

Of these, the Timber Harvest Planning and Operating Ground Rules are the most comprehensive and relevant to managing NPSP. The federal *Fisheries Act* is also pertinent.

Timber Harvest Planning and Operating Ground Rules

Operating Ground Rules, which tenure holders must follow as a condition of their tenure document and harvest approval, provide guidance in how actions are carried out on the ground[147] and therefore greatly influence the management of NPSP. The *Alberta Timber Harvest Planning and Operating Ground Rules Framework for Renewal* (2008)[148] provides guidance in the form of a template for companies to use in developing Operating Ground Rules for their specific FMA.

The ground rule scope is noted in the Framework document: "Ground rules are the practices used in planning and conducting timber harvesting operations which constitute the methods used to implement decisions made in the FMP and other higher level plans such as Integrated Resource Plans (IRP). In the event that these strategic plans do not exist, the ground rules shall establish practices that minimize the chance of negative impacts from roads, timber harvesting and forest management operations and activities" (p. 4). The Framework envisions that ground rules will be reviewed regularly to correct any inconsistencies or problems and so that modifications can be considered that reflect the best and most current knowledge and tools available.

The Framework template includes a list of topics that must be addressed in all ground rules. It includes specific text that is mandatory and would only be changed if, in Alberta's opinion, the result is a higher standard of practice. The Framework includes a number of different ground rules to take into account the variation in landscape and timber type across the province, with the result that the Operating Ground Rules for each FMA are unique and reflect specific regional conditions and circumstances.

The sections that are most relevant to managing NPSP are Chapter 6 (Watershed Protection), Chapter 9 (Soils) and parts of Chapters 7 (Habitat Management) and 11 (Roads).

The purpose of Chapter 6 on Watershed Protection is "to manage the implications of timber operations on water quality, quantity and flow regime by:

- Minimizing the potential for sedimentation in watercourses
- Preventing soil, logging debris and deleterious substances from entering watercourses
- Maintaining aquatic and terrestrial habitat
- Complying with the *Water Act*" (p. 21).

The ground rules in Chapter 6 define operating practices to protect water quality and riparian values. This is where buffer and other requirements are noted for different watercourse classifications, as shown in Table 3.[149] This is one section where specific regional conditions are often incorporated into a company's ground rules. An example of a specific regional condition incorporated into a company's ground rules is

[147] Darren Tapp, Executive Director, Forest Management Branch, Alberta Sustainable Resource Development, personal communication with Kim Sanderson, December 22, 2011.

[148] Alberta Sustainable Resource Development. 2008, *Timber Harvest Planning and Operating Ground Rules,* http://srd.alberta.ca/LandsForests/ForestManagement/ForestManagementPlanning/documents/Annex_4_draft_Jan_15_08Final.pdf

[149] Table 3 is excerpted from *Timber Harvest Planning and Operating Ground Rules. 2008. Alberta Sustainable Resource Development,* pp. 25-27.

noted in the *Spray Lake Sawmills and C05 Timber Harvest Planning and Operating Ground Rules*, updated in January 2011.[150] The following text was added to the Watercourse Protection Area requirements for Large Permanent water bodies (see Table 3):

> "Watercourses with deeply incised **unvegetated** banks shall have the buffer start from the top of the incised valley and not the high water mark."

[150] Online at http://srd.alberta.ca/LandsForests/ForestManagement/documents/SprayLakeSawmills-OperatingGroundRules-Feb032011.pdf

Table 3. Standards and Guidelines for Operating beside Watercourses

Watercourse Classification	Roads, Landings and Bared Areas	Watercourse Protection Areas	Operating Conditions within Riparian Areas and Water Source Areas where Operations are Approved	
			Tree Felling	Equipment Operations
Class "A" Waterbodies*	Not permitted within 100m of high water mark. Any existing roads may be maintained at present classification standards. Any proposed watercourse crossings within 2 km upstream must be specifically approved in the AOP.	No disturbance of timber within 100m of the high water mark; No duff disturbance of intermittent (min 10m vegetated buffer) or ephemeral drainages (minimum 5m vegetated buffer) within 2 km upstream of Class "A" waterbody.	Not permitted without specific Alberta approval	Not allowed without specific Alberta approval
Class "B" Waterbodies*	Not permitted within 60m of high water mark. Any existing roads may be maintained at present classification standards. Any watercourse crossings within 500m upstream must be specifically approved in the AOP.	No disturbance or removal of timber within the appropriate riparian area specified by stream type unless specifically approved in the AOP. No duff disturbance of intermittent (min 10m vegetated buffer) or ephemeral drainages (minimum 5m vegetated buffer) within 500 m upstream of Class "B" waterbody.	Trees shall be felled so that they do not enter watercourse. Should slash or debris enter the watercourse immediate removal is required without a machine entering the watercourse.	Where removal of timber within 60m is approved, no machinery is permitted within 30m of the high water mark.
Large Permanent	Not permitted within 100m of the high water mark or water source area within the riparian management zone unless specifically approved in the AOP.	No disturbance or removal of timber within 60m of high water mark unless specifically approved in the AOP. No removal of timber shall be approved within 10 m of the high water mark.	Trees shall be felled so that they do not enter watercourse. Should slash or debris enter the watercourse immediate removal is required without a machine entering the watercourse.	Where removal of timber within 60m is approved, no machinery is permitted within 20m of the high water mark.
Small Permanent	Not permitted within 30m of the high water mark or water source area within the riparian management zone unless specifically approved in the AOP.	No disturbance or removal of timber within 30m of high water mark unless specifically approved in the AOP. No removal of timber shall be approved within 10 m of the high water mark. Transitional streams: Buffer of treed vegetation will be left for 10m from the high water mark or to the top of the break in slope, whichever is higher.	Trees shall be felled so that they do not enter watercourse. Should slash or debris enter the watercourse immediate removal is required without a machine entering the watercourse.	Where removal of timber within 30m is approved, no machinery is permitted within 20m of the high water mark.

Watercourse Classification	Roads, Landings and Bared Areas	Watercourse Protection Areas	Operating Conditions within Riparian Areas and Water Source Areas where Operations are Approved	
			Tree Felling	Equipment Operations
Intermittent	Not permitted within 30m of the high water mark or water source area within the riparian management zone unless specifically approved in the AOP.	Buffer of brush and lesser vegetation to be left undisturbed along the channel; Width of buffer shall vary according to soils, topographical breaks, water source areas and fisheries values.	Trees shall be felled so that they do not enter watercourse. Should slash or debris enter the watercourse immediate removal is required without a machine entering the watercourse.	Heavy equipment may operate within 20m only during frozen or dry periods. No skidding through watercourse except on snow/ice bridge or logfill. Crossings must be planned with adequate crossings to be removed on completion of operations. Where fish and spawning movements have been identified, special crossings that do not obstruct upstream fish passage or cause stream siltation may be required.
Ephemeral	Construction not permitted within a watercourse or water source area.	Buffer of undisturbed vegetation in wet gullies. Class "A" and "B" waterbody tributaries to be left undisturbed.	Accumulation of slash and debris to be removed progressively	Skidding restrictions apply on Class "A" and "B" waterbody tributaries; Skidding shall only be during dry or frozen conditions; Temporary crossings to be removed on completion of operations; On Class "A" and "B" waterbody tributaries, special crossing structures that do not cause stream siltation may be required.
Lakes (little or no recreation, waterfowl or sportfish potential)	Not permitted within 100m of high water mark unless specifically approved in the AOP.	On lakes exceeding 4 ha in area, no disturbance of timber within 100m of high water mark except where specifically approved in FHP. Where approval is granted to remove timber within the 100m zone, no timber shall be removed within 30m of the high water mark.	Trees shall be felled so that they do not enter watercourses, unless otherwise approved by Alberta. Should slash or debris enter the watercourse immediate removal is required without a machine entering the watercourse.	If timber removal is approved, no machinery to operate within 40m of the high water mark.
Lakes (with recreational, waterfowl or sport fish potential)	For shorelines not located within reserved areas, no disturbances shall be permitted within 200m of the high water mark unless specifically approved in the AOP.	On lakes exceeding 4 ha in area, no disturbance of timber within 100m of high water mark. Alberta in the FHP may require additional protection. On lakes	Trees shall be felled so that they do not enter the waterbody, unless otherwise approved. Should slash or debris enter the watercourse immediate removal	Consideration must be given to aesthetics when harvesting adjacent to lakes with recreational potential.

