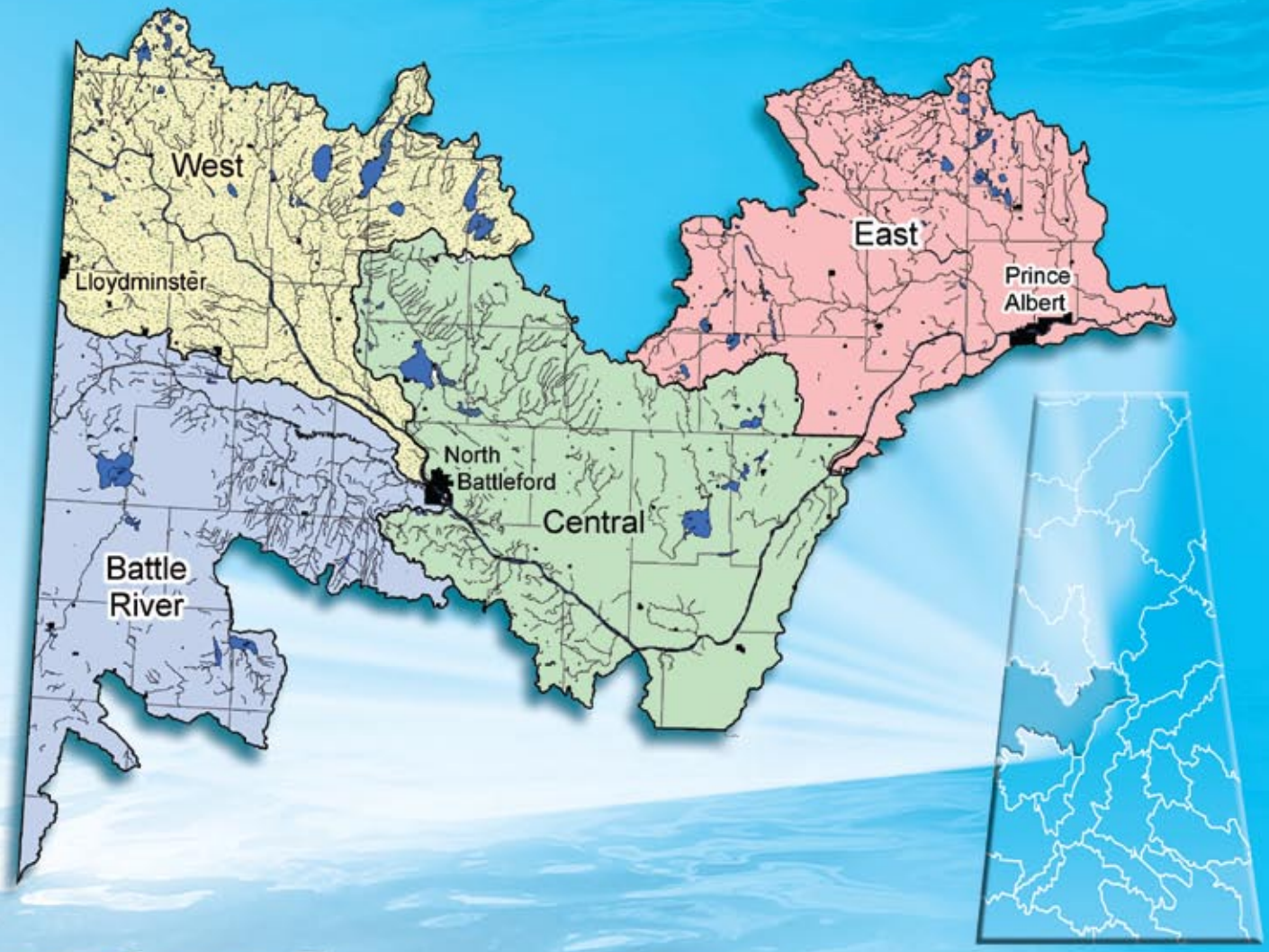
North Saskatchewan River Watershed

Source Water Protection Plan



September 2008

Saskatchewan Watershed Authority

North Saskatchewan River Basin Council

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1. Commitment From Participants

I have looked forward to the completion of the North Saskatchewan River Source Water Protection Plan with some pleasure and satisfaction. This plan reflects three and a half years of sweat equity on the part of dedicated community volunteers, the Saskatchewan Watershed Authority and many experts in water issues, all of whom have made the time to meet in community halls across the watershed. Together, through a collaborative approach, we have hammered out a practical plan to ensure water quality and availability for all of us living in the watershed now and into the future. The strength of this plan comes not only from the depth, but also the breadth of community involvement, that has included voices from rural municipalities, First Nations, hamlets, villages, towns, cities, and resort villages from Lloydminster to Prince Albert, Big River to Neilburg. I look forward to seeing the same level of community engagement continued in its implementation.

Murray Ball
Chair
North Saskatchewan River Watershed
Joint Advisory Committee

2. Introduction to the North Saskatchewan River Watershed

The North Saskatchewan River begins in the Columbia Icefields in the Rocky Mountains of Alberta. Approximately 80,000 km² of land contributes runoff to the North Saskatchewan and Battle Rivers before these rivers flow into Saskatchewan. Alberta contributes over 7 million cubic meters of the water flow into Saskatchewan.

Once it enters Saskatchewan, the North Saskatchewan River proceeds in a southeasterly direction, turning northeast near Langham. Along this journey, it is joined by the Battle River at the Battlefords. The Battle River is the largest tributary to the North Saskatchewan River in Saskatchewan but contributes less than five percent of the total flow.

The North and South Saskatchewan Rivers join at "The Forks" located east of Prince Albert. From there the Saskatchewan River flows into the Nelson River system in Manitoba and ultimately empties into Hudson Bay.

In Saskatchewan, the North Saskatchewan River watershed covers a total of 41,000 km² and includes the Battle River, Eagle Creek, and the Goose Lake internal drainage basin northeast of Rosetown. The Battle River, since it is the largest tributary, has been included in the North Saskatchewan River watershed planning process. Conversely, the Goose Lake internal drainage basin and Eagle Creek, as they contribute less than one percent of the flow, have not been included in the current planning process due to the lack of resources for a fifth planning area within the three-year window for completion of this plan.

The North Saskatchewan River watershed, for planning purposes, includes 51 rural municipalities, 29 First Nations with lands and 17 Indian Reserves, 100 towns and villages, and the Cities of Lloydminster, North Battleford, and Prince Albert. It also includes a portion of the Prince Albert National Park.

Based on 2001 census data, the population within the North Saskatchewan River watershed is approximately 116,500 persons, not including uncensused First Nations lands. The largest portion of the population, 48 percent, resides in the cities of Lloydminster, North Battleford and Prince Albert. Twenty seven percent live in rural municipalities, with larger populations focused around the large urban centers.

3. Introduction to Source Water Protection

The First Step in the Multi-Barrier Approach to Drinking Water Protection

Drinking water supplies can be broken down into three parts: the source water, the drinking water treatment system, and the distribution system that carries the treated water to homes, businesses, schools, and other buildings. As water travels, it can become contaminated in many ways, some of which are known and some of which can only be predicted. The "multi-barrier approach" to protecting drinking water supplies is a preventive approach that identifies all known and potential hazards and ensures barriers are in place to reduce or eliminate the risks of contamination. The implementation of this watershed-wide plan is the first step in protecting source waters.

It cannot be stressed enough that source water protection is only the first barrier to preventing water-borne disease or illness. The second barrier is the routine treatment of water sources. Treatment includes continuous disinfection of water through either chlorination or the use of ultraviolet light. The removal of turbidity causing particles, nitrite, nitrate, and trace metals such as arsenic and uranium may also be required depending on their concentrations. **The only certain way to know what treatment is needed for a particular water supply is to have an expert conduct a comprehensive test of the source water and then to implement the recommended measures to reduce all risks.**

Saskatchewan communities are required to meet strict standards of testing and treatment of their water supplies. Private water supply systems, on the other hand, are tested at the discretion of the landowner. Although people are encouraged to test their water supply, most limit this to the Saskatchewan Ministry of Health's test for *E. coli* (bacteria) and nitrates.

Most watershed residents have an interest in protecting source water and, as such, should be responsible for assisting in the implementation of this plan. Everyone can and should do their part. This can include large-scale activities such as being a municipal councillor responsible for the drinking water for hundreds of people, or smaller-scale activities such as practising stewardship and testing and treating the water on your own farm.

Benefits of Protecting Source Water: Quality and Quantity

Quality – Where there are known sources of pollution, reducing these activities can prevent contaminants from reaching water supplies. Source water protection also includes maintaining and not overloading nature's own purification systems.

Protecting specific ecosystems, such as wetlands which purify water by removing contaminants from our drinking water, also protects water for recreational use as well as for livestock, wildlife, fish and their habitats. Natural riparian (shoreline) areas filter sediments which can carry chemicals and nutrients from upland runoff. This natural capacity to minimize the effects of runoff waters can be significantly reduced by a variety of human activities along the water's edge.

There are economic benefits to having high quality water available for use by many industries, including manufacturing and agricultural processing. Often the availability of dependable high quality water supplies can be the driver that induces an industry to locate in a particular area.

Higher quality source water will require less complex treatment, which translates to less cost. And, should a treatment failure occur, high quality source water poses a lower risk to human health.

Quantity – Water is a renewable resource and different types of water supplies are fully replenished during the hydrological cycle, but at very different rates. For example, water storage in lakes is replenished over a period of about 17 years, while rivers are replenished about every 16 days.

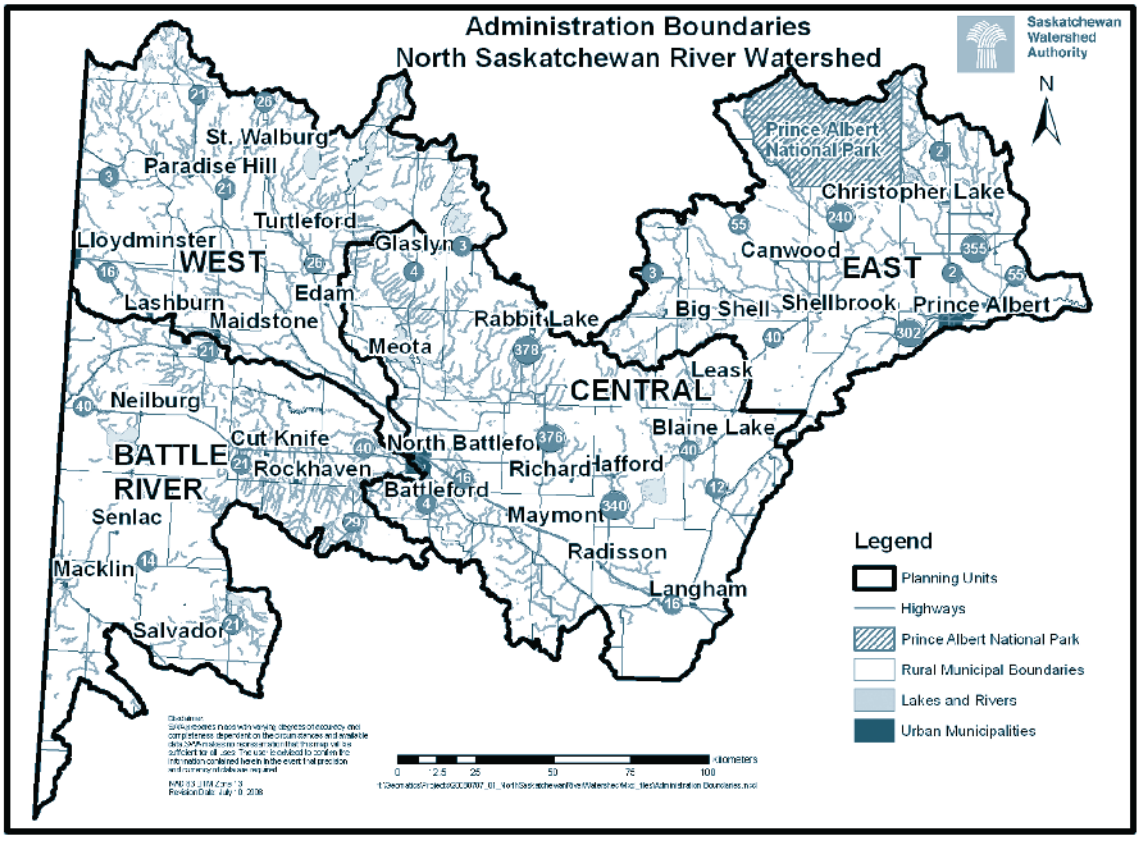
Ground and surface waters are part of the hydrological cycle. Ground water close to the surface can be influenced in both quality and quantity by surface activities. Deeper ground water is influenced much less by surface activities and more by local geology. Surface water supplies are directly affected by surface activities and by seasonal and annual variations in the hydrological cycle. Significant droughts have occurred in the past and will occur in the future. Prudent water management in advance is the best way to minimize the impacts of drought. It is difficult to mitigate the impacts of drought once in the midst of one.

4. Watershed and Aquifer Planning Model

As part of Saskatchewan's Safe Drinking Water Strategy, a watershed and aquifer planning process was officially launched in the North Saskatchewan River watershed in August of 2004. The purpose of the planning process was to identify the threats and opportunities around protecting source water, to provide a plan to address these threats, and to take advantage of opportunities within the watershed. This North Saskatchewan River Watershed Source Water Protection Plan is the result of that planning process.

To facilitate planning and encourage local participation, the North Saskatchewan River watershed was divided into four watershed planning areas: the East, Central, West and Battle River planning areas. As previously noted, because the Battle River is the largest tributary to the North Saskatchewan River, it was decided that the Battle River planning area would be included in this planning process.

The North Saskatchewan River Watershed Source Water Protection Plan was developed co-operatively by Watershed Advisory Committees established in each watershed planning area. The membership of the Watershed Advisory Committees includes representatives from urban and rural municipalities, First Nations, and industry, environmental and agricultural interest organizations. Critical technical support was provided by representatives from a variety of agencies, who formed the North Saskatchewan River Watershed Technical Committee. A complete list of participants in the planning process can be found in the appendices to this document.



To support the work of the Watershed Advisory Committees, the Technical Committee developed a background report to provide a common understanding of the watershed. This report provides summarized information about the many factors that influence the watershed's water quantity and quality. The watershed is described in terms of its physical characteristics, ecology, land use, climate, population, demographics, and major economic activities, which include agriculture, tourism and recreation, and industry. The background report also provides information on water resources in terms of quantity, quality, allocation and use. Different land cover functions are described for upland, riparian and wetland habitats. Watershed management is explored and determined by municipal planning and zoning, federal and provincial legislation, stewardship activities, and funding. The background report is included on the CD attached to this document, and is also available at **www.swa.ca**.

Using the information provided to them, the Watershed Advisory Committees analyzed the threats and opportunities to source water in the watershed. They then developed several objectives, recommendations and key actions to address these threats, and to take advantage of opportunities within the watershed.

This Source Water Protection Plan details the threats to source waters in the North Saskatchewan River watershed, as identified by the Watershed Advisory Committees, and includes the objectives, recommendations and key actions they have developed, through a consensus-based approach, to address those threats. The key actions also include target implementation dates and clearly indicate the agency or agencies responsible for leading or participating in the completion of them.

This plan is intended to be a living document that can evolve to suit the needs of the watershed and its residents as new needs and priorities emerge.

5. Planning Objectives, Recommendations, and Key Actions

5.1 Water Conservation

Traditional water management focuses on increasing supplies to meet any new demand. However, in many areas of the world water demand is reaching or exceeding the sustainable supply, drawing greater attention to conservation as a means to meet growing population, agricultural and industrial needs. While Saskatchewan focuses on conservation, we also have the opportunity and the responsibility to determine the best future use of all our water resources.

Prairie residents have long valued water as critical to their well-being and economic opportunities, and they increasingly appreciate the need to protect supplies through sustainable use. Although Saskatchewan residents use slightly less water for domestic purposes than the national average, Canadians are the second highest users of water in the world.

