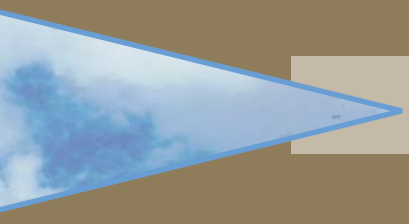
Saskatchewan Environment

Saskatchewan

# State of the Environment Report 2005



# Acknowledgements

We acknowledge the substantial contributions of many individuals who helped in the content development and review of the 2005 Saskatchewan State of the Environment Report. Saskatchewan Environment appreciates the generous contributions of time, expertise and information that have gone into the development of this report.

In particular, Saskatchewan Environment would like to thank staff of the Saskatchewan Watershed Authority for sharing data and expertise in interpreting several indicators, as well as information on the overall use and application of environmental indicators.

The following federal and provincial departments and Crowns were instrumental in guiding the development of indicators:

Agriculture and Agri-Food Canada - Prairie Farm Rehabilitation Administration
Environment Canada
Saskatchewan Agriculture, Food and Rural Revitalization
Saskatchewan Industry and Resources
Saskatchewan Research Council
SaskPower

Thanks also to consultants Shelley Ross and Rob Warnock and also to the Conservation Data Centre, J. Pepper and J. Knelson for their photo contributions.

Saskatchewan Environment staff in every division contributed time and effort towards the completion of the report and their efforts are also appreciated.

# Letter of Transmittal

April 2005

Dear Reader:

In this, Saskatchewan's centennial year, I am pleased to introduce the province's new State of the Environment Report. This report features a new approach, using environmental indicators to measure the health and state of key components of the provincial environment.

Indicators will help improve environmental reporting in several ways. By focusing attention on a single or few critical elements, indicators will help improve communication and understanding of Saskatchewan's environmental health. They will provide insight to help define environmental management goals and to measure progress toward those goals. They can also be used to draw comparisons among different geographical areas and to provide direction to the targeting of programs and services.

This first indicator-based report marks an important step in improving understanding of the provincial environment. In doing so the report focuses on four key functions: 1) briefly describing what we know, and don't know, about the current state of the environment at the provincial level; 2) tracking how the environment is changing over time; 3) providing an overview of why it is important and some of the steps being taken to address the issue; and 4) defining the challenges to improving environmental monitoring and measures for the future.

The indicators used in future State of the Environment reports will evolve by being revised, added to, or removed as we learn more about the environment and how to best use indicators to reflect its condition. Important next steps include working closely with other government departments, industry, First Nations, academia, local government, non-governmental organizations and the private sector to further develop a more integrated system of monitoring and reporting on environmental indicators. Your thoughts and ideas are important to improving the State of the Environment Report, so please take a moment to fill out the survey on page 61. By working together to improve our indicators and our understanding of the environment, we will all be able to make better decisions on how to best take action to keep our environment healthy and productive for the next provincial centennial.

Sincerely,

David Forbes
Minister
Saskatchewan Environment

Saskatchewan Centennial 2005™

# Executive Summary

The purpose of the State of the Environment (SOE) Report is to inform the public of the overall condition of the environment. This eighth report reflects a new approach to Saskatchewan's SOE reporting by using indicators to help improve our understanding of the complex relationships within the environment and our ability to communicate on its condition.