Watercourse Classification	Roads, Landings and Bared Areas	Watercourse Protection Areas	Operating Conditions within Riparian Areas and Water Source Areas where Operations are Approved	
			Tree Felling	Equipment Operations
		less than 4 ha, removal of timber prohibited within 30m of the high water mark and any removal within 100m requires Alberta's approval.	is required without a machine entering the watercourse.	
Water source Areas and Areas Subject to Normal Seasonal Flooding	Construction not permitted unless approved in the AOP; No log decks permitted; The number of stream crossings must be minimized; No disturbance of organic duff layers or removal of lesser vegetation.	Treed riparian management zone of at least 20m on all water source areas; No harvest of merchantable trees or disturbances of lesser vegetation unless specifically approved in the AOP; Buffer width may be altered according to its potential to produce surface water, provided it is approved in the AOP.	Heavy machinery not permitted within water source areas during unfrozen soil conditions; Minimal disturbance or removal of duff or lesser vegetation; Timber may be harvested if stream sedimentation is the only resource concern, provided there is no disturbance of the organic soils and lesser vegetation when harvesting the trees; On unstable areas subject to blowdown, merchantable trees shall be carefully harvested from water source areas to minimize root disturbances of duff layers and watercourse damming.	Road construction, timber harvest, reforestation and reclamation shall be done with equipment capable of operating without causing excessive disturbance to the soil layers; Heavy equipment is not permitted during moist or wet conditions, but may be operated during frozen periods; No soil caps or depositing of soil permitted on roads in water source areas, unless a separation layer is incorporated or the road is designed to provide adequate surface and sub-surface drainage away from the road bed; Where a separation layer is used, the soil cap shall be removed as operations are completed.
Oxbow Lake	Construction not permitted within 100m of oxbow lake unless specifically approved in the FHP.	The buffer shall encompass the area from the high water mark of the main watercourse to 20m beyond the high water mark of the oxbow lake. Oxbow lakes outside the buffer of the main watercourse shall be treated as water source areas.	Heavy equipment not permitted around oxbow lakes during unfrozen conditions. Trees shall be felled so they do not enter the waterbody, unless otherwise approved. Should slash or debris enter the watercourse, immediate removal is required without the machine entering the watercourse.	Approved activities shall be done with equipment capable of operating without causing excessive disturbance.

* Class "A" and "B" waterbodies are defined in the *Water Act.*
AOP = Annual Operating Plan FHP = Final Harvest Plan

Chapter 9 focuses on "Soils;" the purpose of this topic is "to conduct timber harvest, road construction, reforestation and reclamation operations in a way that shall:

- Minimize the potential for soil erosion;
- Prevent soil, logging debris and deleterious substances from entering watercourses;
- Ensure that the capability of the site to support healthy forest tree growth is maintained" (p. 53).

Ground rules to fulfill this purpose cover pre-harvest planning, harvesting and post-harvest reclamation and reforestation. For example:

- Areas susceptible to rutting, puddling or compaction shall be harvested during dry or frozen conditions.
- Roads within harvest areas that are no longer required shall be reclaimed and reforested.

Chapter 7.6 deals with Fisheries and the Aquatic Environment; the purpose of this topic is "to conduct timber operations in a manner that shall minimally affect:

- The health, diversity and natural distribution of aquatic biota;
- The quantity and productive capacity of the aquatic environment, including fish habitat; and
- Fisheries management objectives identified in the FMP." (p. 41)

The section notes that "the primary strategy for maintenance and protection of the aquatic environment and fish habitat is to maintain treed buffers along watercourses and water bodies and adopt rigorous watercourse crossing and erosion control measures" (p. 41). This section requires an assessment of the potential effects on fish and fish habitat for any activity that disturbs or alters the bed and banks of a fish-bearing water body, and refers to the Code of Practice for Watercourse Crossings.

Chapter 11 on "Roads" has two sub-sections relevant to NPSP. Section 11.3 on road construction, maintenance and reclamation states that "Roads shall be constructed, maintained and reclaimed in a timely manner to minimize environmental impacts" (p. 64). Section 11.3 also addresses construction, erosion control and prevention, and reclamation, and contains a total of 22 ground rules. For example:

- Water from roads, ditches and bared soil surfaces shall not be permitted to drain directly into watercourses. Where vegetated buffers alone do not retard water and sediment movement effectively, appropriate obstructions (e.g., logs, rocks, mounds) or sediment control structures shall be installed to dissipate the flow of water and capture sediment prior to entering the watercourse.

Section 11.4 deals with watercourse crossings and provides guidance "so that crossings are constructed, maintained and reclaimed in a manner that ensures negative environmental impacts are minimized and fish and fish habitat are protected. . . Watercourse crossings shall be designed, installed, maintained and deactivated in accordance with all applicable policy and legislation" (p. 67). The *Water Act Code of Practice for Watercourse Crossings* must be followed for all crossings; some situations may be exempt from the *Water Act* and *Code of Practice*, but must still have other approvals as specified in section 11.4. This section contains 27 ground rules.

Alberta Forest Management Planning Standard[151]

The Alberta Forest Management Planning Standard is not a regulation *per se*, but has been approved for use by the Minister.[152] Together with its annexes, interpretive bulletins and updates, it comprises the standard for preparing and implementing FMPs in Alberta. Alberta has adopted the CAN/CSA-Z809-

[151] See http://srd.alberta.ca/LandsForests/ForestManagement/ForestManagementManualsGuidelines.aspx

[152] Darren Tapp, Executive Director, Forest Management Branch, Alberta Sustainable Resource Development, personal communication with Kim Sanderson, December 22, 2011.

2002 *Sustainable Forest Management: Requirements and Guidance Document* (referred to as CSA Z809-02) as the forest management planning system. Section 2 in the Standard outlines the FMP process and content requirements in Alberta. The CSA Standard specifies requirements for sustainable forest management of a defined forest area, including requirements for (a) the management framework; (b) commitment; (c) public participation; (d) performance measures and targets; (e) the systematic review of actions; (f) the monitoring of effectiveness; and (g) continual improvement.[153]

Section 6 in CSA Z809-08, entitled Sustainable Forest Management Performance Requirements, includes a criterion for soil and water. Criterion 6.3.3 is "Conserve soil and water resources by maintaining their quantity and quality in forest ecosystems." Core indicators are also noted.[154]

A number of FMAs note the adherence to the Standard; for example, the FMA issued to Alpac Forest Products Incorporated in July 2011 (OC310/2011) includes General Provision 10(1):

> "The Company shall submit a forest management plan in accordance with the forest planning standards for the Minister's approval on or before May 1, 2015. . ."[155]

Environmental Protection and Enhancement Act

The *Environmental Protection and Enhancement Act* (EPEA)[156] is very wide-ranging and covers any activity that could adversely affect the environment, including activities that could cause the siltation of water or the erosion of any bed or shore of a water body. Environmental protection orders may be issued by Alberta Environment and Water under EPEA. See the description of the Code of Practice for Pesticides described in section 2.1.1.