Approximately 15 percent of household water is used outdoors. Climate change is expected to bring hotter and longer summers, increasing the demand for lawn and garden watering. Indoors, more widespread use of water-saving devices could significantly reduce water consumption.

On agricultural lands, irrigation significantly increases output per hectare of land and provides more stable on-farm production. However, large areas of Saskatchewan with suitable soil types are not currently being irrigated and a growing demand for irrigation water is anticipated. Global warming is expected to increase the frequency and severity of droughts, adding to the pressure to use irrigation to ensure productivity. Significant growth in livestock production and an expanding food processing industry are also increasing the demand on water resources.

Conservation is an essential key to balancing future demands for water with ecosystem protection. Successful water conservation will not necessarily mean that total water use will drop, but it will allow us to do more with the water that is used. Greater water use efficiency will help to secure reliable supplies, protect drinking water sources, maintain aquatic ecosystems, and improve water quality by reducing pollution from wastewater, agricultural and industrial processes.

Each recommendation and action contains the lead agency in bold, and associated agencies or Ministries identified for delivery. This list is not inclusive.

OBJECTIVE: Increase public and corporate awareness of water conservation and the benefits of using water more efficiently.

RECOMMENDATION

The Saskatchewan Watershed Authority, in consultation with SaskWater, local governments and stakeholders, should develop water conservation strategies and promote efficient water use.

KEY ACTION 1: Increase public and corporate awareness of water conservation and the benefits of using water more efficiently.

Responsibility	Completion Date
Saskatchewan Watershed Authority* North Saskatchewan River Basin Council Municipalities	2008 and ongoing

KEY ACTION 2: Review water allocations periodically and revise allocations in consultation with the water users to encourage water conservation.

Responsibility	Completion Date
Saskatchewan Watershed Authority North Saskatchewan River Basin Council Municipalities	2009 and ongoing

RECOMMENDATION

Plumbing regulations, building codes and insurance coverage should be reviewed to allow more efficient water use, for example by recycling or reusing gray water.

KEY ACTION 3: Consider changes to *The Plumbing and Drainage Regulations*, consistent with the Saskatchewan Onsite Wastewater Disposal Guide, and consult with other agencies regarding compatible building codes and insurance coverage for the recycling and reuse of gray water.

Responsibility	Completion Date
Saskatchewan Ministry of Health North Saskatchewan River Basin Council Municipalities	2009 and ongoing

RECOMMENDATION

Government agencies and local stewardship groups should promote rural and urban land management practices that conserve surface and ground water supplies.

KEY ACTION 4: Educate the public about land management practices that conserve water supplies, such as retaining wetlands, stormwater retention, xeriscaping, and storing/collecting rainwater.

Responsibility	Completion Date
North Saskatchewan River Basin Council Saskatchewan Watershed Authority Municipalities	2009 and ongoing

* The organization(s) responsible for each key action are in bold.

RECOMMENDATION

All regulated water supply systems should be metered and users charged, at minimum, the true cost of producing treated water, including capital costs.

KEY ACTION 5: Require all users on municipal systems to be metered.

Responsibility	Completion Date
Municipalities	2012 and ongoing

KEY ACTION 6: Develop a fee structure supporting water conservation, for example by separating utility fees from the water consumption fee and charging true production cost or by eliminating discounts for bulk use.

Responsibility	Completion Date
Municipalities Industry	2011 and ongoing

RECOMMENDATION

Government agencies and stewardship groups should educate the public about the cost-saving benefits of using technologies and land management practices for conserving and recycling water.

KEY ACTION 7: Develop and implement a communication strategy to educate the public about what is involved in the costs of producing treated water, and promote cost effective ways of conserving water by:

- identifying and acknowledging efficient water users and displaying the benefits of proper water management;
- identifying users with potential for significant improvement and targeting education toward those users;
- including water conservation in the school curriculum;
- subsidizing or paying for the replacement (retrofit) of toilets with low flush (or waterless) ones;
- using native grasses rather than exotics in golf courses and lawns; and
- developing facilities and industries which require less water.

Responsibility	Completion Date
North Saskatchewan River Basin Council Saskatchewan Watershed Authority	2010 and ongoing

5.2 Climate Change

Many scientists around the world now recognize that humans are having an impact on the Earth's climate – our world is getting warmer. Climate is naturally variable, and has changed greatly over the history of the Earth. Over the past two million years, the Earth's climate has alternated between ice ages and warm, interglacial periods. On shorter time scales, climate changes continuously. For example, over the last 10,000 years, most parts of Canada have experienced climate conditions that, at different times, were warmer, cooler, wetter and drier than experienced at present (Warren, 2004).

Increased temperatures due to climate change, particularly during the growing season, may lead to increased water demand in the North Saskatchewan River watershed for irrigation of agricultural crops, golf courses, parks, and lawns. An Environment Canada study on threats to water availability speculated that "irrigation may increase northward in the Prairies." (Environment Canada, 2004). Since the majority of irrigation in Saskatchewan currently takes place in the south, in the South Saskatchewan River watershed and the Missouri River basin, northward expansion could include the North Saskatchewan River watershed.

OBJECTIVE: Educate watershed residents on the impacts of climate change and how to become more adaptable to wet and dry weather cycles.

RECOMMENDATION

Provide public education, awareness and incentives on alternative land use practices that do not produce as many greenhouse gases, and on how a healthy watershed will have a long-term positive impact on climate change.

KEY ACTION 8: The federal and provincial governments and non-government organizations should continue to provide incentive funding for the conversion of marginal lands to perennial cover and the retention of natural areas.

Responsibility	Completion Date
Agriculture and Agri-Food Canada – Prairie Farm Rehabilitation Administration Saskatchewan Watershed Authority Ducks Unlimited Canada Saskatchewan Ministry of Agriculture	2008 and ongoing

KEY ACTION 9: Educate the public on the importance of retaining sloughs, wetlands, shelterbelts and surrounding riparian areas in order to moderate local climate.

Responsibility	Completion Date
North Saskatchewan River Basin Council **Saskatchewan Ministry of Agriculture** Saskatchewan Watershed Authority	2009 and ongoing

KEY ACTION 10: Promote an overall reduction of and efficiency in the use of fossil fuels.

Responsibility	Completion Date
North Saskatchewan River Basin Council Saskatchewan Ministry of Environment	2009 and ongoing

RECOMMENDATION

Identify, protect and restore carbon sinks in the watershed.

KEY ACTION 11: Conduct a study to identify the location and importance of different carbon sinks affecting the watershed.

Responsibility	Completion Date
Saskatchewan Ministry of Environment Environment Canada Agriculture and Agri-Food Canada – Prairie Farm Rehabilitation Administration Saskatchewan Ministry of Agriculture	2009

KEY ACTION 12: Encourage incentives for landowners, municipalities and industry to protect and restore carbon sinks.

Responsibility	Completion Date
Environment Canada Saskatchewan Ministry of Environment Agriculture and Agri-Food Canada – Prairie Farm Rehabilitation Administration Saskatchewan Ministry of Agriculture Industry Crown Corporations	2009

RECOMMENDATION

Build capacity for landowners and communities to adapt to anticipated climate change.

KEY ACTION 13: Develop a land cover model to guide development in response to anticipated climate change.

Responsibility	Completion Date
Agriculture and Agri-Food Canada – **Prairie Farm Rehabilitation Administration** Saskatchewan Watershed Authority Ducks Unlimited Canada Saskatchewan Ministry of Agriculture	2011

KEY ACTION 14: Require and provide funding assistance for municipalities to have back-up systems to pump source water and to keep potable and wastewater treatment plants operating in the event of a major power outage.

Responsibility	Completion Date
Saskatchewan Ministry of Environment Saskatchewan Ministry of Municipal Affairs	2010

KEY ACTION 15: Develop an energy assessment category when reviewing/approving the development and operation of water management systems

Responsibility	Completion Date
Saskatchewan Watershed Authority Agriculture and Agri-Food Canada Saskatchewan Ministry of Environment	ongoing

5.3 Ground Water

In Saskatchewan, where many aquifers are protected beneath several meters of glacial till, there is a reduced risk of ground water contamination from the surface. However, the removal of this protective layer, either from an excavation or the establishment of a well, can create a pathway where contaminants can be released directly into the ground water. The best way to remove this possibility is to eliminate these pathways, including ensuring proper safeguards are in place around wells and excavations.

Proper decommissioning of unused water wells is important to prevent contaminants from entering an aquifer, and also to eliminate any physical hazards to humans and animals. The purpose of water well decommissioning is to remove the opportunity for vertical flow, either from the surface or between aquifers. The soil layers above an aquifer act as a physical barrier and a natural filtration system by absorbing and decomposing organic and inorganic contaminants. When a water well is improperly sealed, it becomes a direct route for surficial contamination to enter ground water. After the ground water has been contaminated, natural ground water gradients will transport any contaminants away from the source. Possible point sources of contamination include landfills, effluent lagoons, septic fields, petroleum storage facilities, intensive livestock operations, etc. Non-point contaminant sources include fertilizers, manure spreading, pesticides and herbicides, highway salts, etc. Once contamination has occurred, ground water remediation usually is not economically feasible and, in some cases, nearly impossible.

Regulation of water well abandonment is administered by the Saskatchewan Watershed Authority pursuant to *The Saskatchewan Watershed Authority Act, 2005*. Although the abandonment of water wells is regulated by the Saskatchewan Watershed Authority, the primary responsibility for abandoning water wells rests with the well owner. The work should be completed by a suitably qualified water well contractor.

OBJECTIVE: Maintain safe, clean, sustainable ground water supplies.

RECOMMENDATION

The Saskatchewan Watershed Authority and other organizations should educate the public about the need to properly protect and maintain active wells and decommission unused wells.

KEY ACTION 16: Develop and implement a communication strategy to educate the public about the need to properly protect active wells and decommission unused wells. Example strategies for consideration:

- emphasize that the responsibility and liabilities for these actions resides with the landowner;
- have educational materials available for on-site use when constructing wells and to ensure proper protection procedures are used;
- advertise the problem of inactive (unused) wells; and
- provide educational materials on the needs, methods and costs for ground water protection through the rural municipalities, villages, etc.

Responsibility	Completion Date
Saskatchewan Watershed Authority North Saskatchewan River Basin Council Federation of Saskatchewan Indian Nations Saskatchewan Ministry of Environment	2009 and ongoing

KEY ACTION 17: Encourage people to have their water wells tested through the Rural Water Quality Advisory Program.

Responsibility	Completion Date
Saskatchewan Watershed Authority North Saskatchewan River Basin Council	2010 and ongoing

KEY ACTION 18: Establish a fully-funded program to locate and decommission unused water wells.

Responsibility	Completion Date
Saskatchewan Watershed Authority North Saskatchewan River Basin Council	2010 and ongoing

KEY ACTION 19: All water well locations, including private wells, should have their GPS locations documented and stored in a single data base.

Responsibility	Completion Date
Saskatchewan Watershed Authority North Saskatchewan River Basin Council	2010 and ongoing

RECOMMENDATION

The Saskatchewan Ministry of Environment and the Saskatchewan Ministry of Health should review their requirements for community water systems to avoid the proliferation of more private wells being drilled.

KEY ACTION 20: Review and consider changes to the requirements for community water systems to avoid the proliferation of more private wells being drilled. Examples of issues that could be reviewed include the cost of hiring certified operators, the cost of treatment/re-treatment, and the use of untreated water for sanitation.

Responsibility	Completion Date
Saskatchewan Ministry of Environment **Saskatchewan Ministry of Health**	2011 and ongoing

RECOMMENDATION

Ground water allocations must not exceed ground water recharge rates, which could potentially reduce future ground water availability.

KEY ACTION 21: Conduct periodic reviews of all ground water allocations when new information is available to assess use and sustainability of withdrawals from aquifer systems. The rate at which water is withdrawn should be compared to adequate monitoring data to ensure sustainability.

Responsibility	Completion Date
Saskatchewan Watershed Authority	ongoing

KEY ACTION 22: Complete the regional ground water assessment program for the North Saskatchewan River watershed.

Responsibility	Completion Date
Saskatchewan Watershed Authority	2011

5.4 Surface Water Quantity

Drought

Droughts are complex phenomena with no standard definition. In the Canadian Prairies, droughts of various severities, durations and geographic extents are normal. Catastrophic droughts are a natural, regular occurrence on the Canadian Prairies. Analysis of meteorological records and proxy data for the past two hundred years suggests that the climate in western Canada has been relatively benign during the past century (Environment Canada, 2004). Research by Drs. Leavitt and Chen of the University of Regina indicates that

the drought of the 1930's was only the fifth mildest in the past 1,000 to 2,000 years, and that the average drought lasts 12 years. Droughts of 40 years in duration are not uncommon. The most prolonged dry period lasted 500 years. The climate in the 20th century was one of the wettest on record (Lee, 2001).

Drought conditions had persisted for a number of years throughout the North Saskatchewan River watershed until 2004, when well above normal rainfall was received during the summer and fall, particularly in the eastern part of the watershed. This resulted in the unusual rise in lake levels during summer months at Anglin, Emma, Christopher and other lakes in the area.

Water supply along the Battle River and Eyehill Creek becomes an issue during drought periods. Presently, these rivers are used for domestic and irrigation purposes.

During drought periods, other tributaries, streams and rivers in the watershed dry up, creating problems for producers who are using those water supplies. For example, Turtle Lake River, Englishman River and Big Gully Creek have periodic water supply problems. In addition, flow into the many lakes used for recreation is also reduced during droughts. The effect of drought is often magnified by above-average evaporation from the lakes and reduced direct rainfall onto the lake surfaces.

OBJECTIVE: Ensure watershed residents are prepared to respond/adapt to droughts.

RECOMMENDATION

Educate watershed residents on beneficial management practices related to wise water use and on ways to increase drought tolerance.

KEY ACTION 23: Develop and implement a communication strategy to educate watershed residents about ways to respond to drought.

Responsibility	Completion Date
North Saskatchewan River Basin Council Saskatchewan Watershed Authority Federation of Saskatchewan Indian Nations Agriculture and Agri-Food Canada – Prairie Farm Rehabilitation Administration	2009 and ongoing

RECOMMENDATION

The provincial and federal governments should recognize their role in the implementation of drought management plans, including the provision of funding.

KEY ACTION 24: Develop a priority allocation system for drought situations. For example, local needs and domestic use should always have first priority.

Responsibility	Completion Date
Saskatchewan Watershed Authority	2010

KEY ACTION 25: Develop and promote plan(s) to deal with a 20 to 30 year drought scenario.

Responsibility	Completion Date
Saskatchewan Watershed Authority Municipalities Saskatchewan Ministry of Agriculture Agriculture and Agri-Food Canada	2012

KEY ACTION 26: Emergency measure plans should include guidelines to minimize water use and options for back-up water supplies during droughts.

Responsibility	Completion Date
Municipalities **Saskatchewan Ministry of Corrections, Public Safety and Policing** Saskatchewan Watershed Authority	2009

Flooding and Flood Risk Management

There are four phases in dealing with any type of natural disaster or crisis, including flooding. These phases are mitigation, preparation, response, and recovery. These phases can be followed by communities, businesses, organizations, and individuals.

Mitigation means taking measures in advance to avoid and/or minimize the risk or impact. Preparation implies planning for how to respond to the event. In Saskatchewan, communities and provincial departments and agencies are required to have an Emergency Coordinator and to develop an emergency plan. As an emergency develops, the response will either follow the emergency plan or, if there is no plan, will be ad-hoc. Recovery refers to the actions taken to restore normal operations and functions, and should include a review of the response to see how well the mitigation measures, planning and response dealt with the emergency.

All communities in the North Saskatchewan River watershed are at flood risk from locally

generated runoff from intense thunderstorms. Portions of the communities of Battleford, North Battleford, and Prince Albert are also at risk from flooding on the North Saskatchewan River, and in the case of Battleford, from the Battle River as well. A portion of Prince Albert is also vulnerable to floods from the Spruce River. The Shell River Heights subdivision just outside of Prince Albert is vulnerable to floods on the Sturgeon River as well as from the North Saskatchewan River.