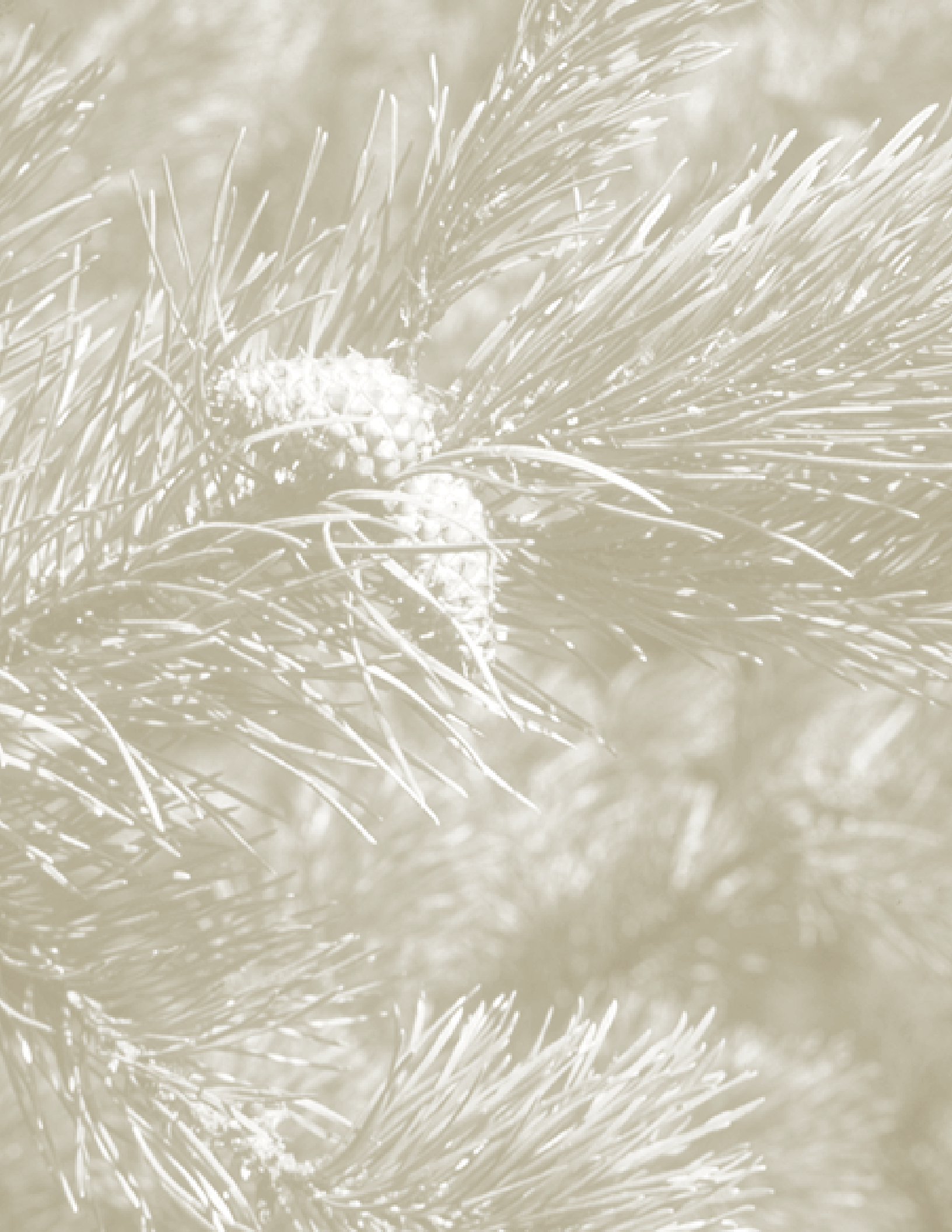
The indicators selected for this report provide a starting point to begin reporting on environmental health using an indicator-based approach. Environmental indicators and the research and data to support them are under development in many areas of government. As more research and data become available and the use of indicators is refined, the choice of indicators used in SOE reporting will evolve.

A number of indicators were selected that fall into three broad categories: Stress Indicators, Condition Indicators, and Response Indicators. Stress indicators measure human activities that produce stresses on the environment. An example used in this report is water consumption. Condition indicators measure the environmental state of something at any one or more points in time. Examples used in this report include greenhouse gas emissions and water quality. Response indicators measure programs or activities implemented to improve the state of the environment. Examples used in this report include recycling initiatives and forest renewal programs.

Overall, the indicators show that the state of the environment in the province is generally good and well served by existing environmental programs. However, the report is consistent with observations in other jurisdictions that environmental issues appear to be changing. The sources of impact on the environment are often more wide-spread across the landscape, such as the invasion of exotic species. Others result from a large number of individual actions, such as habitat fragmentation. Still others cross provincial or national boundaries, such as climate change.

The specific areas examined show water consumption appears to be decreasing across the province. The population of the province has changed little, although shifts are occurring within the province as more people move to the cities. Greenhouse gas emissions are of concern here as they are elsewhere in Canada. Non-renewable resource activity is increasing, particularly mining and oil and gas sectors, although they are highly regulated to minimize impacts. Water quality and quantity are generally good with some areas needing additional attention. Permanent cover has increased dramatically in the south which is benefiting both biodiversity and greenhouse gas emissions. Invasive exotic species remain a concern, as demonstrated by the rapid spread of Dutch elm disease. Perhaps the most positive aspect of the report is the stewardship commitment of Saskatchewan residents, which shows high levels of recycling and participation in conservation programs. Organic farming also continues to grow. Forest harvesting areas are being replanted and better managed through environmental assessments and 20-year forest management plans.

We look forward to the further evolution of indicator reporting and its use in reporting to the public on the state of Saskatchewan's environment.



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# Introduction

This State of the Environment (SOE) report marks a significant change in the approach to reporting on environmental health. As with past reports, this SOE report is provided to inform the public about the overall condition of the province's natural environment. Past reports included a significant portion of descriptive information about Saskatchewan's natural environment. This report is different from the seven previous SOE reports in that it uses representative indicators as a means of evaluating how complex natural systems are functioning. This approach is a growing trend in environmental reporting. The indicator format provides an opportunity for greater understanding of what is happening in our environment in a concise format.