Forest Management Herbicide Reference Manual (2004)

The Herbicide Reference Manual[157] provides information to GoA staff and forest industry personnel about Alberta's requirements and expectations as well as roles and responsibilities regarding the use of herbicides on Crown land. Herbicide application in the context of silviculture is designed to ensure rapid post-harvest re-establishment of crop tree species.

Companies must submit a detailed herbicide application proposal to SRD, requirements for which are described in the manual. This includes identifying and mapping any sensitive areas such as watercourses and buffers. A post-treatment monitoring plan for possible excursions within the project area must also be submitted (an excursion is any off-target application of herbicide).

The manual also includes guidelines for the use of herbicides for silviculture in Alberta, including one related to riparian management zones and watercourse protection buffers. This Guideline is to: "Ensure that the application of herbicides within, or adjacent to, riparian zones that are managed primarily for wildlife and biodiversity values, reflects the vegetation management priorities and objectives of those zones. Use should be made of risk management plans that address the priority habitat resource values and management objectives of riparian areas."[158]

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[153] The CSA has since updated and published CSA-Z809-08, *Sustainable Forest Management*, which supersedes earlier editions. See http://shop.csa.ca/en/canada/sustainable-forest-management/cancsa-z809-08/invt/27017442008/
[154] CSA. 2008, CAN/CSA-Z809-08 *Sustainable Forest Management*; p. 15.
[155] Alpac Forest Products Incorporated FMA, 2011, http://srd.alberta.ca/LandsForests/ForestManagement/ForestManagementAgreements/FMAHolders.aspx
[156] See http://www.qp.alberta.ca/574.cfm?page=E12.cfm&leg_type=Acts&isbncln=9780779755240
[157] Alberta Sustainable Resource Development. 2004, *Forest Management Herbicide Reference Manual*, http://www.srd.alberta.ca/LandsForests/ForestManagement/documents/Herb2004.pdf
[158] Alberta Sustainable Resource Development. 2004, *Forest Management Herbicide Reference Manual*, p. 33.

Public Lands Act

The *Public Lands Act*[159] is relevant to managing NPSP from forestry and any other activity on public land insofar as it prohibits:

- The doing of any act on public land that may injuriously affect watershed capacity,
- The disturbance of any public land in any manner that results or is likely to result in injury to the bed or shore of any river, stream, watercourse, lake or other body of water or land in the vicinity of that public land, or
- The creation of any condition on public land which is likely to result in soil erosion.

***Water Act* (and the Code of Practice for Watercourse Crossings)**

The *Water Act*[160] requires approval from Alberta Environment and Water for any project or activity that, among other things, could cause:

- Siltation of water,
- Erosion of any bed or shore of a water body, or
- An effect on the aquatic environment.

The Code of Practice for Watercourse Crossings[161] describes the requirements for watercourse crossings that are not exempt under the *Water Act* and its regulations.

2.3.2 Use and Implementation of BMPs

Although not specifically identified as BMPs, another document that provides guidance related to managing NPSP is the **Public Lands Operational Handbook (2004).**[162] This handbook applies to all industrial and commercial ventures on public land in Alberta. To help proponents minimize and manage the environmental impacts of their activities, the handbook contains:

- Objectives – an established set of environmental planning and operating targets or results the proponent is expected to achieve.
- Standards – the minimum accepted level that must be met or exceeded to ensure compliance with legislated requirements, established policy and environmental practices that are listed in the handbook.
- Guidelines – a set of suggested operating methods and practices used to achieve the objectives.

The handbook does not supersede or replace existing legislation, regulations or dispositions/approvals. Rather, it assembles a wide range of information in one place for any proponent planning activities on public land and includes in the various guidelines a range of management and operational practices. The document is organized according to the various activities that proponents might undertake, such as managing surface access; timber salvage; site disturbance and clearing; soil, vegetation, water, and waste management; and reclamation. A chapter is also devoted to fisheries and wildlife.

Several sections in the handbook are directly relevant to managing NPSP and reflect the expectation that activities will be managed to:

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[159] Government of Alberta, *Public Lands Act*, RSA 2000; s. 54(1), http://www.qp.alberta.ca/570.cfm?frm_isbn=9780779756162&search_by=link

[160] The *Water Act* is online at http://www.qp.alberta.ca/570.cfm?frm_isbn=9780779754366&search_by=link

[161] See http://www.qp.alberta.ca/documents/codes/CROSSING.pdf

[162] Sustainable Resource Management, Public Lands and Forests Division. 2004, *Public Lands Operational Handbook*, http://www.srd.alberta.ca/MapsPhotosPublications/Publications/documents/PublicLandsOperationalHandbook-Dec2004.pdf

- Prevent soil from entering a watercourse or other water body.
- Minimize the potential for soil erosion, and the amount and degree of soil disturbance.
- Protect bed and banks, and the aquatic and terrestrial habitat of any watercourse or other water body.

2.3.3 Monitoring NPSP and Assessing Management Outcomes

There do not appear to be any specific requirements for forestry companies to monitor water quality on their FMAs. Sedimentation and soil loss are the main concerns and the natural variability during periods of high rainfall or storm events can make it difficult to attribute NPSP to one particular source.

In 2008, SRD established the Forest Operations Monitoring Program to standardize how the department conducts its inspections. Forest Operations Monitoring (FOM) involves field inspections of active timber harvesting and reforestation activities to ensure they meet required provincial standards. The number of FOM inspections done is based on risk of non-compliance and is determined from key factors including volume harvested, previous enforcement actions, trends of unacceptable practices recorded and others. High priority environmental values and sensitivities are considered in the final selection of harvested areas to be inspected. In 2010, 1,757 FOM inspections were done in the province.[163]

SRD has developed a number of documents and forms that outline standard operating procedures to be used when conducting FOM inspections, including a description of the responsibilities for the inspecting officer and team leads.[164] FO-Form 4 FOM Legislative Links Table summarizes the categories (e.g., riparian, watercourse crossings, roads, soils), variance standards, measurement protocols, legal reference for each protocol, and other items.[165] Other documents have been developed for specific aspects of the inspection, such as herbicide applications (FO-SOP 19 Herbicide Application)[166] and road reclamation, which addresses erosion control, watercourse crossings and drainage.[167]

The Alberta Government monitors compliance by conducting planned and random audits of forest operations and timber production and by conducting field inspections. Forest companies and individuals also self-report.[168] Contraventions assessed over the last five years appear on the SRD website[169] and the overwhelming majority relate to violations under the *Public Lands Act*, such as unauthorized use of public land and contravention of terms and conditions.