Floods at all these communities can be caused by either high flows in the rivers or by ice jams. Ice jam flooding occurred in 1943 on the North Saskatchewan River at Prince Albert and in 2005 on the Battle River. Particularly high flow rates on the North Saskatchewan River have been observed in 1915, 1974, and 1986. Historic information also indicates an extreme flood occurred on the North Saskatchewan River in 1899.

After a series of severe floods (and costly damage payouts) across the province in the late 1960's and early 1970's, the provincial and federal governments entered into an agreement to implement the Canada-Saskatchewan Flood Damage Reduction Program. Under this program, the senior governments would undertake flood studies to determine flood risk based on up to and including a 1:500 event and map the vulnerable portions of communities. The communities could participate in the program by adopting land use bylaws that recognized flood prone areas and restricted the types of new developments that could occur in those areas. If a community agreed to designation under the program by adopting those bylaws, assistance would be provided to implement measures to mitigate future flood damages. The communities of Battleford and North Battleford were designated under the program on December 4th, 1990. While hydrologic and hydraulic studies were completed for Prince Albert, the city was never designated under the program. The program expired in the mid-1990's when the federal government withdrew its support. However, the province continues to maintain the principles and objectives of flood risk mitigation through its sub-division review and approval process.

The Saskatchewan Watershed Authority also administers an Urban Flood Control Assistance Program designed to assist urban centers alleviate flooding caused by flood water entering from outside their limits and passing through the urban centre. Additionally, the Saskatchewan Watershed Authority has pumping equipment available for rental by communities. More information on these programs can be found on the Saskatchewan Watershed Authority website, **www.swa.ca**, or by contacting any Saskatchewan Watershed Authority office.

OBJECTIVE: Ensure residents are adequately prepared to respond to all types of flood events.

RECOMMENDATION

Educate the public about flood proofing their homes and properties, and encourage farmers to identify possible risks from flooding on their operation.

KEY ACTION 27: Develop and implement a communication plan to educate watershed residents about preparing for floods.

Responsibility	Completion Date
North Saskatchewan River Basin Council Saskatchewan Watershed Authority Saskatchewan Ministry of Corrections, Public Safety and Policing Federation of Saskatchewan Indian Nations	2009

KEY ACTION 28: Encourage farmers to identify possible environmental risks from flooding by taking advantage of Environmental Farm Planning.

Responsibility	Completion Date
Provincial Council of Agricultural Development and Diversification Boards Saskatchewan Watershed Authority Saskatchewan Ministry of Agriculture Agriculture and Agri-Food Canada - Prairie Farm Rehabilitation Administration	ongoing

RECOMMENDATION

The provincial government should work with municipalities to develop a watershed-wide approach to flood mitigation and to prevent upstream activities from creating more flooding problems downstream.

KEY ACTION 29: Develop drainage plans in all new subdivisions and developments to prevent impacts within the subdivision and on adjacent properties.

Responsibility	Completion Date
Municipalities Saskatchewan Watershed Authority Saskatchewan Ministry of Municipal Affairs	ongoing

KEY ACTION 30: Study the impacts of upstream land use changes on high flows on a sub-watershed basis, and develop sub-watershed flood mitigation plans.

Responsibility	Completion Date
Saskatchewan Watershed Authority Saskatchewan Ministry of Environment	2012

RECOMMENDATION

Ensure existing and future buildings and infrastructure are not developed in flood hazard areas.

KEY ACTION 31: Review and establish estimated peak water levels to ensure existing buildings and infrastructure are properly protected from flooding.

Responsibility	Completion Date
Saskatchewan Watershed Authority Saskatchewan Ministry of Municipal Affairs Municipalities	2009 and ongoing

KEY ACTION 32: Ensure zoning bylaws allow only flood-tolerant activities to occur within flood prone areas and restrict development in flood prone low lands.

Responsibility	Completion Date
Municipalities Saskatchewan Ministry of Municipal Affairs	2009 and ongoing

RECOMMENDATION

Emergency plans for each jurisdiction should include flood mitigation and the protection of critical infrastructure.

KEY ACTION 33: Provide municipalities with information on beneficial management practices related to protecting critical infrastructure such as sewage lagoons, pump stations, and potable-water and waste-treatment facilities from flooding.

Responsibility	Completion Date
Saskatchewan Ministry of Environment Saskatchewan Watershed Authority	2009 and ongoing

RECOMMENDATION

Ensure threatened watershed residents are aware of potential flooding through an effective flood warning communication policy.

KEY ACTION 34: Develop an effective flood warning communication strategy that ensures that municipalities, small communities and landowners are notified about predictable flood events.

Responsibility	Completion Date
Saskatchewan Watershed Authority Saskatchewan Ministry of Corrections, Public Safety and Policing	2008

5.5 Apportionment of Inter-Provincial Water Flows

Increasing Water Use by Alberta

North Saskatchewan River

Alberta Environment recently completed a trend analysis of annual stream flow volumes for nine major rivers in Alberta, including the North Saskatchewan River (Seneca, 2004). A statistically significant downward trend was found in the 90 years of recorded flows at Edmonton between 1912 and 2001. However, the report cautions that the trend may be due in part to increasing consumptive use over the period from the river upstream of the gauging station. This increased consumption can be attributed to the establishment of several coal-fired power plants and withdrawals to supply municipal drinking water for Edmonton, in addition to
any evaporative losses from the two hydro-electric reservoirs upstream. The trend also does not take into account the municipal water returned to the river downstream of the gauging station.

Based on flow values from 1977 to 2003, the average annual flow volume for the North Saskatchewan River is 100 percent the natural flow volume, with a range from 97.4 percent to 103.4 percent. There is a tendency in above-average flow years for the recorded flow to be less than natural and in below-average flow years for the recorded flow to be higher than natural. This is due to the upstream reservoirs holding water back in higher flow years and releasing more in drier years.

Battle River

During the course of the Battle River watershed planning in Alberta, a simple correlation was made between recorded flows at the border station and time (specifically, from 1980 on). This analysis seemed to indicate a strong negative trend. If the recorded flows at Unwin are added to the linear regression, pushing the data set back to 1944, the trend is still downward, but not as alarming. The Saskatchewan Watershed Authority has raised the issue of apparently declining flows of the Battle River with the Prairie Provinces Water Board. An updated hydrology and water use study of the whole watershed is being completed under the direction of the Prairie Provinces Water Board to ensure that Saskatchewan continues to receive the fifty percent of the natural flow to which it is entitled.

Recorded flow data for the Battle River at the Environment Canada gauging station located near the Alberta-Saskatchewan border is available for the period of 1981 to 2001. Over the 21-year period, Alberta has consistently met or exceeded its annual commitment to provide 50 percent of the natural flow to Saskatchewan, as outlined in the 1969 Master Agreement on Apportionment. In fact, on average Alberta has passed 81.2 percent of the natural flow to Saskatchewan, representing a mean annual surplus to Saskatchewan of approximately 81,000 dam^3. An assessment of the seasonality of this surplus flow illustrated that surplus volume is consistently available in early spring, quickly peaking in April then decreasing into late summer.

Manitou Lake / Eyehill Creek

Local concerns were raised with the Watershed Authority in 2000-2001 that increasing water use in the Alberta portion of Eyehill Creek was causing declining levels at Manitou Lake. These concerns led the Prairie Provinces Water Board's Committee on Hydrology to determine possible explanations. A review of authorized water projects in Alberta by Alberta Environment indicated water use had not increased in the Eyehill Creek effective drainage area. An investigation by Environment Canada found that below normal local precipitation was largely responsible for the lake level decline (Hopkinson, 2001).

There is some question as to whether or not Saskatchewan is receiving the amount of water it should be during drought periods, as apportionment is not monitored on Eyehill Creek at the Alberta–Saskatchewan boundary. Furthermore, the current natural flow methodology does not consider natural runoff and water use upstream of Sounding Lake in Alberta. An updated hydrology and water use study would be necessary to determine the amount of water that the Sounding Creek basin contributes in high flow years.

OBJECTIVE: Ensure residents are adequately prepared to respond to all types of flood events.

RECOMMENDATION

Saskatchewan should be prepared to press the Prairie Provinces Water Board to have Alberta meet its apportionment commitment under the 1969 Master Agreement on Apportionment.

KEY ACTION 35: Investigate the flows in Eyehill Creek and assess if there has been a change in the amount of water flowing out of the Sounding Creek basin.

Responsibility	Completion Date
Saskatchewan Watershed Authority Prairie Provinces Water Board	2010

RECOMMENDATION

Establish minimum in-stream flow requirements for the Battle and North Saskatchewan Rivers.

KEY ACTION 36: Investigate in-stream flow needs in the North Saskatchewan and Battle Rivers.

Responsibility	Completion Date
Saskatchewan Watershed Authority Prairie Provinces Water Board Fisheries and Oceans Canada Partners FOR the Saskatchewan River Basin	2012

KEY ACTION 37: Investigate ways to maintain a base flow in the Battle River.

Responsibility	Completion Date
Saskatchewan Watershed Authority Prairie Provinces Water Board Fisheries and Oceans Canada Saskatchewan Ministry of Environment Alberta Environment	2013

RECOMMENDATION

Formalize relationships between the North Saskatchewan River Watershed Advisory Committees and the Watershed Planning and Advisory Councils in Alberta on the North Saskatchewan and Battle Rivers to ensure good watershed management.

KEY ACTION 38: The Watershed Advisory Committees should investigate establishing an inter-provincial sub-committee of stakeholders or a watershed association.

Responsibility	Completion Date
Partners FOR the Saskatchewan River Basin Saskatchewan Watershed Authority North Saskatchewan River Basin Council	2012

5.6 Surface Water Supply

Protecting Municipal Surface Water Supplies

As previously mentioned, there are many benefits to protecting source waters, including the maintenance of safe and adequate water supplies. Source water protection serves as the first barrier to prevent contaminants from reaching the tap. An important step in protecting surface water supplies is to identify the areas of land from where the water drains.

OBJECTIVE: Ensure surface water supplies are managed in a sustainable manner.

RECOMMENDATION

The provincial and federal governments should support water supply development programs and develop new ones.

KEY ACTION 39: Develop policies and strategies to encourage the development of potential water supply systems in the North Saskatchewan River watershed, through such activities as:

- deepening dugouts, enhancing water storage areas, and exploring ground water sources; and
- where feasible, developing rural water pipelines.

Responsibility	Completion Date
Agriculture and Agri-Food Canada – Prairie Farm Rehabilitation Administration **Saskatchewan Watershed Authority** North Saskatchewan River Basin Council	2011

RECOMMENDATION

Create a means to allow the re-allocation of surface water from one user to another or from one project to another.

KEY ACTION 40: Investigate a defined term for future water approvals and allocations.

Responsibility	Completion Date
Saskatchewan Watershed Authority North Saskatchewan River Basin Council	2010

KEY ACTION 41: Monitor actual water use to ensure sustainable use of water supplies.

Responsibility	Completion Date
Saskatchewan Watershed Authority	2010

RECOMMENDATION

Explore options for increased use of the apportioned water allotment in the North Saskatchewan River.

KEY ACTION 42: Conduct a long-term water demand and supply study for the North Saskatchewan River.

Responsibility	Completion Date
Saskatchewan Watershed Authority **Agriculture and Agri-Food Canada –** **Prairie Farm Rehabilitation Administration** Saskatchewan Ministry of Agriculture Saskatchewan Ministry of Energy and Resources	2012

RECOMMENDATION

Maintain natural flows in the watershed, as much as possible.

KEY ACTION 43: Educate landowners on the benefits of maintaining natural flows by discouraging drainage and tolerating natural fluctuations that do not affect property or infrastructure.

Responsibility	Completion Date
North Saskatchewan River Basin Council Municipalities	2010 and ongoing

RECOMMENDATION

Develop a better understanding of the factors and causes that impact water quantity and related water quality changes.

KEY ACTION 44: Educate the public regarding water use by all industries in the watershed.

Responsibility	Completion Date
Saskatchewan Watershed Authority Saskatchewan Ministry of Energy and Resources Saskatchewan Ministry of Agriculture	2010

KEY ACTION 45: Promote local input into water supply management and use by establishing river and lake advisory committees comprised of both upstream and downstream users. Allow the North Saskatchewan River Basin Council to be involved to ensure all interests are represented when water management decisions are made.

Responsibility	Completion Date
Saskatchewan Watershed Authority North Saskatchewan River Basin Council Fisheries and Oceans Canada	2010

Storage, Diversions, and Lakes with Control Structures

Impact of Lake Level Control Structures

The four operable lake control structures in the North Saskatchewan River watershed are associated with lake level management, primarily for recreational purposes. These structures are located on Jackfish, Emma and Christopher Lakes, as well as on the Spruce River, which controls levels on Anglin Lake. The effectiveness of each structure in keeping lake levels within the desired summer ranges depends on the water balance of each lake.

Jackfish Lake Control Structure

Jackfish Lake has a poor water balance, with evaporation losses often equalling or exceeding annual inflows. Consequently, the operation of the control structure has little to no effect on lake level declines. Issues around operation of this control structure include: supplying water to the Jackfish Marsh Ducks Unlimited project and to other downstream landowners for cattle watering purposes; obtaining land control to raise the full supply level of the lake; flooding hay lands when water levels are high; and importing water into the lake during periods of drought.

Spruce River Dam/Emma Lake Diversion Project

Annual inflows to Anglin Lake almost always exceed evaporation. The surplus water is either passed downstream or pumped to Emma and Christopher Lakes, which have more marginal water balances.

There are many issues surrounding the operation of the above projects. These include concerns that the Spruce River Dam operation is causing unnatural flooding of approximately 10 kilometres of farmland along the Little Red River, washing out roads on the Little Red River Indian Reserve, impacting loon and fish survival, and restricting recreational use on Anglin Lake.

The issues regarding the operation of the Emma Lake Diversion project include

disagreements among stakeholders on desirable water levels on all three lakes, responsibility for the power costs of pumping between Anglin and Emma/Christopher Lakes, and questions about whether releases from Anglin Lake should be restricted when the lake is low.

OBJECTIVE: Maintain lakes at sustainable water levels.

RECOMMENDATION

The agencies responsible for the operation of control structures should prepare reservoir operating plans with input from all stakeholders.

KEY ACTION 46: Prepare reservoir operating plans for all control structures which:

- ensure future decisions on recreational lakes bear in mind the problems associated with lake levels and land control;
- determine the risk levels of managing artificial water levels on recreational lakes and get public agreement on the acceptable risks or sacrifices;
- consider the downstream impacts of artificially managing lake levels, including in-stream flow needs and fish passage concerns at the structures; and
- ensure all land easements are secured.

Responsibility	Completion Date
Saskatchewan Watershed Authority **Structure Owners** North Saskatchewan River Basin Council Municipalities Ducks Unlimited Canada Watershed Associations Fisheries and Oceans Canada Saskatchewan Ministry of Energy and Resources Parks Canada Saskatchewan Ministry of Tourism, Parks, Culture and Sport Saskatchewan Ministry of Environment	2012

RECOMMENDATION

Educate watershed residents about the competing interests on lakes with control structures between upstream and downstream users and on the impacts of natural water level fluctuations and downstream flows.

KEY ACTION 47: Develop and implement a communication strategy to educate watershed residents about what the ramifications of manipulating water levels are.

Responsibility	Completion Date
Saskatchewan Watershed Authority North Saskatchewan River Basin Council Fisheries and Oceans Canada	2010

KEY ACTION 48: Promote recreational infrastructure that works within a lake's natural range of fluctuation.

Responsibility	Completion Date
North Saskatchewan River Basin Council Saskatchewan Ministry of Municipal Affairs	2010 and ongoing

5.7 Water Quality

Water Quality Monitoring

Water quality in the North Saskatchewan and Battle Rivers was examined over the past 15 years using the Water Quality Index. Long-term trend analyses were also completed for a number of water quality parameters over the time period 1986-2002.