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[163] Alberta Sustainable Resource Development. 2010, *Sustainable Forest Management, Current Facts & Statistics*, http://www.srd.alberta.ca/LandsForests/ForestManagement/ForestManagementFactsStatistics/documents/MonitoringOperations-CurrentFactsAndStatistics-2010.pdf

[164] See http://www.srd.alberta.ca/FormsOnlineServices/Directives/ForestryDirectives.aspx

[165] See http://www.srd.alberta.ca/FormsOnlineServices/Directives/documents/FO-Form04-FOMLegislationLinks-Jun2011.pdf

[166] See http://www.srd.alberta.ca/FormsOnlineServices/Directives/documents/FO-SOP19-HerbicideApplication-Jun2011.pdf

[167] See http://www.srd.alberta.ca/FormsOnlineServices/Directives/documents/FO-SOP22-RoadReclamation-Jun2011.pdf

[168] Adapted from http://www.srd.alberta.ca/LandsForests/ForestManagement/ComplianceEnforcement.aspx

[169] See http://www.srd.alberta.ca/LandsForests/ForestManagement/documents/ForestManagement-Contraventions-Jan05-2012.pdf

2.3.4 Woodlots and Agroforestry

A woodlot is any tract of land that supports naturally occurring or planted trees. Most woodlots in Alberta are family-owned and often are operated as part of an agricultural operation. These properties occupy over 1.5 million ha of forested land in Alberta's agricultural zone with an average size of 20-40 ha.[170]

Historically, forested private land was cleared for agricultural purposes or to supply wood to local communities and industries, and little thought was given to longer term sustainable forest management. But in addition to their timber value, woodlots produce other valuable ecological goods and services that are relevant to the management of NPSP. Among other things, they protect soil from wind and water erosion and contribute to cleansing, filtering and stabilizing wetlands and water bodies.

Alberta Agriculture and Rural Development has produced various resources for woodlot owners to raise awareness about the importance of sustainable woodlot management and the range of benefits that can result. The primary resources are:

- Woodlot Management Guide of Alberta[171]
- Guide and Template for Basic Woodlot Management Plan[172]

The Woodlot Management Guide describes aspects of forest ecology and timber management, but also provides information on soil characteristics, the role of wetlands, pest management, and grazing considerations, and includes lists of BMPs for each topic. The Guide for developing a woodlot management plan explains how such a plan can accomplish a number of goals, including avoiding negative environmental impacts.

2.3.5 Other Initiatives

The **Foothills Research Institute** (FRI)[173] (formerly the Foothills Model Forest) conducts applied research on the cultural, ecological, economic and social values of Alberta's forested landscape. The FRI has also worked with partners on initiatives that help address NPSP in forested areas. Two examples are the Fish and Watershed Program and the Foothills Stream Crossing Partnership.

The Fish and Watershed Program[174] develops planning tools for forest and land management that are designed to help maintain fish habitat and water quality in forests with industrial operations. Tools include watershed classification systems and riparian (wetlands) management strategies.

The Foothills Stream Crossing Partnership (FSCP), established in 2004, is a multi-industry partnership to improve the condition and performance of stream crossings on the landscape along the Eastern Slopes. The FRI is the coordinating agency for this initiative. Since its inception, the FSCP has inventoried and prioritized over 1,400 crossings belonging to more than 40 companies and government agencies. All FSCP companies with crossings in high-risk watersheds participate in the design of remediation plans, outlining the strategies, timing and justification for the order in which crossings are mitigated. To date, six watersheds have remediation plans and two more are being developed. By working with other companies in the watershed, FSCP members can plan to fix fish barriers in a sequential order up the

[170] Text in the first two paragraphs of this section adapted from Alberta Agriculture and Rural Development website, http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/apa11063
[171] Alberta Agriculture and Rural Development, *Woodlot Management Guide of Alberta*, http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/apa11063
[172] Alberta Agriculture and Rural Development, Guide for Basic Woodlot Management Plan, http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/apa7779
[173] FRI, http://foothillsresearchinstitute.ca/pages/home/default.aspx
[174] FRI, http://foothillsresearchinstitute.ca/pages/ProgramsFish_Watershed/default.aspx

watershed, and sedimentation problems from the top of the watershed down. This approach increases the efficacy of money and time spent, encourages dialogue among stakeholders, and takes an integrated approach to remediating crossings by considering other problems in the watershed, unlike traditional enforcement approaches.[175]

The FRI is now starting a new Water Program, which will include work on assessment procedures, data management, extension, BMPs and other priorities.

The **Government of Alberta** is also working on a new wetlands policy for the province, which could have implications for the management and mitigation of NPSP, particularly in the Green Area.

2.4 Oil and Gas

The conventional oil and gas sector has long been a major economic force in Alberta and although the amount of unvegetated land required for a well or facility and the associated roads may range from less than a hectare to a few hectares, the total numbers are very large. The land area covered by well sites and facilities varies, making it difficult to determine a total area occupied by such activities. Land is also disturbed for the construction of pipelines and for exploration purposes, including seismic lines.

Typically, the three phases of development activity in which the conventional oil and industry is engaged are exploration, extraction and reclamation, each of which is guided by specific policy and regulatory tools and BMPs. Oil and gas activities occur in both the White and Green Areas of the province. Potential sources of NPSP to surface waters from this industry are primarily soil erosion and spills. Data related to soil erosion and sedimentation from oil and gas activities seem to be scarce. Compared to the three land use activities previously discussed (agriculture, urban and forestry), conventional oil and gas appears to be a relatively small contributor to NPSP.

2.4.1 Policy and Regulatory Tools

The conventional oil and gas industry is governed by numerous pieces of federal and provincial legislation most of which are unrelated to NPSP. Relevant policy and regulatory tools that apply or could be applied to NPSP from conventional oil and gas activities are administered by AEW, SRD and the Energy Resources Conservation Board (ERCB). These include:

- *Environmental Protection and Enhancement Act* (including the Environmental Code of Practice for Exploration Operations, and Remediation Certificate Regulation, AR 154/2009)
- Exploration Regulation AR 284/2006 and associated Exploration and Lands Directives
- ERCB Directives 036, 055, and 071
- *Water Act*

Environmental Protection and Enhancement Act

The Environmental Protection and Enhancement Act (EPEA) prohibits activities that could affect the environment unless approval is granted. Such approvals govern water quality release and disposal of chemically influenced water, and require monitoring plans and reporting of industrial or wastewater runoff, groundwater and surface water quality.

[175] Ngaio Baril, Project Coordinator, Foothills Stream Crossing Partnership, personal communication with Kim Sanderson, January 10, 2012.

2.6 The Role of Regional Watershed Planning and Stewardship Bodies

In addition to the Alberta Water Council, the province's *Water for Life* strategy[221] established two new types of partnerships and gave them roles in stewarding the health of Alberta's watersheds. These partnerships are Watershed Planning and Advisory Councils (WPACs) and Watershed Stewardship Groups (WSGs).

The 2003 Strategy envisioned that WPACs would "lead in watershed planning, develop best management practices, foster stewardship activities within the watershed, report on the state of the watershed, and educate users of the water resource" (p.16). WPACs were subsequently designated by AEW to assess the condition of their watershed and prepare plans to address watershed issues. These 11 independent, non-profit organizations also conduct education and stewardship activities. WPACs typically include representatives of key stakeholders in the watershed, including provincial, municipal and federal governments, important industrial sectors, conservation groups, and aboriginal communities. They engage watershed residents in their work and seek consensus on solutions to watershed issues.[222]

Each WPAC develops its own bylaws, mission and objectives, and establishes priority areas of work for its region. In general, WPACs and WSGs themselves do not do monitoring, but they can encourage or recommend that their partners initiate monitoring. Each WPAC is expected to develop an Integrated Watershed Management Plan. It is important to note that watershed management plans differ from water management plans in that they focus on watershed boundaries and contemplate land use issues and water quality issues, but they are not recognized under the *Water Act*. Water management plans are defined under the *Water Act* and primarily address water quantity issues.[223]

WSGs typically comprise community, volunteer-based partnerships actively engaged in environmental stewardship of their watershed, often supported by local businesses and industries who have taken the initiative to protect their local creek, stream, stretch of river, or lake. A number of such groups already existed when the *Water for Life* Strategy was prepared and the Strategy envisioned that they would continue to play a vital role in water management.[224] Alberta now has over 140 stewardship groups undertaking a wide variety of activities across the province.