Water Quality Monitoring Stations

Water quality in the Saskatchewan River system is assessed using a network of water quality monitoring stations. The monitoring network was established to assess current water quality conditions, determine how water quality is changing over time, and to see if it is being impacted by municipal or industrial discharges.

Currently there are seven active stations along the length of the North Saskatchewan River. From west to east the stations are located as follows: Highway 17 at the Alberta-Saskatchewan boundary (Prairie Provinces Water Board sampling location); North Battleford; Highway 16 (Borden Bridge); Prince Albert; Cecil Ferry North and South banks; and after the confluence of the North and South Saskatchewan Rivers at Codette Reservoir.

For the Battle River there is currently one active station at Unwin, Saskatchewan (Prairie Provinces Water Board sampling location).

Water Quality Index

The Canadian Water Quality Index was developed by the Canadian Council of Ministers of the Environment Water Quality task group, and was based on an index that had been developed earlier by the Ministry of Environment, Lands and Parks in British Columbia (Canadian Council of Ministers of the Environment, 1999). The Water Quality Index is a useful tool to simplify complex water quality data and provides a mechanism to report overall water quality.

The Water Quality Index is a mathematical calculation that compares values for various water quality parameters (e.g. nutrients, bacteria, metals, and pesticides) to specific water quality objectives. The results of these comparisons are combined to provide a water quality ranking system (good, fair, poor) for individual water bodies. The index consists of a combination of three factors:

1) Scope (how many?) – number of objectives not met

2) Frequency (how often?) – frequency that objectives are not met

3) Amplitude (how much?)– amount by which objectives are not met

These three factors are combined to produce an index value between 0 and 100, with zero representing the worst water quality and 100 representing the best water quality. Once the Water Quality Index value has been determined the water quality for a particular water body can be further simplified by assigning it to one of the following descriptive categories:

> ***Excellent:*** (Index value 95-100) – water quality is protected with a virtual absence of threat or impairment; conditions are very close to natural or pristine levels;
>
> ***Good:*** (Index value 80-94) – water quality is protected with only a minor degree of threat or impairment; conditions rarely depart from natural or desirable levels;
>
> ***Fair:*** (Index value 65-79) – water quality is usually protected but occasionally threatened or impaired; conditions sometimes depart from natural or desirable levels;
>
> ***Marginal:*** (Index value 45-64) – water quality is frequently threatened or impaired; conditions often depart from natural or desirable levels; and
>
> ***Poor:*** (Index value 0-44) – water quality is almost always threatened or impaired; conditions usually depart from natural or desirable levels.

When calculating the Water Quality Index, the greater the number of samples collected for an individual station within a given year the greater the statistical confidence in the reported value. However, for the purposes of this report the Water Quality Index was calculated and reported for a particular monitoring station if a minimum of three different sampling dates were available within a year.

Surface Water Quality Objectives

In Saskatchewan, ambient water quality is compared to the Saskatchewan Surface Water Quality Objectives (Saskatchewan Environment and Resource Management, 1997). These objectives are based on different water uses, including contact and non-contact recreation, protection of aquatic life, irrigation and livestock watering. These objectives apply to all water bodies in the province.

To assess overall water quality, the Saskatchewan Watershed Authority selected sixteen parameters to be incorporated into the Water Quality Index, including nutrients, minerals, metals, pesticides and bacteria.

OBJECTIVE: Develop and implement a watershed-wide surface water quality monitoring strategy to identify stressors, track trends and enable actions to be taken to implement corrective and preventative measures to maintain a healthy watershed.

RECOMMENDATION

The Saskatchewan Watershed Authority, the Saskatchewan Ministry of Environment and Environment Canada should develop a coordinated and integrated program to collect and share water quality information with the public and watershed residents.

KEY ACTION 49: Water quality monitoring should be conducted regularly on lakes and rivers with recreational activities to protect the public. Any results should be compared to the Saskatchewan Surface Water Quality Objectives for Recreation and Aesthetics.

Responsibility	Completion Date
Prairie North Regional Health Authority **Saskatoon Regional Health Authority** **Prince Albert Parkland Regional Health Authority** **Saskatchewan Ministry of Health** Saskatchewan Watershed Authority North Saskatchewan River Basin Council Saskatchewan Ministry of Environment	2010 and ongoing

KEY ACTION 50: Develop a monitoring plan for the North Saskatchewan River watershed that includes a sampling site on the Battle River near the confluence with the North Saskatchewan River, such as the Saskatchewan Ministry of Environment site location. Sampling should be conducted a minimum of three times a year, but preferably four times a year representing each season. Sampling should begin as soon as possible.

Responsibility	Completion Date
Saskatchewan Ministry of Environment North Saskatchewan River Basin Council	2008 and ongoing

KEY ACTION 51: Incorporate water quality sampling data collected by municipalities, lake stewardship groups, Environment Canada, the Saskatchewan Ministry of Environment, and the Saskatchewan Watershed Authority into one easily-accessible program.

Responsibility	Completion Date
Saskatchewan Ministry of Environment Saskatchewan Watershed Authority Environment Canada North Saskatchewan River Basin Council	2010

RECOMMENDATION

Determine the significant point and non-point pollution sources, their causes, and the mitigation measures which can reduce their impacts.

KEY ACTION 52: Provide detailed information on point and non-point stressors from the State of the Watershed Report to the North Saskatchewan River Basin Council, which will work with partners to mitigate potential stressors.

Responsibility	Completion Date
Saskatchewan Watershed Authority North Saskatchewan River Basin Council	2009

KEY ACTION 53: Develop and deliver a program to educate people on the importance of protecting water quality and monitoring threats and health risks to source water.

Responsibility	Completion Date
North Saskatchewan River Basin Council Saskatchewan Watershed Authority Partners FOR the Saskatchewan River Basin Saskatchewan Ministry of Environment	2009

RECOMMENDATION

Develop inter-provincial policies and an integrated approach to effectively regulate and manage water quality.

KEY ACTION 54: Review the Prairie Provinces Water Board's surface water quality sample data from the border sites in this watershed and compare them to Environment Canada's surface water quality objectives.

Responsibility	Completion Date
Saskatchewan Watershed Authority Prairie Provinces Water Board Saskatchewan Ministry of Environment	2009

Agricultural Impacts

Agricultural Non-Point Source Effects

Pollutants that come from diffused or widespread areas and are transported to surface and ground water, resulting in poorer water quality, are considered to be non-point source pollutants. Examples of agricultural non-point source pollutants are herbicides, pesticides,

nutrients, salts and bacteria. The mechanisms that transport this material include erosion, leaching, direct deposition, or the pollutant becoming airborne.

Supplementary fertilizer nutrients are used to increase crop yields. Nitrogen fertilizers are based on ammonia, which can be used directly as a fertilizer, or converted to either solid compounds (urea, ammonium phosphate, ammonium nitrate, and ammonium sulphate) or to nitrogen solutions.

Phosphate fertilizers are produced from phosphate rock. In 1996, 1,576,000 tonnes of nitrogen and 297,000 tonnes of phosphorus as fertilizer were applied to cropland in Canada. In addition, 384,000 tonnes of nitrogen and 139,000 tonnes of phosphorus were applied as manure (Chambers et al., 2001).


Photo courtesy of Saskatchewan Ministry of Agriculture

Manure consists of undigested feed (liquid and solid), metabolic waste, bedding material, and waste feed and water. In 1996, approximately 4.7 million beef cattle, 1.2 million dairy cattle, 11 million hogs, 102.3 million poultry, and 3.2 million other livestock were reared in Canada. Not surprisingly, manure storage and disposal are management considerations on many Canadian farms.

Almost all manure produced on Canadian farms is applied to agricultural land. Manure supplies soils with both nutrients and organic matter. Depending upon the type of livestock and the feed being used, fresh manure can contain 50 to 80 percent of the nitrogen and phosphorus originally present in the feed (Chambers et al., 2001). However, not all nutrients in manure are immediately available to crops. Some are tied up in organic forms and become available over time as the material decomposes, thereby acting as a nutrient source over several years. Average manure application in 1996 ranged from an estimated 114 kilograms of nitrogen per hectare in Quebec to 301 kilograms of nitrogen per hectare in British Columbia, and 38 kilograms of phosphorous per hectare in the Atlantic to 184 kilograms of phosphorus per hectare in British Columbia (Chambers et al., 2001). These figures do not include nutrient loadings from beef cattle manure, since these animals are commonly left out to pasture for most of the year.

Nitrogen fixed from the air by legume crops can add significantly to the soil's nitrogen supply. The ability of legumes to improve soil nitrogen concentrations is the basis for crop rotation schedules on most farms. The nitrogen fixed by legumes, however, is tied up in the plant and must decompose and mineralize to be available to subsequent crops. Atmospheric nitrogen fixation rates for legume species range from 53 kilograms of nitrogen per hectare per year for chickpeas to 100 kilograms of nitrogen per hectare per year for clover. In 1996, nitrogen input from atmospheric nitrogen fixation by legumes ranged from 20,000 tonnes of nitrogen in the Atlantic region to 476,000 tonnes of nitrogen in the Prairies, for a total of 773,000 tonnes of nitrogen fixed by legumes in Canada (Chambers et al., 2001).

The difference between nutrient inputs (from fertilizer, manure, nitrogen fixation, atmospheric deposition, sewage biosolids, and seeds and planting material) and outputs (from crop and fodder production) indicates either a nitrogen surplus (input greater than output) or deficit

(input less than output). For all agricultural land in Canada, annual inputs in 1996 (2.8 million tonnes of nitrogen and 442,000 tonnes of phosphorus) exceeded outputs (2.5 million tonnes of nitrogen and 386,000 tonnes of phosphorus) by 10.7 percent and 12.7 percent, respectively (Chambers et al., 2001). These are average values, of course, and individual regions may have had either surpluses or deficits. Nevertheless, this national surplus of roughly 0.3 million tonnes of nitrogen and 56,000 tonnes of phosphorus sets the stage for nutrient losses to the environment. Application to agricultural lands of chemical fertilizer or manure in excess of plant requirements can lead to a buildup of nutrients in the soil and their eventual loss to surface waters, ground water, or the atmosphere.

OBJECTIVE: Reduce and minimize water contamination from non-point sources.

RECOMMENDATION

Educate the public on the environmental impacts of different agricultural practices and on the benefits of implementing beneficial management practices.

KEY ACTION 55: Create an awareness campaign to educate the public on such topics as:

- the success of the Environmental Farm Plan process and how many beneficial management practices have been implemented;
- how beneficial management practices help prevent nutrients and contaminants from non-point or diffused sources from entering surface and ground waters; and
- examples of producers being good stewards of the land and the impacts this has had on the ecosystem.

Responsibility	Completion Date
Provincial Council of Agricultural Development and Diversification Boards Saskatchewan Ministry of Agriculture Agriculture and Agri-Food Canada Local Stewardship Groups Saskatchewan Watershed Authority	2008 and ongoing

KEY ACTION 56: Provide information on the Watershed Evaluation of Beneficial Management Practices (WEBs) study on the effects of changing farming practices, when information is available.

Responsibility	Completion Date
Agriculture and Agri-Food Canada Provincial Council of Agricultural Development and Diversification Boards Saskatchewan Ministry of Agriculture	2008 and ongoing

KEY ACTION 57: Encourage senior government and industry officials to develop a coordinated, long-term and consistent approach to incentives for beneficial management practice adoption.

Responsibility	Completion Date
North Saskatchewan River Basin Council	2008 and ongoing

KEY ACTION 58: Increase awareness of the values of wetlands, riparian areas, and shelterbelts to protect water quality and to prevent wind erosion.

Responsibility	Completion Date
North Saskatchewan River Basin Council Ducks Unlimited Canada Saskatchewan Watershed Authority Saskatchewan Ministry of Agriculture Agriculture and Agri-Food Canada Provincial Council of Agricultural Development and Diversification Boards	2008 and ongoing

RECOMMENDATION

Promote an ecosystem-based approach for land management.

KEY ACTION 59: Provincial and federal agriculture policy should encourage the conversion of marginal cropland to long-term permanent cover and encourage the retention of permanent cover.

Responsibility	Completion Date
Saskatchewan Ministry of Agriculture North Saskatchewan River Basin Council Ducks Unlimited Canada Agriculture and Agri-Food Canada – Prairie Farm Rehabilitation Administration	2008 and ongoing

RECOMMENDATION

Encourage society to develop a program that will compensate farmers for losses of production or income associated with the provision of ecological goods and services.

KEY ACTION 60: Provide a coordinated approach to promoting understanding of and research on ecological goods and services.

Responsibility	Completion Date
Agriculture and Agri-Food Canada North Saskatchewan River Basin Council Ducks Unlimited Canada Saskatchewan Ministry of Agriculture	2010 and ongoing

KEY ACTION 61: Develop a funding strategy that will generate revenue to support an ecological goods and services compensation program.

Responsibility	Completion Date
Agriculture and Agri-Food Canada North Saskatchewan River Basin Council Saskatchewan Ministry of Agriculture	2010 and ongoing

RECOMMENDATION

Encourage governments, industry and universities to continue research on improving beneficial management practices for all agricultural practices and on monitoring the non-point agricultural effects on water quality.

KEY ACTION 62: Earmark increasing portions of the Agriculture Development Fund and related funding sources for research and monitoring of agricultural impacts affecting the North Saskatchewan River watershed.

Responsibility	Completion Date
Saskatchewan Ministry of Agriculture North Saskatchewan River Basin Council	2010 and ongoing

Livestock in Riparian Areas

Unmanaged grazing along streambanks can damage them both directly due to trampling and indirectly by reducing riparian vegetation cover that otherwise protects the banks from erosion due to overland runoff and stream flow. Without the binding root mass, soil particles may slowly erode from the streambanks due to flowing water, or soil may enter the stream in large quantities as banks are undermined and collapse. Destabilization of streambanks from unmanaged grazing leads to erosion and downstream sedimentation affecting water quality and fish habitat.

OBJECTIVE: Minimize the impact of livestock wintering sites and grazing in riparian areas.

RECOMMENDATION

Educate landowners on the beneficial management practices that help minimize the impacts of livestock grazing and wintering sites on riparian areas, and on available funding for beneficial management practices.

KEY ACTION 63: Provide education on the benefits of feeding and watering livestock away from water bodies.

Responsibility	Completion Date
Saskatchewan Ministry of Agriculture Agriculture and Agri-Food Canada – Prairie Farm Rehabilitation Administration Saskatchewan Watershed Authority North Saskatchewan River Basin Council Fisheries and Oceans Canada Provincial Council of Agricultural Development and Diversification Boards	2009 and ongoing

KEY ACTION 64: All levels of government should continue the assistance funding available through the Canada-Saskatchewan Farm Stewardship Program, to minimize the impact of livestock on water quality.

Responsibility	Completion Date
Agriculture and Agri-Food Canada Saskatchewan Ministry of Agriculture Saskatchewan Watershed Authority North Saskatchewan River Basin Council Municipalities	2009 and ongoing

KEY ACTION 65: Prince Albert National Park and the Saskatchewan Ministry of Environment should consider the impact of bison on the riparian areas of the Sturgeon River and the need to protect these areas through the Sturgeon River Plains Bison Stewards.

Responsibility	Completion Date
Sturgeon River Plains Bison Stewards Saskatchewan Watershed Authority North Saskatchewan River Basin Council Saskatchewan Ministry of Environment Parks Canada	2008

RECOMMENDATION

Environment Canada should continue to take a stewardship approach in resolving the livestock-in-water issue

KEY ACTION 66: Environment Canada should continue to work cooperatively with the Saskatchewan Watershed Authority, the Saskatchewan Ministry of Agriculture, and the Saskatchewan Ministry of Environment on the livestock-in-water issue.

Responsibility	Completion Date
Environment Canada Saskatchewan Ministry of Agriculture Agriculture and Agri-Food Canada – Prairie Farm Rehabilitation Administration Saskatchewan Watershed Authority North Saskatchewan River Basin Council Saskatchewan Ministry of Environment Municipalities	2008 and ongoing

Intensive Livestock Operations

The long-term trend in the Canadian livestock industry is towards a gradual decrease in the number of livestock farms and a steady increase in average farm size. Existing livestock farms and the new ones being established are becoming larger and more specialized. Livestock production, along with the associated amounts of manure produced, are also getting more concentrated in some regions.