The renewed *Water for Life* Strategy (2008, p.14)[225] reiterated the important role of regional and local partnerships: "Because the people who are immediately affected by specific water issues can also more directly and effectively find solutions to address them, *Water for Life* is a shared responsibility through a network of partnerships, use of outcome-based approaches, and collaboration in delivery of services. The *Water for Life* partnerships are an important vehicle through which *Water for Life* goals are achieved."

The 2011-2014 Strategic Plan for the North Saskatchewan Watershed Alliance notes that "Collaborative planning has been adopted by the GoA as the desired approach to managing water and land in an integrated way. The current dependency on voluntary action underscores the importance of building a lasting collaborative planning and management framework to support continued stakeholder engagement in the implementation of the Integrated Watershed Management Plan."[226] This approach is fundamental to

[221] Government of Alberta. 2003, *Water for Life: Alberta's Strategy for Sustainability*, http://environment.gov.ab.ca/info/library/6190.pdf
[222] See Alberta Environment and Water, http://www.waterforlife.alberta.ca/01261.html
[223] See Water Matters, http://www.water-matters.org/topic/water-for-life/wpacs-and-wsgs
[224] Adapted from *Water for Life*, 2003, p. 16, and Alberta Environment and Water, http://www.waterforlife.alberta.ca/01316.html
[225] Government of Alberta. 2008, *Water for Life: A Renewal*, http://environment.gov.ab.ca/info/library/8035.pdf
[226] North Saskatchewan Watershed Alliance. 2011. *Strategic Plan 2011-2014*, p.5.

making progress on NPSP, as WPACs themselves have no authority to enforce their recommended approaches; rather, they rely on the voluntary commitment of partners (civic and business leaders and the general public) to ensure action. Another challenge faced by WPACs in managing NPSP and other issues is how to integrate their work with other initiatives such as the provincial Land Use Framework and its accompanying regional plans, GoA efforts to implement a Cumulative Effects Management System, and specific regional planning activities (such as municipal or regional development plans and initiatives such as the Industrial Heartland in the Edmonton area).

The NPSP project team agreed to more closely examine how three WPACs are addressing NPSP in their work:

- The Bow River Basin Council,
- The North Saskatchewan Watershed Alliance, and
- The Oldman Watershed Council.

WSGs are examined broadly and selected examples of NPSP work are highlighted.

2.6.1 The Bow River Basin Council

The Bow River Basin Council (BRBC)[227] was established in 1992 as an advisory body to the provincial Minister of Environmental Protection. In 2004, Alberta Environment designated the BRBC as the WPAC for the Bow River Basin. In 2005, the BRBC released a State of the Watershed report[228] that identified water quality concerns as one of the highest priority issues facing the basin.

The Bow watershed supports a number of diverse land uses, including a wide variety of recreational pursuits, agriculture, industry (logging, oil and gas development, hydroelectric generation) and urban development. The province's Long-Term River Network (LTRN) has four monitoring sites on the Bow River: one upstream of Calgary at Cochrane, one at the Carseland Weir, one at Cluny and one at Ronalene; there is also one station on the Elbow River at the 9th Avenue bridge in Calgary.[229]

In 2005, the BRBC, its partners and stakeholders began developing a watershed management plan to align resource and development decisions across land use sectors and jurisdictions. Phase One of the **Bow Basin Watershed Management Plan** was released in September 2008; it focused on surface water quality and was intended to serve as a decision-support tool.[230] It was developed using an environmental performance management system to achieve surface water quality outcomes with associated timelines for management actions, research, monitoring and evaluation.

The Plan contains reach-specific water quality objectives (WQOs), targets, warning levels, and baseline water quality data, acknowledging that "WQOs currently have no legal standing, but can be recognized and used as a guide for regulatory authorities, and as a means of supporting and maintaining designated water uses."[231] Reach-specific WQOs were developed for indicators in the Bow River mainstem and the Elbow River and Nose Creek sub-basins, which have implications for NPSP management.

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[227] See BRBC, http://www.brbc.ab.ca/
[228] BRBC. 2005, *BRBC State of the Watershed Report*. http://wsow.brbc.ab.ca/index.php?option=com_content&view=article&id=93&Itemid=179
[229] See http://environment.alberta.ca/01614.html for a map of all LTRN sites and more information.
[230] BRBC. 2008, *Bow Basin Watershed Management Plan, Phase One: Water Quality*, http://www.brbc.ab.ca/index.php?option=com_content&view=article&id=96&Itemid=210
[231] BRBC. 2008, *Bow Basin Watershed Management Plan, Phase One: Water Quality*, p.10

6. Implementing a Non-Point Source Pollution Program

This chapter summarizes the research findings and presents conclusions, drawing on the experience of jurisdictions that have a specific NPSP program in place for protecting water quality. Key features that appear to be important to the success of a NPSP program are identified and illustrated with examples. Alberta's approach is evaluated in the context of the key components, and gaps are noted where appropriate. The section concludes with an example to consider if a NPSP program were to be developed.

6.1 Components of an Effective NPSP Program

Although none of the Canadian provinces examined for this report has an integrated NPSP program, all U.S. and European jurisdictions studied do have such programs. The experience of these jurisdictions is used to outline some of the key components for an effective NPSP program. Each component is accompanied by an explanation and examples. Where there is an example of the component from B.C., Ontario or Saskatchewan, it is noted even though the example is not in the context of a formal NPSP program. Much of the Canadian work mentioned in the examples is in the early stages and it is too soon to effectively assess how well these initiatives are managing NPSP. The examples, which include both favourable and unfavourable experiences, are listed in the same order as in this report, with the section number in brackets. The components, described in more detail in the following sections, are:

- Clear lead agency
- Good baseline data
- Careful development of NPSP plan
- Sound regulatory framework
- Partnerships with other regulatory agencies
- Partnerships with non-regulatory bodies
- Awareness and education
- Adequate funding
- Implementation and enforcement
- Ongoing monitoring and assessment
- Watershed approach
- Measures to address municipal NPSP

6.1.1 Clear Lead Agency

One government department or agency should have overall responsibility for the NPSP program in a jurisdiction. One department needs to drive the NPSP initiative and this is usually the department responsible for water quality. This department conducts the basic monitoring, has an overall view of the issue and is not attached to any one sector of the economy. It also undertakes ongoing monitoring and assessment of the program. If responsibilities are delegated to or shared with another department, the lead department should retain some role in enforcement, as another department will have different priorities and be less focused on protecting water quality.

Examples:

- The Saskatchewan Watershed Authority is the lead agency in that province for many activities related to NPSP, with a focus on watershed management and source protection. Although its activities are not formally structured as a NPSP program, SWA led the development of nine source water protection plans and oversees state of the watershed reporting (s. 3.4.3).
- The California State Water Resources Control Board (which operates through nine regional boards) is the lead agency in that state (s. 4.2.3.1) and has successfully implemented the effective Irrigated Lands Regulatory Program (s. 4.2.4.1).

- In North Carolina, the Department of Environment and Natural Resources is the lead agency, but the NPSP program is implemented by two divisions within the department, the Division of Water Quality and the Division of Soil and Water Conservation (s. 4.3.3.1).
- In the State of Washington, shared responsibilities make it difficult for the Department of Ecology to enforce measures to reduce NPSP in agriculture and forestry. In its 2010 report on NPSP, the Department emphasized the importance of clarifying roles and responsibilities to ensure efficient and effective implementation of the program (s. 4.6.8).

6.1.2 Good Baseline Data

Good baseline water quality monitoring data are essential to understanding the contribution that NPSP makes to water pollution in any location. A comprehensive stream monitoring network is the first requirement but further insight into pollution sources can be obtained through random ambient monitoring. In addition to monitoring on a planned schedule, event monitoring (during spring runoff or after a major summer precipitation event, for example) will indicate the load of sediment and other pollutants that enter the water from diffuse sources. Monitoring results can be used to identify the major pollutants, such as sediment, specific nutrients, and pesticides, and to estimate the loads. Government water quality monitoring can be supplemented with monitoring by trained volunteers. Depending on their level of training and experience, data may be used for screening, determining river status and water quality trends, or even for management decisions. Government regulations may also require those who generate NPSP to monitor water quality.

Baseline monitoring makes it possible to identify and classify:

- Water bodies that are of good quality, where no deterioration should be allowed;
- Water bodies where the status is less than good, but where improvements can be expected using mandatory requirements (such as accepted practices or rules); and
- Water bodies where water quality is poor and improvement cannot be expected without significant changes in land management practices.[1372]

Examples:

- Ontario's Provincial Water Quality Monitoring Program collects surface water quality information from rivers and streams at more than 400 locations across the province. The program is undertaken in partnership with Conservation Authorities, which collect samples for analysis in Ministry of Environment laboratories (s. 3.3.9).
- The US EPA requires each state to monitor water quality and classify rivers based on monitoring results and to estimate pollutant loading from all sources relative to a water body's assimilative capacity for the selected pollutants (s. 4.1.3.1).
- North Carolina undertakes random ambient monitoring in addition to monitoring on about 30% of the state's rivers (s. 4.3.3.3).
- Wisconsin uses citizen monitoring as a key part of its monitoring of lakes and streams (4.7.3.3).
- The EU Water Framework Directive requires monitoring sites at a representative selection of water bodies that are at risk of NPSP, to assess the magnitude and impact of the diffuse source pressures (s. 5.1.2).

[1372] These three bullets are based on the work of the Diffuse Pollution Management Advisory Group in Scotland.

6.1.3 Careful Development of a Plan

The detailed plan and long-term goals for reducing NPSP will depend on its sources. A good plan should be even-handed across different sectors, should not be too complex and will work best if it has support at the political level. The plan should identify goals, set targets and be reviewed at regular intervals (e.g., every five years) so that it can be adjusted, based on monitoring results. It should include measures to keep clean waters clean. As noted in s. 6.1.10, it can take some time to see results.

Examples:

Identify the problems and sources of NPSP:

- Ontario's source water protection plans address both point source and NPSP. Regulations describe a detailed framework for developing these plans; they identify 21 activities that could threaten drinking water supplies and many of these activities are non-point sources (s. 3.3.3, particularly Figure 3).
- The US EPA requires all states to develop plans to reduce the total maximum daily load (TMDL) of pollutants for NPSP, as well as the load from point sources in impaired waters (s. 4.1.3.1). This complex system, which is the foundation of the federal US approach to all water pollution, is different from the approaches seen in Canada. However, some form of classification of rivers and lakes can identify priority areas and provide focus for an implementation plan.
- Scotland prepared characterization reports for river basins which identify priority catchments where water quality needs to improve to be fit for specific uses, such as drinking water (s. 5.3.3.1 and s. 5.3.3.4).

Be even-handed across different sectors:

- California is planning to extend use of the conditional waiver system from agricultural lands to forest lands, including recreation areas (s. 4.2.5).
- Wisconsin has Runoff Rules that apply to agriculture, to property owners who apply fertilizer to two hectares or more and to NPSP from stormwater and construction sites (s. 4.7.4 and s. 4.7.6).
- Scotland's General Binding Rules apply to the built environment (buildings and roads, with the exception of single residential buildings), agriculture and forestry and do not select a single sector. Scotland's EPA set up the Diffuse Pollution Management Advisory Group, with members from a cross-section of rural, environmental and biodiversity interests, to help gain support for the NPSP program and show that agriculture was not a special target (s. 5.3.3.1).

Avoid complexity:

- Although Ontario's process to develop source water protection plans is very thorough and has resulted in a great deal of valuable analysis, it is also complex (s. 3.3.3, particularly Figure 3).
- Washington's Forest Watershed Analysis Manual is very detailed and relies on local initiatives to address cumulative effects in each small watershed, so has not been widely implemented (s. 4.6.5).
- The NPSP requirements in the Netherlands are extremely complex and onerous on the agricultural community (s. 5.4.4).

Set goals and targets

- California's NPSP plan was to meet objectives by 2013, in three phases (s. 4.2.3.1).
- The Tar-Pamlico River Basin Nutrient Strategy in North Carolina set targets for nitrogen and phosphorus relative to 1991 levels. The plan is implemented in phases, with a review and adjustments to the strategy at each phase (s. 4.3.7.2).

Protect clean waters:

- The US EPA requires the identification and protection of Outstanding Resource Waters. It also has a Healthy Watersheds Initiative with funding for partnerships to keep clean water clean (s. 4.1.3.8).
- Wisconsin has identified one-fifth of its rivers as Outstanding Resource Waters, and requires wider buffers to protect them in urban areas (s. 4.7.3.1 and s. 4.7.6).

Obtain support at the political level

- Political support is evident in several pieces of state legislation to protect water quality.
- Milwaukee, Wisconsin has a successful Low Impact Development (LID) program that was initiated under direction from the city's mayor (s. 4.7.6.1).

6.1.4 Sound Regulatory Framework

There are three basic approaches to the management of NPSP:

1. **Non-regulatory best (beneficial) management practices (BMPs)**
2. **Regulatory-based incentives for BMPs**
3. **Waste discharge laws and regulations, such as those that apply to Concentrated Animal Feeding Operations (CAFOs).**

There is a role for each approach but an effective NPSP program needs a regulatory basis. Legislation to mandate the implementation of measures to reduce NPSP means the requirements can be enforced when necessary. The basic requirements may be called General Binding Rules (GBRs) or may require adoption of Accepted Agricultural Practices or Accepted Forestry Practices. Compliance with GBRs or Accepted Practices means that those who undertake activities that create NPSP are required to follow the rules, but no registration or permit is required to operate. However, if inspection shows an activity is affecting water quality, enforcement may follow. The legislated requirements can be supplemented by programs that encourage adoption of BMPs through education and funding. BMPs usually aim to reduce the impact of substances of concern, whether sediment, nutrients or other pollutants, rather than managing the natural hydrology. They are frequently encouraged in agriculture and forestry and are part of some urban LID programs.