Additional research would be required before concluding whether or not the livestock concentration in certain regions has reached limits where it could pose an ecological threat. It would require establishing local or regional nutrient budgets based on the amounts of manure produced, farmland available for manure disposal, soil characteristics, crop requirements, and use of chemical fertilizer. This could help identify areas where the environment might be at risk from a lack of sufficient land to recycle animal waste (Statistics Canada, 1997).

OBJECTIVE: Reduce and minimize water quality impacts of intensive livestock operations.

RECOMMENDATION

Educate producers on what constitutes an intensive livestock operation and bring into compliance, using incentives, all non-approved intensive livestock operations.

KEY ACTION 67: Provide education and assistance to promote beneficial management practices for livestock operations.

Responsibility	Completion Date
Saskatchewan Ministry of Agriculture Agriculture and Agri-Food Canada – Prairie Farm Rehabilitation Administration Saskatchewan Watershed Authority North Saskatchewan River Basin Council	2008 and ongoing

RECOMMENDATION

Encourage rural municipalities to develop zoning bylaws for intensive livestock operation development.

KEY ACTION 68: Encourage rural municipalities to develop zoning bylaws for intensive livestock operation development when bringing them into compliance with *The Planning and Development Act*, 2007.

Responsibility	Completion Date
Saskatchewan Ministry of Municipal Affairs Municipalities Saskatchewan Ministry of Agriculture	2008 and ongoing

RECOMMENDATION

The provincial government should re-examine the regulations around the approval of intensive livestock operations and consider a classification system based on animal numbers only.

KEY ACTION 69: The North Saskatchewan River Basin Council would be available to assist rural municipalities in reviewing and providing recommendations and expertise on intensive livestock operation proposals with regards to source water protection.

Responsibility	Completion Date
Municipalities North Saskatchewan River Basin Council	2008 and ongoing

KEY ACTION 70: In the event of a spill or failure of a waste containment facility, intensive livestock operation operators should be required to contact downstream water users.

Responsibility	Completion Date
Saskatchewan Ministry of Municipal Affairs Rural Municipalities North Saskatchewan River Basin Council	2008 and ongoing

KEY ACTION 71: The Saskatchewan Ministry of Agriculture should share monitoring data with other government agencies, and the Saskatchewan Watershed Authority should include this data in the State of the Watershed Report in a manner that allows the public to identify waterbodies that could potentially be affected.

Responsibility	Completion Date
Saskatchewan Ministry of Agriculture **Saskatchewan Watershed Authority** Saskatchewan Ministry of Environment	2008 and ongoing

Manure Management

Manure is a valuable nutrient source which, if used properly, can create economic benefits to the producer while avoiding environmental impacts. Manure will improve the organic matter content of the soil, improve soil tilth (relative ease of tillage), and increase diversity of soil microorganisms. Liquid swine effluent, if stored in a manure storage lagoon, does not increase the population of pathogenic organisms such as *E.coli* in the soil. Manure storage lagoons have a hostile environment which kills most pathogenic organisms.

When manure is treated as a waste, it is often applied in the cheapest fashion possible (i.e. dumped on lands closest to where it was produced), which may ultimately cause environmental problems. Research has shown that where manure is over-applied (i.e. applied at a rate greater than the agronomic rate), nitrates will migrate down into the soil profile and will pose a threat to ground water. But when applied as a valuable fertilizer resource in a balanced manner, manure spreading and incorporation will cause few or no problems.

Proper manure management includes soil incorporation. This is especially important when manure is broadcasted. Once incorporated, manure becomes bound to the soil and will ultimately be used by plants. To ensure the correct application rate is used, both manure and soils must be nutrient tested. Applying manure at the agronomic rate and getting it into the soil will prevent water contamination.

Proper manure management planning includes soil testing, manure testing for nutrients, matching of nutrients to crop demand, accurate application of the manure and long-term record keeping to prevent water contamination.

OBJECTIVE: Reduce and minimize impacts of manure on water quality through proper manure management, which utilizes manure as a valuable asset rather than a waste product.

RECOMMENDATION

Educate livestock producers and the general public on the benefits of using beneficial management practices to manage manure.

KEY ACTION 72: Educate producers on manure management through workshops, field days, etc.

Responsibility	Completion Date
North Saskatchewan River Basin Council Saskatchewan Ministry of Agriculture	2008 ongoing

RECOMMENDATION

Incorporate the latest findings from research on manure nutrient management into environmental regulations.

KEY ACTION 73: Continue to develop and promote affordable manure management technology to limit environmental impacts.

Responsibility	Completion Date
Saskatchewan Ministry of Agriculture North Saskatchewan River Basin Council University of Saskatchewan and other institutions	2008 and ongoing

KEY ACTION 74: Promote economical ways to use manure as an asset, such as for power generation or as a nutrient source, and encourage the use of proper composting methods.

Responsibility	Completion Date
Saskatchewan Ministry of Agriculture North Saskatchewan River Basin Council	2008 and ongoing

KEY ACTION 75: Develop a record-keeping process for manure management

Responsibility	Completion Date
Saskatchewan Ministry of Agriculture North Saskatchewan River Basin Council	2008 ongoing

Drainage and Wetland Loss


Photo courtesy of Ducks Unlimited Canada

Wetlands play an important hydrological role in storing and releasing water, filtering contaminants, recharging local and regional ground water supplies, preventing erosion and possibly regulating peak floodwater flows. Wetlands also store water and help reduce flooding during runoff, but become less effective in larger runoff events.

Drainage programs have been in place since the late 1920's. The majority of land that could be easily drained in Saskatchewan was done so by the end of the 1970's. This was also the time when grain prices were very high. Therefore, a significant amount of land was drained to allow for more acres to be farmed. In 1981, an approval process for drainage works was put into place. Works constructed prior to 1981 do not require approval but are subject to complaints. Flood control projects also often result in the drainage of wetlands.

The Government of Saskatchewan has estimated that 40 percent of wetlands in the southern half of the province have been lost since settlement due to drainage and degradation, while half of those remaining are threatened by future development (Hael et al., 2000). The extent and amount of drainage in the North Saskatchewan River watershed is not known. Further study would be required to determine the amount of wetland drainage within the watershed.

Drainage has the potential to increase water velocity in rivers, creeks, etc. As velocity increases, water can carry more sediment. When velocity is decreased, such as when flows enter an impoundment or a level portion of ditch or channel, the water will deposit its sediment load.

During high runoff events, wetlands will fill and spill to downstream. The amount of water added from drained wetland areas during a high runoff event is small when compared to the total volume of flood waters. Therefore, during high runoff events, drainage has little impact on downstream water flows and flooding, but can add to flows in low to medium flood events. Drainage generally serves to increase peak flows and to decrease flow duration. During wet periods, an area straddling Highway 16 from Lloydminster to Waseca has had issues regarding flooding of farmland and unauthorized drainage.

Wetland drainage is often as much a cultural as an economic decision. Topography is also a major factor influencing drainage. For example, landowners near creek systems are more likely to drain because of the slope and gentle undulations conducive to wetland drainage.

The provincial government recognizes

the importance of wetlands, and the Saskatchewan Watershed Authority has committed to updating its drainage policy. This policy will guide the Authority's approach to regulating and managing drainage and wetland retention issues (Saskatchewan Watershed Authority, 2006).

OBJECTIVE: Reduce and minimize the negative environmental impacts of drainage.

RECOMMENDATION

Educate landowners about the ecological impacts of draining wetlands and the potential for negative impacts to downstream landowners.

KEY ACTION 76: Promote land use options more in tune with nature, such as leaving flood prone areas and riparian areas in permanent cover. This could be accomplished by encouraging producers to complete Environmental Farm Plans, and by promoting conservation easements and tax credit programs.

Responsibility	Completion Date
Saskatchewan Watershed Authority North Saskatchewan River Basin Council Saskatchewan Ministry of Agriculture Ducks Unlimited Canada Nature Conservancy of Canada Provincial Council of Agricultural Development and Diversification Boards First Nations Agricultural Council of Saskatchewan Inc.	2008 and ongoing

KEY ACTION 77: Promote the Wetland Conservation and Drainage Management Policies for Southern Saskatchewan.

Responsibility	Completion Date
Saskatchewan Watershed Authority North Saskatchewan River Basin Council	2008 ongoing

RECOMMENDATION

Educate landowners on the benefits of maintaining and restoring wetlands, and encourage stewardship of water and riparian areas.

KEY ACTION 78: Promote ecosystem friendly education programs such as Project WET (Water Education for Teachers), the AWARE (Accent on Wellness in Agriculture and Rural Environments) program and other water-related education programs.

Responsibility	Completion Date
North Saskatchewan River Basin Council Saskatchewan Watershed Authority Ducks Unlimited Canada Partners FOR the Saskatchewan River Basin	2008 and ongoing

KEY ACTION 79: Educate landowners about land management options for flood prone areas and wetlands.

Responsibility	Completion Date
North Saskatchewan River Basin Council Saskatchewan Watershed Authority Ducks Unlimited Canada Partners FOR the Saskatchewan River Basin Saskatchewan Ministry of Agriculture Rural Municipalities Fisheries and Oceans Canada	2008 ongoing

RECOMMENDATION

Drainage activities should be properly planned and engineered, and should take account of future drainage issues. Drainage activities and wetland management should also be conducted in consultation with all affected landowners.

KEY ACTION 80: Develop effective codes of drainage practice that include consultation with all affected landowners.

Responsibility	Completion Date
Saskatchewan Watershed Authority North Saskatchewan River Basin Council Municipalities	2008 and ongoing

KEY ACTION 81: Monitor wetland loss in critical areas of the North Saskatchewan River watershed.

Responsibility	Completion Date
Saskatchewan Watershed Authority Ducks Unlimited Canada North Saskatchewan River Basin Council	2008 and ongoing

KEY ACTION 82: Any drainage projects that are approved should provide a protective mechanism against future liability concerns.

Responsibility	Completion Date
Saskatchewan Ministry of Environment Saskatchewan Watershed Authority North Saskatchewan River Basin Council Municipalities	2008 and ongoing

KEY ACTION 83: The provincial government should eliminate nuisance liability to alleviate the hardship on affected inter-municipal jurisdictions regarding drainage issues.

Responsibility	Completion Date
Saskatchewan Ministry of Municipal Affairs Saskatchewan Watershed Authority North Saskatchewan River Basin Council	2008 and ongoing

RECOMMENDATION

Develop publicly and privately supported incentive programs to maintain wetlands, based on their benefits in protecting surface or ground water supplies.

KEY ACTION 84: Inventory wetlands in the watershed to classify which ones are important for surface and ground water supplies and important to the hydrological cycle.

Responsibility	Completion Date
Saskatchewan Ministry of Environment **North Saskatchewan River Basin Council** Saskatchewan Watershed Authority Ducks Unlimited Canada Agriculture and Agri-Food Canada – Prairie Farm Rehabilitation Administration Partners FOR the Saskatchewan River Basin	2013

KEY ACTION 85: Highlight wetland restoration programs and include a target number of wetlands to be restored by the stewardship group.

Responsibility	Completion Date
North Saskatchewan River Basin Council Saskatchewan Watershed Authority Ducks Unlimited Canada Agriculture and Agri-Food Canada – Prairie Farm Rehabilitation Administration Saskatchewan Ministry of Environment	2009 and ongoing

RECOMMENDATION

Request continued provincial cabinet support for effective drainage management.

KEY ACTION 86: The North Saskatchewan River Basin Council needs to communicate directly with the appropriate Ministries regarding drainage management.

Responsibility	Completion Date
North Saskatchewan River Basin Council	2009 and ongoing

RECOMMENDATION

The federal and provincial governments should create long-term programs with ongoing financial commitment and wide-scope continuity to rationalize drainage and wetland issues, and to compensate landowners for the ecological goods and services provided by natural ecosystems on their lands.

KEY ACTION 87: Work with government and non-government organizations to include wetland benefits in an incentive program that includes mitigation for impacted wetlands.

Responsibility	Completion Date
North Saskatchewan River Basin Council Saskatchewan Watershed Authority Ducks Unlimited Canada Agriculture and Agri-Food Canada – Prairie Farm Rehabilitation Administration Saskatchewan Ministry of Environment	2009 and ongoing

Community Impacts

Sewage Treatment and Disposal

Municipal wastewater, or sewage, comes from households, office buildings, and small- to medium-sized industries, and is a complex mixture of suspended solids, microorganisms, and debris. Some 200 chemicals have also been identified in this waste stream in Canada (Chambers et al., 2001). The nutrients in this mix come from human waste, industrial byproducts, household cleaning products such as laundry detergent, automatic dishwashing detergent, and general cleaners.

Human waste contributes more than 90 percent of household nitrogen loadings, with most of the nitrogen in the form of ammonia (Chambers et al., 2001). Human waste is also the largest source of phosphorus in sewage, followed at a distant second by automatic dishwashing detergent.

Almost all municipal wastewater in Canada undergoes one or more of the following levels of treatment:

- *primary treatment*, which uses physical processes to remove suspended solids;
- *secondary treatment*, which uses biological processes to break down organic material and remove additional suspended solids; and
- *tertiary treatment*, which uses advanced chemical or biological treatment to remove specific compounds or materials that remain after secondary treatment.

Some of the nutrients in wastewater can be removed by settling, but a precipitating agent such as alum can also be added at any of these stages to increase phosphate removal. Effective nitrogen removal requires the addition of specialized bacteria during secondary treatment. Higher treatment levels generally imply lower nutrient loadings to the receiving waters, but even primary treatment can reduce loadings substantially.

The percentage of Canadians served by wastewater treatment has been increasing; in 1999, 73 percent of Canadians were served by municipal sewer systems. An additional 25 percent relied on septic beds for sewage treatment. The remaining two percent were in communities with populations less than 1,000 and likely serviced by lagoons. Of those with sewers, 97 percent (21.9 million Canadians) had some level of wastewater treatment provided in 1999, compared with 72 percent in 1983. The remaining three percent (approximately 0.8 million Canadians) were serviced by sewage collection systems that discharged untreated sewage directly into lakes, rivers, or oceans. Discharges of untreated sewage can also occur in municipalities served by combined sewer systems. These systems carry both raw sewage and storm water; during periods of high rainfall or snowmelt, however, they are often allowed to overflow directly into receiving waters to prevent sewage from backing up into basements or overloading the treatment facility. Combined sewer overflows can be a major source of nutrient loadings (Environment Canada, 2004).

OBJECTIVE: Minimize the impacts from sewage effluent spills and disposal from all sources.

RECOMMENDATION

Educate the public on the benefits of proper sewage management and on the available options to reduce the negative impacts.

KEY ACTION 88: Develop and implement a communication strategy to educate the public about the benefits of proper sewage management and on the available options to reduce the negative impacts.

Responsibility	Completion Date
North Saskatchewan River Basin Council Saskatchewan Watershed Authority Saskatchewan Ministry of Environment Saskatchewan Ministry of Health Municipalities	2010 and ongoing

RECOMMENDATION

Provide municipalities and communities with affordable and government-approved alternatives for sewage disposal to reduce impacts. Communities that need to be targeted with new affordable methods include cottage developments, colony farms, First Nations, outfitters, and recreational and work camps.

KEY ACTION 89: Investigate new sewage treatment methods and work with municipalities and communities to set up pilot projects to test these new methods.

Responsibility	Completion Date
North Saskatchewan River Basin Council Saskatchewan Watershed Authority Saskatchewan Ministry of Environment Environment Canada Prairie North Regional Health Authority Prince Albert Parkland Regional Health Authority Saskatoon Regional Health Authority Indian and Northern Affairs Canada Municipalities	2010 and ongoing

RECOMMENDATION

Work towards discharging sewage effluents when it will have the least negative impact.

KEY ACTION 90: Develop and implement a strategy to assist municipalities and communities to work towards minimizing the environmental impact of their sewage effluent release.