Examples:

- Under Ontario's *Nutrient Management Act*, farms must have nutrient management strategies and plans to deal with animal waste and other substances that are kept on farm properties or spread on fields. The Act establishes the framework for best practices in nutrient management and creates standards that give BMPs the force of law. It also provides standards for how nutrients are stored and applied to farmland to reduce the likelihood of groundwater or surface water contamination (s. 3.3.4.1).
- Ontario has banned the cosmetic use of pesticides, overriding municipal pesticide bylaws and establishing one set of rules for the province (s. 3.3.5.3). B.C. is considering such a ban (s. 3.2.4.1).
- California uses the conditional waiver system set out under the *Porter-Cologne Act*, which requires farmers to take certain actions to reduce NPSP discharges (e.g., attend a training course, prepare a nutrient management plan, conduct monitoring). Farmers who fail to comply with the waiver requirements may have to meet much more stringent water permit conditions (s. 4.2.3.1). The conditional waiver system may be extended to forestry, including recreational use of forest lands.

- Vermont requires farmers to follow Accepted Agricultural Practices relating to manure management and other activities. Permits are required for medium and large farm operations (s. 4.5.4.1), and additional programs encourage adoption of BMPs (s. 4.5.4.2). Accepted management practices for logging are not mandatory, but if water quality is affected, the operator can be fined (s. 4.5.5).
- Wisconsin's Runoff Management Rule sets performance standards for agriculture and for stormwater flowing from new construction and roads (s. 4.7.4 and s. 4.7.6).
- The EU Water Framework Directive requires measures to prevent or control the input of NPSP (prohibiting entry into water) or prior authorization or registration, based on binding rules. The Nitrates Directive addresses NPSP from fertilizer and manure and requires special measures in nitrate-vulnerable zones (s. 5.1.2).
- NPSP in Scotland is regulated through GBRs (s. 5.3.3.1). GBRs for agriculture set buffer zones that apply to fertilizer application, livestock and cultivation close to water and wetlands (s. 5.3.4). A GBR requires sustainable urban drainage systems for runoff from all new buildings and roads, except from single residential buildings (s. 5.3.6). There are also mandatory GBRs for forestry (s. 5.3.5).

6.1.5 Partnerships with other Regulatory Agencies

NPSP is created from many types of land use, so the lead department should seek partnerships with other government departments or agencies to implement a program. The departments responsible for agriculture, forestry and public lands will be essential partners in designing and implementing a program for those sectors, while those representing municipal governments and transportation will need to be involved in developing plans for the built environment. It may be appropriate to have a formal Memorandum of Understanding (MOU) with other agencies, so that roles and responsibilities are clearly defined.

Examples:

- B.C.'s ministries of Environment, and Forests, Lands and Natural Resource Operations have collaborated to develop and implement the Forest and Range Evaluation Program to evaluate how effectively licensees are meeting government objectives and desired outcomes (s. 3.2.5.3).
- In Vermont, the Agency of Natural Resources is responsible for water quality management but the Legislature delegated responsibility for reducing NPSP from agriculture to the Agency of Agriculture and there is an MOU between the two agencies (s. 4.5.3.1). Partnerships with various government agencies are essential for reducing the NPSP loads flowing into Lake Champlain (s. 4.5.7).
- In England, the National Auditor noted that partnerships can be important but coordination and greater clarity of roles and responsibilities were needed at the national level (s. 5.2.9).
- Scotland's EPA provided training for staff in Scotland's Environmental and Rural Services and the national parks so they could help implement and enforce the NPSP program (s. 5.3.3.5). It has been pointed out that co-training with field staff of stakeholder organizations is the most effective mechanism to develop a common understanding of the issues.[1373]

6.1.6 Partnerships with Non-regulatory Bodies

Partnerships with non-governmental organizations, including those representing agricultural and other sector interests, and with academic bodies are very important for effective implementation of NPSP programs. In fact, "Engagement with the polluting sectors is a pre-requisite for effective pollution

[1373] Ibid.

control and prevention."[1374] Many successful NPSP projects in the U.S. have been implemented through bodies responsible for conservancy or wetlands. At the regional or local level there have been constructive partnerships between government and local groups who are keen to protect specific watersheds. Academic organizations have played an important role in education on NPSP and in research to determine changes achieved through NPSP implementation. Several academic bodies have focused on research and education on LID.

Examples:

- Ontario's Conservation Authorities have some regulatory responsibilities but they also initiate voluntary partnerships with federal, provincial and municipal governments and various non-government and other organizations at the community level, focusing on environmental protection, water resource management and education (s. 3.3.3).
- In Saskatchewan, eight watershed stewardship organizations have been established to implement source water protection plans developed for their regions (s. 3.4.3). Saskatchewan's Agri-Environmental Group Plans were developed on a partnership basis with producers to make watershed improvements in their area (s. 3.4.4.2).
- The Willamette Partnership in Oregon is trying to combine a regulatory approach and market-based tools to address watershed issues (s. 4.4.5.1).
- In Washington many success stories are the result of partnerships between local government, business, non-profit groups, First Nations and citizens (s. 4.6.3.4). The Puget Sound Partnership has taken a lead in encouraging LID and, in partnership with Washington State University Extension, has developed comprehensive manuals and trained several hundred professionals in LID (s. 4.6.6).
- The Wisconsin Lakes Partnership which includes the Wisconsin Department of Natural Resources, the University of Wisconsin Extension and other bodies, is recognized as a model for collaboration (s. 4.7.3.5). The Wisconsin Buffer Initiative is a partnership between farmers, University of Wisconsin scientists, public agencies and the Nature Conservancy (s. 4.7.4).

6.1.7 Awareness and Education

It is important to raise awareness about NPSP and ensure the various sectors that contribute to or are affected by NPSP are informed, both before a reduction program is introduced and during its implementation. In a jurisdiction that has previously paid relatively little attention to NPSP, it may be necessary to raise awareness in government and the relevant sectors through conferences and meetings before a NPSP plan is developed. Well-informed sectors can participate more effectively in the planning process and advise how best to raise public awareness in their sectors before a plan is implemented. Once a plan is in place, it may be possible to use first-time infringements as an opportunity for education, rather than impose a penalty. Education may be included as part of the NPSP plan, as seen in California.

Examples:

- The US EPA provides grants for education, training, technology transfer and demonstration projects under the *Clean Water Act* (CWA), Section 319 funding for NPSP programs (s. 4.1.3.2).
- In California the Central Coast Water Quality Control Board required irrigators to take a 15-hour course on NPSP, as part of the conditional waiver requirement under the Irrigated Lands Regulatory Program in that region. The waiver conditions were developed in partnership with local bodies (s. 4.2.4.1).

[1374] D'Arcy, B.J. *A Strategy for the Control of Diffuse Pollution of Water in Scotland*, Diffuse Pollution Initiative Report No. 20, 5th draft 2004.

- In England, many farmers surveyed in the Catchment Sensitive Farming Delivery Initiative were not convinced that their actions contributed to NPSP, so the National Auditor emphasized the need to increase awareness and demonstrate the benefit of mitigation measures (s. 5.2.4).

6.1.8 Adequate Funding

Any effective NPSP program needs sufficient long-term funding to cover the costs of staff for planning, education, implementation, monitoring and enforcement. Funding will also be needed if the plans include cost share programs that encourage implementation of BMPs. Government can determine whether some form of cost-recovery is desirable (as in California's Irrigated Lands Regulatory Program monitoring requirements) or whether the program will allow offset fees (as in North Carolina). Some costs associated with inspections may be reduced if there is cross-training with field staff who are involved in other existing programs (as in Scotland).