Responsibility	Completion Date
North Saskatchewan River Basin Council Saskatchewan Watershed Authority Saskatchewan Ministry of Environment Environment Canada	2010 and ongoing

RECOMMENDATION

Government regulations and resources need to be improved to ensure sewage disposal is better regulated where there is no community collection and treatment system.

KEY ACTION 91: Need greater enforcement to ensure regulations are met by private sewage disposal and commercial/domestic sewage haulers, including those on federal and provincial lands.

Responsibility	Completion Date
Prairie North Regional Health Authority **Prince Albert Parkland Regional Health Authority** **Saskatoon Regional Health Authority** Saskatchewan Ministry of Environment Environment Canada	2010 and ongoing

RECOMMENDATION

The Saskatchewan Ministry of Environment should consider the environmental impacts from high salt ground water when it is used as a water source and then released as treated effluent into a surface water system.

KEY ACTION 92: Conduct a study to determine the impacts of high salt ground water when it is used as a water source and then released as treated effluent into a surface water system, such as what occurs at Maidstone and in the Battle River watershed.

Responsibility	Completion Date
Saskatchewan Ministry of Environment **Environment Canada**	2009

RECOMMENDATION

Improve information transfer and spill/discharge notification between Alberta and Saskatchewan, and between Saskatchewan communities and other downstream users.

KEY ACTION 93: Review the spill warning communication strategy both within Saskatchewan and between Alberta and Saskatchewan to consider making it more effective.

Responsibility	Completion Date
Saskatchewan Ministry of Corrections, Public Safety and Policing **Saskatchewan Ministry of Environment** Alberta Environment Environment Canada Municipalities	2009

Waste Disposal Grounds

There are 63 waste disposal grounds in the North Saskatchewan River watershed. Of these, there is information on the status and potential impacts of 26 sites: 18 in the North Battleford area and eight in the Prince Albert area. Of these sites, 10 are now closed, with most being used as waste transfer stations. However, only a few of these sites have actually been decommissioned, and probably none can be ruled out as having no potential impacts on ground water. The only waste disposal site that is listed as having no potential impact on ground water is the new state-of-the-art facility at Prince Albert. The Saskatchewan Ministry of Environment is currently undertaking a review of all landfills or waste disposal grounds.

OBJECTIVE: Minimize the impacts of waste disposal on surface and ground water quality.

RECOMMENDATION

Educate the public on ways to minimize the impacts of waste disposal.

KEY ACTION 94: Develop and implement a communication strategy to educate the public on how to minimize the impacts of waste disposal. This strategy could include initiatives to:

- discourage waste disposal on private land and inform landowners about regulations that apply to waste disposal on private land;
- encourage municipalities to be proactive in cleaning up illegally dumped waste materials to discourage unauthorized disposal sites;
- educate rural residents on why burning waste is harmful and why it is important to separate wastes;
- promote reduce-reuse-recycle; and
- encourage the consumer to avoid excess packaging, and advocate that all packaging be recyclable.

Responsibility	Completion Date
North Saskatchewan River Basin Council Saskatchewan Watershed Authority Saskatchewan Ministry of Environment Environment Canada	2010 and ongoing

RECOMMENDATION

Ensure federal, provincial, and municipal representatives remain at the discussion table to determine how a regional waste disposal system should operate and to solve ongoing waste/recycling problems, including development of a balanced funding program between all three levels of government.

KEY ACTION 95: Chemical companies should be made aware of disposal problems, be encouraged to minimize packaging, and be required to accept full packaging returned to them.

Responsibility	Completion Date
North Saskatchewan River Basin Council Saskatchewan Ministry of Environment Environment Canada	2010 and ongoing

KEY ACTION 96: Lobby federal, provincial and municipal representatives to work out all regional waste disposal and recycling problems, including funding.

Responsibility	Completion Date
North Saskatchewan River Basin Council Saskatchewan Ministry of Environment Environment Canada Indian and Northern Affairs Canada	2009 and ongoing

RECOMMENDATION

Develop ways to dispose of and/or recycle products that contain heavy metals and other potentially dangerous materials.

KEY ACTION 97: Establish a hazardous waste collection day program in rural areas.

Responsibility	Completion Date
North Saskatchewan River Basin Council Saskatchewan Ministry of Environment	2009 and ongoing

KEY ACTION 98: Develop ways to dispose of/recycle products that contain heavy metals and other potentially dangerous materials, such as home heating fuel tanks, fluorescent light bulbs, and batteries.

Responsibility	Completion Date
Saskatchewan Ministry of Environment North Saskatchewan River Basin Council Saskatchewan Waste Reduction Council	2009 and ongoing

RECOMMENDATION

All landfills should undergo the same review and approval process, and should be made environmentally safe when taken out of service.

KEY ACTION 99: Monitor abandoned and new landfills to determine if leachate is contaminating surface and/or ground water. Specific guidelines and water quality standards will be needed to ensure that surface discharge from landfills meets the Saskatchewan Surface Water Quality Objectives.

Responsibility	Completion Date
Saskatchewan Ministry of Environment North Saskatchewan River Basin Council	ongoing

RECOMMENDATION

Governments should investigate other alternatives to landfills, such as waste incineration for power production.

KEY ACTION 100: Investigate other alternatives to land fills, such as incineration and cogeneration (also for power generation), recycling, reducing packaging, reusing containers, developing degradable plastics, etc.

Responsibility	Completion Date
Saskatchewan Ministry of Environment North Saskatchewan River Basin Council Saskatchewan Waste Reduction Council	ongoing

Storm Water Runoff

Storm water from cities and other communities is a potential source of pollutants, but there is uncertainty about what it specifically contains and in what concentrations. Storm water is not currently monitored, but it is suspected to contain salt, oil, nutrients, sediments, as well as any number of chemicals that might be poured down storm water drains. Storm water management guidelines are being developed by the Saskatchewan Ministry of Environment.

OBJECTIVE: Minimize chemical and biological contaminant levels in storm water runoff from urban areas.

RECOMMENDATION

Educate urban residents on the negative impacts of storm water runoff and on the responsible use of chemicals such as fertilizers and pesticides.

KEY ACTION 101: Develop and implement a communication strategy to educate the public about the benefits of proper storm water runoff management and the responsible use and disposal of household and garden chemicals.

Responsibility	Completion Date
North Saskatchewan River Basin Council Saskatchewan Ministry of Environment Saskatchewan Watershed Authority Partners FOR the Saskatchewan River Basin Municipalities	2010 and ongoing

RECOMMENDATION

Urban municipalities should be encouraged to adopt beneficial management practices as outlined in the 2006 Provincial Stormwater Management Guidelines.

KEY ACTION 102: Encourage storm water management options like reducing quantity and improving quality of runoff, to be part of the design criteria for all new subdivisions.

Responsibility	Completion Date
Saskatchewan Ministry of Municipal Affairs **Municipalities** North Saskatchewan River Basin Council Saskatchewan Ministry of Environment	2008 and ongoing

KEY ACTION 103: Encourage the preservation of urban wetlands and green spaces, the building of storm water retention ponds, and ground water recharge systems to reduce the quantity and improve the quality of storm water runoff.

Responsibility	Completion Date
Saskatchewan Ministry of Municipal Affairs **Municipalities** North Saskatchewan Watershed Stewardship Group Saskatchewan Ministry of Environment	2008 and ongoing

RECOMMENDATION

Educate municipalities and other jurisdictions on beneficial management practices related to the application and storing of road salt and for disposing of contaminated (hauled) snow.

KEY ACTION 104: Develop and implement a communication strategy to educate municipalities on beneficial management practices related to the application and storing of road salt, and for disposing of contaminated snow.

Responsibility	Completion Date
North Saskatchewan River Basin Council Saskatchewan Ministry of Environment Saskatchewan Watershed Authority Environment Canada	2010 and ongoing

RECOMMENDATION

The provincial government should develop an environmental plan for communities and urban residents (similar to the Environmental Farm Plan) which considers the environmental risk of all urban activities and mitigates these activities by advocating the adoption of beneficial management practices.

KEY ACTION 105: Develop and implement an environmental program for communities and urban residents to rate and reduce their "ecological footprint."

Responsibility	Completion Date
Saskatchewan Ministry of Environment North Saskatchewan River Basin Council	2007 and ongoing

Recreational Impacts

There are a number of recreational lakes in the watershed. The natural beauty of these lakes, coupled with their recreation potential, has resulted in the development of cottages and resorts. The resulting increase in population can have impacts on the water and lake environment. It is critical that all developments have proper sewage waste treatment. A leaky system, improper surface application or improper mounding can result in contamination of the lake.

The development of cottages can also decrease the natural vegetative buffer zone around lakes. Riparian zones filter out contaminants, protect the bank and property from erosion, and provide valuable fish and wildlife habitat. As more cottages are developed, more of the natural vegetation may be removed. Replacing riparian vegetation with concrete, short-mowed grass, and pathways will result in the natural buffering capacity of the riparian zone being lost, as well as increased runoff with associated contamination. Other activities such as importing

sand to create man-made beaches, especially where beaches are not natural or sustainable, will lead to water quality problems and a loss of fish habitat. Poorly designed docks and marinas will contribute to erosion and silting by changing shoreline water movements.


Photo courtesy of Nature Saskatchewan

Fuel spills and poorly maintained boat motors can also deteriorate water quality. Boating-related wave action can damage fish and wildlife habitat.

The use of all-terrain vehicles in riparian areas is also a concern. These vehicles can destroy the vegetation and result in increased erosion and bank destabilization.

There are many beneficial management practices that can help eliminate or minimize the impacts of increased activity on and around recreational lakes. The book "On the Living Edge: Your Handbook for Waterfront Living" provides cottage owners and other shoreline users with environmentally-friendly practices to protect water quality and sustain the natural beauty of their lake (Kipp & Callaway, 2003).

OBJECTIVE: Minimize the impacts of recreational activities on water quality.

RECOMMENDATION

The provincial government should assist municipalities to determine recreational development criteria based on the ecological sustainability of a water body and on what is acceptable to watershed residents.

KEY ACTION 106: Develop lake capacity criteria for use by rural municipalities and resort villages when reviewing existing development plans and approving new ones.

Responsibility	Completion Date
Saskatchewan Ministry of Environment **Saskatchewan Ministry of Parks, Tourism, Culture and Sport** **Saskatchewan Ministry of Municipal Affairs** Municipalities North Saskatchewan River Basin Council	2012

KEY ACTION 107: Municipalities should incorporate developmental guidelines consistent with *The Planning and Development Act, 2007* into community planning to minimize impacts on riparian and shoreline areas while taking recreation activities into account.

Responsibility	Completion Date
Saskatchewan Ministry of Municipal Affairs Municipalities North Saskatchewan River Basin Council	2008

KEY ACTION 108: Educate developers, cabin owners and all recreational users on how to mitigate their impacts on lakes and rivers.

Responsibility	Completion Date
North Saskatchewan River Basin Council Saskatchewan Ministry of Municipal Affairs Municipalities Saskatchewan Watershed Authority Provincial Association of Resort Communities of Saskatchewan	2009 and ongoing

RECOMMENDATION

The provincial government should be conducting health and shoreline inspections of all cottage and marina developments on a regular basis.

KEY ACTION 109: Initiate regular health inspections in recreational areas, including inspections to ensure sewage holding tanks are not leaking.

Responsibility	Completion Date
Prairie North Regional Health Authority **Prince Albert Parkland Regional Health Authority** **Saskatoon Regional Health Authority** North Saskatchewan River Basin Council	2009 and ongoing

KEY ACTION 110: Initiate regular shoreline inspections of all recreational areas and marina developments to ensure riparian and shoreline areas are being protected.

Responsibility	Completion Date
Saskatchewan Ministry of Environment North Saskatchewan River Basin Council Municipalities	2009 and ongoing

Industrial Impacts

General Industry

OBJECTIVE: Minimize the impacts of industrial activities on water quality and quantity.

RECOMMENDATION

Educate the public about regulations and options for recycling and disposal of industrial waste.

KEY ACTION 111: Auto wreckers, repair shops and car owners should be educated about recycling auto fluids.

Responsibility	Completion Date
Saskatchewan Ministry of Municipal Affairs North Saskatchewan River Basin Council	2008 and ongoing

KEY ACTION 112: Provide public awareness about proper procedures for reporting non-compliance by industry.

Responsibility	Completion Date
Saskatchewan Ministry of Municipal Affairs North Saskatchewan River Basin Council	2010 and ongoing

RECOMMENDATION

The provincial government should provide incentives and set and enforce effluent load regulations on small industries (similar to larger ones) to protect water.

KEY ACTION 113: The provincial government should re-instate the incentive program for decommissioning orphaned gas stations.

Responsibility	Completion Date
Saskatchewan Ministry of Environment North Saskatchewan River Basin Council	2010 and ongoing

KEY ACTION 114: The provincial government should establish an effective recycling program for hazardous waste products such as auto fluids in rural areas.

Responsibility	Completion Date
Saskatchewan Ministry of Environment North Saskatchewan River Basin Council Saskatchewan Waste Reduction Council	2010 and ongoing

KEY ACTION 115: The provincial government should ensure industrial effluent regulations to protect water are enforced.

Responsibility	Completion Date
Saskatchewan Ministry of Environment North Saskatchewan River Basin Council	2010 and ongoing

RECOMMENDATION

The provincial government and industry should work together to reduce industry's reliance on water. Industry should also avoid practices that result in water being lost from the watershed and should be working towards using recycled water or other alternatives in all of its activities.

KEY ACTION 116: Industry should be closely scrutinized regarding the amount of surface and ground water used and should be required to recycle this water where possible.

Responsibility	Completion Date
Saskatchewan Ministry of Energy and Resources Saskatchewan Watershed Authority Saskatchewan Ministry of Environment	2008 and ongoing

Oil and Gas Industry

Oil and gas development is a significant industry. Provincially, the oil and gas industry accounted for $2.6 billion in capital investment in 2007, as well as 26,000 direct and indirect jobs (Pryce, 2008). Almost all of the current active oil and gas development is occurring in the western part of the watershed. While municipalities control land use, most in this area do not control oil and gas development. As of February 2005, there were over 12,600 oil wells in the watershed area; however not all of these are active.


Photo courtesy of
Saskatchewan Ministry of Energy and Resources

The main uses of water by the oil and gas industry are for flood injection, enhanced (heavy) oil recovery, and oil sand mining. Other uses include drilling fluids, fire fighting and domestic services, and for pipeline, vessel and tank testing. Water sources include water produced from oil extraction, saline ground water, and potable ground and surface waters. The industry is motivated to minimize water use by focusing more on recycling, using non-potable sources of water, and research into other non-water-dependent recovery options.

There is a large difference between the amount of water allocated and the amount used. Initially, there is a high water requirement to pressurize the formation. Once pressurized, water use drops off significantly. All aspects of water use by the oil and gas industry are regulated.

OBJECTIVE: Minimize the impacts of oil and gas activities on water quality.

RECOMMENDATION

The oil and gas industry and the Saskatchewan Ministry of Energy and Resources should educate the public on how the industry protects water and on how much water it uses.

KEY ACTION 117: Environmental protection procedures for the petroleum industry should be made readily available to the general public.

Responsibility	Completion Date
Saskatchewan Ministry of Energy and Resources Saskatchewan Ministry of Environment Canadian Association of Petroleum Producers Canadian Association of Geophysical Contractors Small Explorers and Producers Association of Canada Canadian Association of Oilwell Drilling Contractors	ongoing

KEY ACTION 118: The Saskatchewan Watershed Authority should communicate with the public and other agencies about how much water the industry uses.

Responsibility	Completion Date
Saskatchewan Watershed Authority Saskatchewan Ministry of Energy and Resources Canadian Association of Petroleum Producers Canadian Association of Geophysical Contractors Small Explorers and Producers Association of Canada Canadian Association of Oilwell Drilling Contractors	ongoing

KEY ACTION 119: Provide public education about recourse options if there are problems with any industrial activities.