Examples:

Funding for regulatory programs

- The US EPA provides funding for NPSP projects under the CWA Section 319, and for water quality management planning under the CWA Section 205(j), which is in addition to funds provided by various state governments (s. 4.1.3.2).
- In California's Irrigated Lands Regulatory Program, farmers are required to conduct monitoring to determine whether measures are effectively reducing water pollution, thus reducing the total cost of monitoring paid by government (s. 4.2.4.1).
- In North Carolina it was pointed out that NPSP programs tend to be chronically underfunded compared to point source programs (s. 4.3.8).

Funding for BMPs

- The USDA provides funds for the Conservation Reserve Enhancement Program and others that encourage adoption of agricultural BMPs, some of which may reduce NPSP (s. 4.1.4.1).
- California has a special fund to encourage local jurisdictions to implement LID projects (s. 4.2.6).
- In England, the National Auditor criticized the lack of flexibility in a grant program, which meant that funding was not being spent on measures that would deliver the maximum value at the farm level (s. 5.2.9).

6.1.9 Implementation and Enforcement

Once a NPSP management plan is developed, it should be implemented and enforced fairly across all sectors. As mentioned earlier, if responsibility for program implementation has been delegated to a different government agency, it is important for the lead agency to retain powers to enforce compliance. If a program requires compliance with certain conditions it is important that all those affected are required to comply, or it may place an unfair burden on those who are meeting the rules. A jurisdiction should have a clear system that enables the public to provide confidential information about infractions, which can then be investigated.

Examples:

- The California Irrigated Lands Regulatory Program issues notices and fines to irrigators who fail to join the regional monitoring coalition and fail to meet the conditional waiver requirements (s. 4.2.4.1).
- The North Carolina Division of Water Quality has power to issue a notice of violation for NPSP resulting from forestry even though the Forest Service is responsible for inspecting sites after harvesting (s. 4.3.5).

- In Vermont, if the Department of Environmental Conservation receives a complaint about agricultural NPSP, it is referred to the Agency of Agriculture, which is required to investigate (s. 4.5.4.1).
- The National Auditor in England criticized the Environment Agency for not consistently following up on inspections or using the information to show the ineffectiveness of some measures (s. 5.2.9).
- In Scotland, if citizens report non-compliance with GBRs, Scottish EPA staff are required to visit the site and address the issue (s. 5.3.4).

6.1.10 Ongoing Monitoring and Assessment

Ongoing monitoring is essential to assess the success of a NPSP program; monitoring programs should be reviewed at regular intervals and adjusted as necessary. This monitoring and assessment should form the basis for a public report on the program's achievements. The effectiveness of individual projects or methods may be assessed in various ways, including through a research project conducted by a local academic institution or by a government agency with that type of mandate. Since NPSP varies with runoff, it is advisable to use running averages to determine trends. There may also be a time lag between the implementation of measures to reduce NPSP and improvements in water quality, which needs to be considered during the evaluation process.

Examples:

Monitoring and assessment

- The US EPA requires annual reports on the implementation of NPSP programs that it funds (s. 4.1.3.4).
- The USDA funds use of BMPs but programs are voluntary and the department does not effectively monitor and assess their effectiveness (s. 4.1.4).
- To make efficient use of resources, Washington uses a five-year cycle of scoping, data collection, data analysis, technical reporting and implementation for Water Quality Management Areas, with about one-fifth of the watershed regions starting at year one of the cycle each year (s. 4.6.7).
- Wisconsin monitors the implementation of BMPs in forestry, through monitoring of timber harvest sites (s. 4.7.5).
- The Netherlands undertakes a large amount of monitoring, including at 500 selected agricultural operations, to evaluate NPSP reduction measures (s. 5.4.3.2).

Research

- The University of Washington has monitored some LID projects to show how they reduce storm flow and pollutants (s. 4.6.6).
- The Wisconsin Department of Natural Resources is evaluating the effectiveness of riparian management zones on water quality (s. 4.7.5) and the University of Wisconsin is conducting a paired watershed study (s. 4.7.4).
- In the Netherlands, research monitoring has been conducted to determine the impacts of roads on NPSP (s. 5.4.6).

Time lag

- In the Tar-Pamlico Basin in North Carolina, the expected improvement in water quality, based on the implementation of measures to reduce NPSP, has not been achieved. This may be due to historic pollutants seeping from groundwater or being released from sediments. It may also be because the model used to estimate the benefit of certain measures (e.g., buffer strips) is not accounting for all factors (s. 4.3.7.2).

6.1.11 Watershed Approach

A watershed approach is an effective way to implement a NPSP program at the regional and local levels. It enables those living and working in the area to implement or adapt a program to focus on the needs of a specific watershed. Partnerships between different sectors may be easier to set up at a watershed level, especially partnerships involving non-government organizations working at the local level. In some EPA success stories, projects were initiated by funding applications from local organizations that were well-informed and passionate about addressing local issues.

Examples:

- Ontario's source protection plans will cover 38 different watersheds (s. 3.3.3, particularly Figure 3).
- Saskatchewan is similarly developing its source water protection plans on a watershed basis, and the Saskatchewan Watershed Authority reports on the state of the province's watersheds (s. 3.4.3).
- Most EPA success stories are for watersheds. Some watershed projects may be quite large, such as the reduction of pesticide discharges in the Sacramento and Feather Rivers in California (s. 4.2.4.1), but many are smaller.
- California's NPSP program is implemented primarily through its Watershed Management Initiative, using an integrated planning approach specific to each watershed and focusing on high priority watersheds (s. 4.2.7).
- Vermont's Ecosystem Restoration Program uses a watershed approach that combines regulatory requirements with non-regulatory partnerships (s. 4.5.7) and there are several success stories for small watersheds (s. 4.5.8).
- Washington's Department of Ecology has worked effectively with conservation districts, local governments and landowners to reduce the impacts of ranching on water quality (s. 4.6.4).
- Wisconsin's Priority Watershed and Lake Program was effective in meeting targets in more than 90% of critical sites over a 30-year period (s. 4.7.4).
- The EU Water Framework Directive requires river basin management plans that contain a summary of the significant pressures and impacts of human activity with an estimation of diffuse source pollution (s. 5.1.2).

6.1.12 Measures to Address Municipal NPSP

Even if LID requirements are not part of a jurisdiction's NPSP plan, individual municipalities may take initiatives to implement LID. However, if a jurisdiction does not include requirements for LID, it may still be necessary to alter legislation to allow municipalities more powers to manage stormwater in new, sustainable ways. Implementation of LIDs is often achieved through regional or local partnerships.

Examples:

- Toronto has implemented a comprehensive Wet Weather Flow Master Plan, which integrates many activities under one initiative, including LID approaches (s. 3.3.5.1).
- California has amended its Construction General Permit to require LID techniques where economically achievable (s. 4.2.6). LID in California is encouraged by the California Water and Land Use Partnership, which includes not only government agencies, but non-profit organizations and academia (s. 4.2.6).
- The North Carolina State University Water Quality Group has set up a LID group to help practitioners implement LID in the state and provides training (s. 4.3.6).
- The City of Portland's "Grey to Green" BMPs include a comprehensive suite of LID measures and the program is highly regarded world-wide. In addition to city projects funded from its construction budget, there are incentives to private property owners (s. 4.4.4).