Responsibility	Completion Date
Saskatchewan Ministry of Energy and Resources Saskatchewan Ministry of Environment Canadian Association of Petroleum Producers Canadian Association of Geophysical Contractors Small Explorers and Producers Association of Canada Canadian Association of Oilwell Drilling Contractors	ongoing

RECOMMENDATION

The provincial government and the oil and gas industry should work together to reduce the industry's reliance on water. The oil and gas industry should also avoid practices that result in water being lost from the watershed and should be working towards using recycled water or other alternatives in all of its activities.

KEY ACTION 120: The oil and gas industry should be closely scrutinized regarding the amount of surface and ground water used and should be required to recycle this water where possible.

Responsibility	Completion Date
Saskatchewan Ministry of Energy and Resources Saskatchewan Watershed Authority Saskatchewan Ministry of Environment	2008 and ongoing

RECOMMENDATION

The provincial government should audit the reclamation of seismic holes and all types of oil and gas wells to determine if proper procedures are being used to protect ground water, and if these procedures are effective in the long-term in preventing cumulative effects of all the activities in the area.

KEY ACTION 121: The oil and gas industry should use tampers, not dynamite, for seismic testing where practical to reduce the chance of ground water contamination, and directional drilling where practical to reduce or eliminate the number of oil and gas wells in flood plains.

Responsibility	Completion Date
Saskatchewan Ministry of Energy and Resources Saskatchewan Ministry of Environment Saskatchewan Petroleum Industry/ Government Environment Committee	2009 and ongoing

KEY ACTION 122: Continue to ensure mitigation measures and operational procedures are designed to prevent contamination from occurring.

Responsibility	Completion Date
Saskatchewan Ministry of Energy and Resources Saskatchewan Ministry of Environment Saskatchewan Petroleum Industry/ Government Environment Committee Saskatchewan Watershed Authority North Saskatchewan River Basin Council	2008 and ongoing

KEY ACTION 123: Rural municipalities or landowners should notify the Saskatchewan Ministry of Energy and Resources of any problems.

Responsibility	Completion Date
Rural Municipalities North Saskatchewan River Basin Council Saskatchewan Ministry of Energy and Resources Saskatchewan Ministry of Environment	2008 and ongoing

RECOMMENDATION

The provincial government and the oil and gas industry should develop and implement a strategy for the safe transportation of unrefined oil and waste salt water.

KEY ACTION 124: Work with Enform to develop industrial beneficial management practices to deal with the safe transportation of oil and waste salt water.

Responsibility	Completion Date
North Saskatchewan River Basin Council Saskatchewan Ministry of Energy and Resources Saskatchewan Ministry of Environment	2008 and ongoing

KEY ACTION 125: Ask the Saskatchewan Transportation and Environment Committee to address the issue of safe transportation practices with the oil and gas industry.

Responsibility	Completion Date
North Saskatchewan River Basin Council Saskatchewan Ministry of Energy and Resources Saskatchewan Ministry of Environment Environment Canada	2008 and ongoing

KEY ACTION 126: Safe driving initiatives should continue to be promoted in the oil industry.

Responsibility	Completion Date
Saskatchewan Ministry of Energy and Resources Canadian Association of Petroleum Producers Canadian Association of Geophysical Contractors Small Explorers and Producers Association of Canada Canadian Association of Oilwell Drilling Contractors	ongoing

Forestry

Healthy forested areas provide source water protection functions such as erosion control, snow and water storage and filtration of surface runoff. Extensive forest harvesting within a watershed in the Boreal forest can have impacts on water quality and quantity.


Photo courtesy of Government of Saskatchewan

Commercial harvesting occurs within the North Saskatchewan River watershed. All commercial forest harvesting in the provincial forest is subject to annual operating plans approved by the Saskatchewan Ministry of Environment. Commercial harvesting can also occur on private and Indian Reserve lands, which are not subject to the Saskatchewan Ministry of Environment's licensing requirements. Forest harvesting license areas are not based upon watersheds. Licensed areas identified in this section are for land within the watershed. Licensed areas outside of the watershed are not included.

Markets influence prices, and the amount of harvesting will vary in the watershed from one year to the next. Although there may be variability in the volume of timber harvested from year to year, mills within the watershed target a consistent supply within a range based on the licence requirements and their specific mill requirements.

OBJECTIVE: Mitigate and reduce negative impacts on water quality through sustainable forest management practices on private, Crown and Indian Reserve lands.

RECOMMENDATION

Forest management plans and term supply licenses should be ecosystem-based, and annual operating plans should include more site-specific, rather than blanket, guidelines to manage harvesting in riparian areas.

KEY ACTION 127: Forest harvesting guidelines should be available so that they could be used to protect riparian areas on private lands and Indian Reserves.

Responsibility	Completion Date
Saskatchewan Ministry of Environment North Saskatchewan River Basin Council Saskatchewan Watershed Authority Federation of Saskatchewan Indian Nations Fisheries and Oceans Canada Mistik Management	2008 and ongoing

KEY ACTION 128: Develop an education strategy for forestry companies that includes codes of practice for use with harvesting operations on private land and reserves.

Responsibility	Completion Date
Saskatchewan Ministry of Environment North Saskatchewan River Basin Council Saskatchewan Watershed Authority Federation of Saskatchewan Indian Nations Fisheries and Oceans Canada Saskatchewan Environmental Society	2008 and ongoing

RECOMMENDATION

Forestry companies should be required to take measures to prevent erosion and sedimentation in water, and establish riparian vegetation where impacts have occurred.

KEY ACTION 129: Ensure appropriate vegetation is established in riparian areas that would prevent erosion and sedimentation into the water. The appropriate vegetation would have to be defined in each operating plan.

Responsibility	Completion Date
Saskatchewan Ministry of Environment North Saskatchewan River Basin Council Saskatchewan Watershed Authority Fisheries and Oceans Canada	2008 and ongoing

5.7 Natural Habitat

Biodiversity

Biological resources provide the basis for life on earth and the foundation for fundamental social, ethical, cultural and economic values. These values can be divided into three areas:

1) Intrinsic value describes the inherent nature of biodiversity, not the value of biodiversity to human society. It usually means that biodiversity should be valued for what it is, not its specific role within the biosphere.
2) Option value describes the value placed on maintaining biodiversity for unknown future needs. More biodiversity will provide a safely net of diversity, assigning a value to risk aversion in the face of uncertainty.
3) The last area is utilitarian value. People use biodiversity in a myriad of ways. In addition to direct uses such as food or construction materials, biodiversity provides indirect values through ecological services (Environment Canada, 1995).

OBJECTIVE: Maintain biodiversity to protect natural ecosystems.

RECOMMENDATION

Government and non-government organizations should deliver a broad educational program on biodiversity, habitat and watershed functions.

KEY ACTION 130: Develop and implement a communication strategy to educate the public about the importance of biodiversity and watershed functions.

Responsibility	Completion Date
North Saskatchewan River Basin Council Saskatchewan Watershed Authority Saskatchewan Ministry of Environment Ducks Unlimited Canada Fisheries and Oceans Canada	2011 and ongoing

KEY ACTION 131: Re-establish the health of riparian areas and buffer strips and plant naturally-existing species along water bodies as demonstration projects.

Responsibility	Completion Date
North Saskatchewan River Basin Council Saskatchewan Watershed Authority Saskatchewan Ministry of Environment Ducks Unlimited Canada Fisheries and Oceans Canada	2011 and ongoing

RECOMMENDATION

Biodiversity and ecosystem functions should be researched to determine their value as natural capital (i.e. ecological goods and services) within the economy.

KEY ACTION 132: Continue to research ecological goods and services and how biodiversity and ecosystem functions are valued as natural capital.

Responsibility	Completion Date
North Saskatchewan River Basin Council Saskatchewan Watershed Authority Saskatchewan Ministry of Environment Ducks Unlimited Canada Agriculture and Agri-Food Canada – Prairie Farm Rehabilitation Administration	2011 and ongoing

RECOMMENDATION

Society should compensate private landowners for lost income due to providing ecological goods and services by protecting natural ecosystems and using beneficial management practices.

KEY ACTION 133: Work with government and non-government organizations to develop an ecological goods and services program to compensate landowners for protecting natural ecosystems and using beneficial management practices.

Responsibility	Completion Date
North Saskatchewan River Basin Council Saskatchewan Watershed Authority Saskatchewan Ministry of Environment Ducks Unlimited Canada Agriculture and Agri-Food Canada	2011 and ongoing

RECOMMENDATION

Establish local biodiversity indicators to measure and minimize impacts from human activities and to monitor biodiversity.

KEY ACTION 134: Establish biodiversity indicators as part of State of the Watershed Reporting.

Responsibility	Completion Date
Saskatchewan Watershed Authority North Saskatchewan River Basin Council	2009 and ongoing

RECOMMENDATION

Strategies to protect biodiversity should be incorporated into the federal and provincial environmental impact assessments, and into the municipal and First Nations' community planning and zoning bylaw processes.

KEY ACTION 135: Incorporate biodiversity protection into environmental impact assessments.

Responsibility	Completion Date
Saskatchewan Ministry of Environment Environment Canada	2011 and ongoing

KEY ACTION 136: Encourage municipalities and First Nations to incorporate biodiversity protection into their community planning and zoning bylaw processes.

Responsibility	Completion Date
North Saskatchewan River Basin Council Saskatchewan Ministry of Municipal Affairs Federation of Saskatchewan Indian Nations Indian and Northern Affairs Canada	2010 and ongoing

KEY ACTION 137: Educate and create awareness about invasive species within the watershed.

Responsibility	Completion Date
North Saskatchewan River Basin Council Saskatchewan Watershed Authority Saskatchewan Ministry of Environment Federation of Saskatchewan Indian Nations Ducks Unlimited Canada Agriculture and Agri-Food Canada	2009 and ongoing

Fish Habitat

Fish habitat may be affected directly or indirectly by land and water management practices. Practices that affect fish habitat typically also affect water quantity and quality for use by humans. In general, activities that harm fish habitat and fish also harm the quality of source water for human use. Conversely, measures taken to protect fish habitat also provide protection of water quantity and quality for human use.

One major overlap in fish habitat and water quality concerns is sediment. Sediment affects water quality and has detrimental impacts on fish and fish habitat. Various activities increase sediment loads in water, including erosion and transport of sediment from land surfaces due to land use practices and lack of effective riparian buffers. Erosion from within the stream course itself is increased due to higher stream flows resulting from land use changes and wetland drainage. A major source of excess sediment in some streams is channelized sections of stream that lack the natural erosion-reducing features of deep-rooted riparian vegetation, natural meanders and riffle-pool structures. Large, episodic sediment releases occur in many streams when poorly constructed or undersized culvert crossings wash out during high flows.

OBJECTIVE: Protect fish habitat.

RECOMMENDATION

Educate watershed residents on how fish habitat can be easily and unknowingly damaged, and how and why it should be protected.

KEY ACTION 138: Develop and implement a communication strategy to educate the public on how and why fish habitat should be protected.

Responsibility	Completion Date
Fisheries and Oceans Canada **North Saskatchewan River Basin Council** Saskatchewan Ministry of Environment	2011 and ongoing

Riparian Area Protection

Riparian areas are the transition zones between upland areas and wetlands, streams or lakes. Due to increased water availability, this zone is usually characterized by dense vegetation.

Riparian areas can effectively control erosion by forming a physical barrier that slows the surface flow of sediment and debris, by stabilizing wetland edges and streambanks, and by promoting infiltration. The required width of a buffer is determined by the type of vegetation present, the extent and impact of the adjacent land use, and the functional value of the receiving wetland. Studies have found the bulk of sediment removal in surface runoff occurs in the first few meters of the buffer zone. A vegetative buffer strip can effectively remove 75 to 97 percent of the sediment load from surface runoff.

Buffer strips can also effectively remove nutrients from surface water flow. The main mechanisms of nitrate removal are uptake by vegetation roots and anaerobic microbial denitrification in the saturated zone of the soil. Relatively narrow buffers seem to be very effective in reducing 35 to 96 percent of nitrogen. Phosphorus reduction has been found to be 27 to 97 percent effective in buffer strips that contain both woody, herbaceous vegetation, grasses and cropped buffer systems. Buffer strips can also trap a significant proportion of pathogens (up to 74 percent of fecal coliforms). Low soil moisture and high soil temperature substantially decrease survival of total and fecal coliform bacteria.

The key process for pesticide retention in buffer strips is infiltration. Grass buffer strips can reduce pesticides by 8 to 100 percent.

In the North Saskatchewan River watershed, the natural riparian habitat has been altered by various landscape activities such as industry, agriculture and urban development. No systematic riparian assessment has been conducted, however.

Riparian areas can be dominated by sedge, grass, or rush communities, by shrub communities, forest communities, or even lichen encrusted rock communities. Each of these community types offers different ecosystem functions, and they are not readily interchangeable. Each of these community types also has certain environmental requirements to remain stable. Forest community types, particularly in the Boreal forest, require periodic disturbance by fire in order to renew themselves, as the common tree species are either moderately or largely shade intolerant.

Areas adjacent to watercourses such as lakes, streams and rivers are typically exposed to similar forms of disturbance as non-riparian areas. While certain topographical features such as islands and peninsulas, vegetation community types like sphagnum bogs or willow fens, and other features including prevailing winds can make portions of these areas less susceptible to the same frequency, intensity or type of disturbance, their function can be impaired or altered by removing their disturbance/renewal regime.

OBJECTIVE: Protect, restore and develop healthy riparian areas.

RECOMMENDATION

Educate the public on riparian area functions and their importance in protecting water quality.

KEY ACTION 139: Develop and implement a strategy to provide education to rural, urban and recreational residents on the value of riparian areas and on beneficial management practices to protect all types of riparian areas.

Responsibility	Completion Date
North Saskatchewan River Basin Council Saskatchewan Ministry of Environment Saskatchewan Watershed Authority Partners FOR the Saskatchewan River Basin Ducks Unlimited Canada Saskatchewan Ministry of Agriculture Agriculture and Agri-Food Canada – Prairie Farm Rehabilitation Administration Fisheries and Oceans Canada	2010 and ongoing

RECOMMENDATION

Identify the different types of land use impacts on riparian areas and how these impacts can be mitigated.

KEY ACTION 140: Conduct a more comprehensive riparian area assessment of potentially high-risk and vulnerable areas in the North Saskatchewan River watershed and develop a strategy to protect them.

Responsibility	Completion Date
Saskatchewan Watershed Authority North Saskatchewan River Basin Council	2010

KEY ACTION 141: Develop a strategy to protect high-risk and vulnerable areas.

Responsibility	Completion Date
Saskatchewan Watershed Authority North Saskatchewan River Basin Council	2011 and ongoing

RECOMMENDATION

Federal, provincial and municipal government agencies should develop consistent or compatible developmental guidelines to protect riparian areas.

KEY ACTION 142: Include riparian area protection as an item of provincial interest in amendments to *The Planning and Development Act, 2007*.

Responsibility	Completion Date
Saskatchewan Ministry of Municipal Affairs Saskatchewan Watershed Authority Saskatchewan Ministry of Environment	2008

RECOMMENDATION

The provincial government should support municipal governments in the development and funding of land use plans that protect riparian areas, and should ensure that there is sufficient provincial and municipal capacity to enforce appropriate regulations.

KEY ACTION 143: Encourage municipal governments to use developmental guidelines and zoning to protect riparian areas.

Responsibility	Completion Date
Saskatchewan Ministry of Municipal Affairs Saskatchewan Watershed Authority Saskatchewan Ministry of Environment	2008 and ongoing

KEY ACTION 144: Create a flow chart which indicates what approvals are required when working near water, and which agencies issue these approvals.

Responsibility	Completion Date
Saskatchewan Watershed Authority North Saskatchewan River Basin Council Saskatchewan Ministry of Environment Saskatchewan Ministry of Municipal Affairs	2008 and ongoing

KEY ACTION 145: Local municipal governments or rural municipalities should require the developer to hire inspectors to oversee new developments in critical riparian areas (as defined by the riparian assessment mentioned above) to protect the environment as part of the approval for the development permit.

Responsibility	Completion Date
Saskatchewan Ministry of Municipal Affairs North Saskatchewan River Basin Council Municipalities	2008 and ongoing

6. Appendices

A. Participants in the Planning Process

Battle River Advisory Committee

Member	Organization
Alois Schaab	Rural Municipality of Heart's Hill No. 352
Archie Weenie	Sweetgrass First Nation
Bernadette Poppleton	Rural Municipality of Hillsdale No. 440
Bill Halewich	Town of Battleford
Brad Stensrud	Town of Battleford
Carl Kennedy	Little Pine First Nation
Chris Odishaw	Town of North Battleford
Don Ferguson	Rural Municipality of Paynton No. 470
Eric Tootoosis	Poundmaker Cree Nation
Fred Holden	Border Conservation and Development Area #158
Fred Roschker	Town of Cut Knife
Grant Wasmuth	Town of Cut Knife
Jim Schmidt	Battlefords Wildlife Federation
John Donville	Rural Municipality of Battle River No. 438
Ken Andersen	Border Conservation and Development Area #158
Lawrence Loehndorf	Rural Municipality of Heart's Hill No. 352
Lyndon Tootoosis	Poundmaker Cree Nation
Milton Bingham	Rural Municipality of Cut Knife No. 439
Murray Ball	Village of Neilburg
Omer White	Sweetgrass First Nation
Ryan Pewapisconias	Little Pine First Nation
Velma Foster	Rural Municipality of Paynton No. 470
Vince Murphy	Rural Municipality of Hillsdale No. 440
Wes Paskemin	Sweetgrass First Nation

Central Advisory Committee

Member	Organization
Andrew Hawrysh	Redberry Lake Biosphere Reserve
Archie Wainwright	Rural Municipality of Great Bend No. 405
Brad Pattinson	Jackfish and Murray Lake Watershed Association No. 1
Craig Hamilton	Rural Municipality of Mayfield No. 406
Curtis Moccasin	Saulteaux First Nation
David Strain	Rural Municipality of North Battleford No. 437
Delbert Miller	Village of Speers
Don Tkachuk	Town of Hafford
Ed Hobday	Rural Municipality of Corman Park No. 344
Eugene Sass	Rural Municipality of Redberry No. 435
Greg Ferris	Rural Municipality of Mayfield #406
Harold Daniels	Mistawasis First Nation
Hugh J. Foster	Rural Municipality of Douglas No. 436
Joe Kasahoff	Rural Municipality of Corman Park No. 344
John Serhienko	Rural Municipality of Blaine Lake No. 434
John W. Kindrachuk	Rural Municipality of Douglas No. 436
Peter Kingsmill	Redberry Lake Biosphere Reserve
Randy Strelioff	City of North Battleford
Robert Greer	Rural Municipality of Glenside No. 377
Robert L'Heureux	Jackfish and Murray Lake Watershed Association No. 1
Ron Saunders	Rural Municipality of Great Bend No. 405
Sarah Gopher	Saulteaux First Nation
Steve Grzybowski	Rural Municipality of Redberry No. 435
Ted Nicholson	Village of Speers
Valerie Holowach	Stewards of Jackfish and Murray Lakes Inc. Village of Meota
Walter Kabaroff	Rural Municipality of Blaine Lake No. 434

East Advisory Committee

Member	Organization
Alfred Corriveau	Rural Municipality of Paddockwood No. 520
Brian Snell	Rural Municipality of Garden River No. 490
Craig Bighead	Sturgeon Lake First Nation
Don Moe	Town of Shellbrook
Donald Heidt	Rural Municipality of Garden River No. 490
Doug Panter	Rural Municipality of Big River No. 555
Doug Wilson	Big Shell Lake Watershed Stewardship Association Inc. Provincial Association of Resort Communities of Saskatchewan
Gary Robinson	Rural Municipality of Spiritwood No. 496
George Tomporowski	Town of Shellbrook
Gord Plantz	Village of Canwood
Greg Edeen	Village of Canwood
Hank Ethier	Rural Municipality of Buckland No. 491
John Swystun	City of Prince Albert
Jonathon Miller	Sturgeon Lake First Nation
Lee Atkinson	City of Prince Albert
Louis Hradecki	Village of Albertville
Lyle Muller	Rural Municipality of Shellbrook No. 493
Mark Hawrylak	Domtar Pulp and Paper Products Incorporated
Matt Jurgens	Prince Albert Wildlife Federation
Morley Rudolph	Rural Municipality of Canwood No. 494
Murray Hidlebaugh	Saskatchewan Parks and Recreation Association
Murray Peterson	Prince Albert National Park
Norman Stolle	Prince Albert National Park
Orest Swystun	Rural Municipality of Lakeland No. 521
Ralph Hudson	Rural Municipality of Lakeland No. 521
Robert Strube	Rural Municipality of Shellbrook No. 493
Ron Reeves	Rural Municipality of Canwood No. 494

West Advisory Committee

Member	Organization
A.V. "Tony" Leeson	Town of St. Walburg
Albert Cholewa	Village of Paradise Hill
Annette Morin	Rural Municipality of Turtle River No. 469
Barry Mykytuk	Rural Municipality of Parkdale No. 498
Bert Faber	Husky Energy
Charles Bodnar	Rural Municipality of Mervin No. 499
Claus Young	Rural Municipality of Frenchman Butte No. 501
David Lundquist	Rural Municipality of Eldon No. 471
David Ollen	Northminster Irrigation District #20
Don Ferguson	Rural Municipality of Paynton No. 470
Ernie Jimmy	Thunderchild First Nation
Greg Donald	Rural Municipality of Eldon No. 471
Herb Flieger	City of Lloydminister
John Cameron	Turtle Lake Watershed Inc.
John Gebhardt	Rural Municipality of Wilton No. 472
John Hoegl	Northminster Irrigation District #20
Ken Baker	City of Lloydminister
Ken McConnell	Village of Edam
Larry Chambers	Lloydminister and District Fish & Game Association
Larry McDaid	Village of Edam
Laverna Star	Thunderchild First Nation
Lorne Topley	Lloydminister and District Fish & Game Association
Louis McCaffrey	Rural Municipality of Turtle River No. 469
Mae Trotzuk	Town of St. Walburg
Marvin Studer	Rural Municipality of Loon Lake No. 561
Merle Robinson	Turtle Lake Watershed Inc.
Rob Saunders	City of Lloydminister
Robert Perkins	Brightsand Lake Concerned Citizens Organization
Velma Foster	Rural Municipality of Paynton No. 470
Warren McKenzie	Rural Municipality of Britannia No. 502
Wayne L Burzinski	Lloydminister and District Fish & Game Association
Willie Thompson	Rural Municipality of Parkdale No. 498
Winston Hougham	Rural Municipality of Britannia No. 502

Technical Committee

Member	Organization
Bart Oegema	Saskatchewan Watershed Authority
Bill Henley	Saskatchewan Ministry of Agriculture
Brad Ashdown	Saskatchewan Watershed Authority
Brian Mathieson	Saskatchewan Ministry of Energy and Resources
Don Dill	Saskatchewan Watershed Authority
Doug Daniels	Saskatchewan Ministry of Municipal Affairs
Girma Sahlu	Environment Canada
Jennifer Nelson	Partners FOR the Saskatchewan River Basin
Jeremy Brown	Saskatchewan Watershed Authority
Jessica Clay	First Nations Agricultural Council of Saskatchewan
Joanne Sketchell	Saskatchewan Watershed Authority
Joel Brimacombe	Agriculture and Agri-Food Canada – Prairie Farm Rehabilitation Administration
John Durbin	Saskatchewan Watershed Authority
John Nanson	Saskatchewan Ministry of Municipal Affairs
John Thompson	Saskatchewan Ministry of Environment
Murray Koob	Saskatchewan Ministry of Environment
Nolan Shaheen	Saskatchewan Watershed Authority
Paul Holtcamp	Ducks Unlimited Canada
Richard Koroluk	Prairie North Health Region
Richard Zitta	Saskatchewan Ministry of Environment
Rick Stilling	Saskatchewan Ministry of Environment
Ross Herrington	Environment Canada
Sheldon Ofukany	Saskatchewan Watershed Authority
Tracey Leibel (Reiniger)	Saskatchewan Ministry of Highways and Infrastructure
Twyla Armstrong	Agriculture and Agri-Food Canada – Prairie Farm Rehabilitation Administration
Vince Harper	Fisheries and Oceans Canada

Planning Team

Brad Ashdown	Saskatchewan Watershed Authority
Collin McGuire	Saskatchewan Watershed Authority

B. Glossary of Terms

Aerobic – living or taking place only in the presence of oxygen.

Allocation – the amount of water assigned for use, out of the total amount that is available for use in a particular watershed or aquifer.

Anaerobic – living or taking place in the absence of oxygen.

Aquatic – consisting of, relating to or being in water; living or growing in, on or near water.

Aquifer – a geological unit which can yield water to a well in usable amounts.

Aquitard – a layer of low permeability which restricts or confines the flow of water.

Bank – the rising ground bordering a water body or watercourse that serves to confine the water to the channel or bed.

Base of Ground Water Exploration – a feature known as the base of ground water exploration was established for the initial provincial ground water maps and is shown on the cross section. Below the base of exploration, useable ground water is either not present or is at too great of a depth to warrant drilling for small users.

Bed – that portion of a water body or watercourse that is periodically or continuously covered by water.

Bedrock formations – rock deposited prior to glaciation. These layers are overlain by glacial deposits which consist of glacial till, sand and gravel.

Biodiversity (biological diversity) – the many and varied species of life forms on earth, including plants, animals, micro-organisms, the genes they possess and their habitats.

Boundary – the line or elevation contour surrounding a water body or watercourse where the aquatic vegetation and terrestrial plant species known to tolerate water saturated soils change entirely to terrestrial vegetation tolerating little or no soil saturation and includes a minimum surrounding area of five metres measured outward from the top of the bank.

Climate – meteorological elements (e.g. precipitation, temperature, radiation, wind, cloudiness) that characterize the average and extreme conditions of the atmosphere over long periods of time at a location or region of the earth's surface.

Climate change – an alteration in measured meteorological conditions that significantly differ from previous conditions and are seen to endure, bringing about corresponding changes in ecosystems and socio-economic activities.

Conservation – the preservation and renewal, when possible, of human and natural resources. The use, protection and improvement of natural resources according to principles that ensure their highest economic and social benefits.

Conservation easement – a legal agreement between a property owner and a conservation agency to restrict the type and amount of development on the owner's property.

Development – building, engineering, mining or other operations that alter or intensify the use of a resource.

Deleterious substance – any substance that is deleterious to fish, fish habitat, or to the use by man of fish that frequent that water. See the *Fisheries Act* for further details.

Discharge – the flow of surface water in a stream or ditch or the flow of ground water from a spring or flowing artesian well; the rate of flow.

Diversion – the removal of water from any waterbody, watercourse or aquifer (either for use or storage), including the removal of water for drainage purposes. Construction of any works required for the diversion of water need approval pursuant to section 50 of *The Saskatchewan Watershed Authority Act, 2005*. The total diversion is equal to the allocation plus any losses from evaporation or seepage.

Drainage – movement of water off land, either naturally or man-made.

Drought – generally in reference to periods of less than average or normal precipitation over a set time, sufficiently prolonged to cause serious hydrological imbalance that results in biological or economic losses.

Ecological – pertains to the relationship between living organisms and their environments.

Economic development – the process of using and converting resources into wealth, jobs and an enhanced quality of life.

Ecosystem – a dynamic complex of organisms (biota), including humans and their physical environment, that interacts as a functional unit in nature.

Effective drainage area – the area which is estimated to contribute runoff in at least half of the years.

Effluent – the treated wastewater discharged into the environment.

Facultative – bacteria that can live in a range of external conditions, including both aerobic and anaerobic conditions.

First Nation – an Indian band or an Indian community functioning as a band but not having official band status, not including Inuit or Métis peoples.

Glacial till (Till) – unsorted mixture of silt, clay and sand that were deposited from retreating glaciers.

Grazing management – activities that ensure stocking rates are appropriate to sustain long-term health of livestock grazing conditions during wet and dry seasons.

Gross drainage area – the area bounded by the height of land between adjacent watersheds.

Ground water – subsurface water usually in aquifers; water that occurs in voids or crevices of rock and soil.

Habitat – natural surroundings or native environment where a plant or animal grows and lives.

Headwater – small streams and lakes that are the sources of a river, located in the upper reaches of a watershed.

Hydro – from Greek hydor, meaning "water."

Hydrogeology – the science of subsurface waters and related geologic aspects.

Hydrology – the science of the waters of the earth, their occurrences, circulation and distribution on or below the earth's surface.

Intensive Livestock Operation (ILO) – production facilities such as feedlots and buildings where many animals are raised in a confined space that does not have naturally-growing vegetation and where waste accumulates if not removed (as defined by *The Agricultural Operations Act* in Saskatchewan).

Invasive species – non-native organisms that can invade and disturb natural ecosystems resulting in the displacement of the native species.

Land cover – predominant vegetation on the surface of a parcel of land.

Land use – present use of a given area of land.

Leachate – a liquid that has percolated through or out of another substance such as soil or refuse, and may contain nutrients or contaminants.

Median – a value in a sorted range of values by which there is the same number of values above it as there is below it. A statistical term used in non-parametric statistics.

Monitoring – testing or sampling, especially on a regular or ongoing basis.

Native prairie – age-old plant communities of the prairie and parkland regions that may contain more than 200 types of grasses, flowers and shrubs (native grassland and parkland aquatic and terrestrial habitats).

Non-point source pollution – single or multiple contaminants of unknown origin that enter waterways, degrading water quality.

Noxious weed – undesirable plants that can cause physical or economic damage.

Partnership – co-operative, collaborative alliance between/among stakeholders in a non-legal arrangement used to improve and build relationships and achieve common goals.

Permeability– the rate or flow of a liquid or a gas through a porous material such as soil or rock.

Point source contamination – a static and easily identifiable source of air, soil or water pollution.

Riparian – an area of land adjacent to or connected with a stream, river, lake or wetland that contains vegetation that is distinctly different from vegetation of adjacent upland areas.

Riparian areas – the zone of vegetation alongside waterways and other surface water. Lush and diverse vegetation is the best sign of healthy, well-managed riparian areas and is critical to filtering and slowing runoff.

River basin – an area that contributes to form a watershed. (See Watershed)

Sewage – the waste and wastewater from residential or commercial establishments that are normally discharged into sewers.

Sewage lagoon – a shallow pond where sunlight, bacterial action and oxygen work to purify wastewater; also used for storage of wastewater.

Source water protection – the prevention of pollution and the sound management of factors and activities that (may) threaten water quality and quantity of lakes, reservoirs, rivers, streams and ground water.

Stakeholder – individual or group with direct or indirect interest in issues or situations, usually involved in understanding and helping resolve or improve their situations.

Stewardship – judicious care and responsibility by individuals or institutions for reducing their impacts on the natural environment.

Upstream petroleum industry – everything that occurs before the product reaches the refinery. This includes all wells and facilities, including oil and gas production sites, pipelines, flowlines and associated equipment, satellites, batteries, metering stations, compressor stations, pump stations, truck unloading stations and gas plants.

Water quality – the chemical, physical and biological characteristics of water with respect to its suitability for a specific use.

Watershed – an elevated boundary contained by its drainage divide and subject to surface and subsurface drainage under gravity to the ocean or interior lakes.

Watershed health – the desired maintenance over time of biological diversity, biotic integrity and ecological processes of a watershed.

Watershed and aquifer management – a process within the geographic confines of a watershed or aquifer that facilitates planning, directing, monitoring and evaluating activities to ensure sustainable, reliable, safe and clean water supplies.

Watershed and aquifer planning – a process, within the geographic confines of a watershed or aquifer and with the participation of stakeholders, to develop plans to manage and protect water resources.

Wetland – an area of low-lying land covered by water, often enough to support aquatic plants and wildlife for part of the life cycle. The wetland area includes the wet basin and adjacent upland.

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