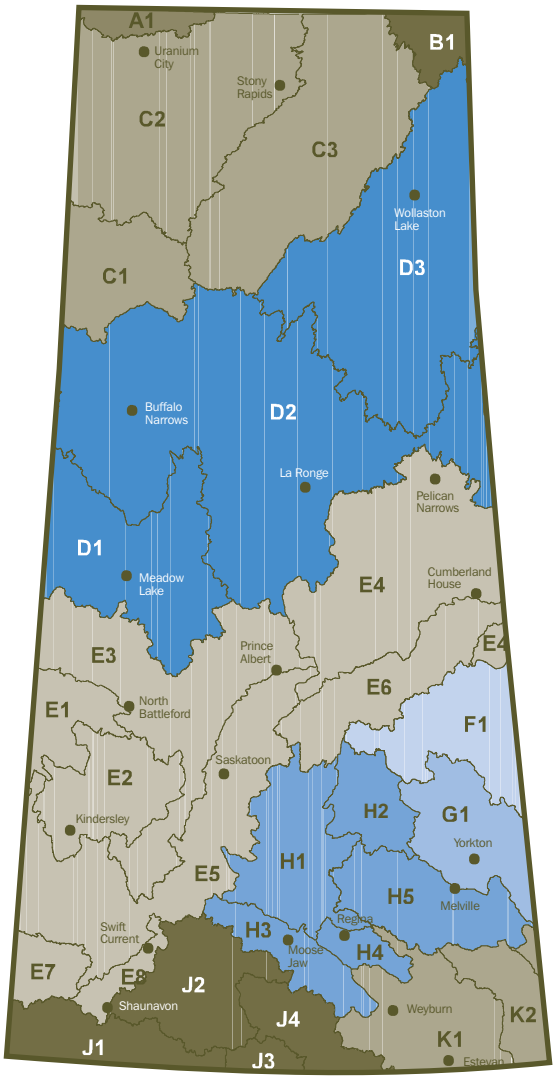
Environmental indicators and the data collection to support them are under development in many areas of government. As data becomes available and the use of indicators is refined, the choice of indicators used in SOE reporting will evolve. It should be expected that in future SOE reports, new indicators will be added, some indicators may be set aside for a time and others will be replaced permanently.

The report looks at 10 different components of the environment, each with one to three indicators that help give better insight on what is going on within the sector. The interpretation of trend data of the indicators provides a more in-depth consideration of the components themselves.

The public, government and industry can use this, and future Saskatchewan SOE reports, as a means of tracking how certain components of the environment are doing. Individuals can learn how to positively impact environmental health and watch for improved monitoring, accountability and change as the actions described in the report are implemented.

Indicator information can be applied to different spatial areas and contexts. In this report, the spatial units used are either the province as a whole, ecozones and ecoregions (see Ecoregions of Saskatchewan map) or watersheds (see Watersheds and Major Basins of Saskatchewan map). In using watersheds, it may appear that the focus of reporting is completely on water, but watersheds describe areas of land that contain streams and rivers all of which drain into a single larger body of water, such as a larger river, a lake or an ocean. Homes, farms, small towns and big cities are all found in watersheds. Watersheds cross municipal, provincial and even international borders and come in all shapes and sizes. Some are millions of square kilometers in size; others are just a few hectares. No matter where you are, you're in a watershed! By using the spatial context of watersheds, the important link between land and water is emphasized.

## Watersheds and Major Basins of Saskatchewan




Source: Saskatchewan Watershed Authority, n.d.

## Ecoregions of Saskatchewan


Source: Padbury and Acton, 1994.

**Legend - Watersheds and Major Basins**

Slave River Basiin
A1 - Tazin River

Kazaa River Basin
B1 - Kasba Lake

Athabasca River Basin
C1 - Athabasca River
C2 - Lake Athabasca
C3 - Black Lake

Churchill River Basin
D1 - Beaver River
D2 - Churchill River
D3 - Reindeer River/Wollaston Lake

Saskatchewan River Basin
E1 - Battle River
E2 - Eagle Creek
E3 - North Saskatchewan River
E4 - Saskatchewan River
E5 - South Saskatchewan River
E6 - Carrot River
E7 - Cypress Hills North Slope
E8 - Swift Current Creek

Lake Winnipeg Basin
F1 - Lake Winnipegosis

Assiniboine River Basin
G1 - Assiniboine River

Qu'Appelle River Basin
H1 - Upper Qu'Appelle River
H2 - Quill Lakes
H3 - Moose Jaw River
H4 - Wascana Creek
H5 - Lower Qu'Appelle River

Milk River Basin
J1 - Milk River
J2 - Old Wives Lake
J3 - Poplar River
J4 - Big Muddy Creek

Souris River Basin
K1 - Upper Souris River
K2 - Lower Souris River

## What is an Indicator?

Environmental indicators are measurements that can be used to simplify, describe, monitor and interpret change. Indicators do not provide us with all the details on a particular topic, but they do give us key information that can show how things in the environment are doing. Environmental indicators are like more common indicators that we use regularly. For instance, blood pressure and body temperature readings are indicators of more complicated processes within our bodies. Elevated rates are cause for concern and indicate that we need to do more checking to identify the problem. Information provided by environmental indicators works in the same way. They signal that there maybe a problem that requires further investigation and help us to make better decisions.

Environmental indicators can tell us what is going on in the environment. Indicators help to measure ecological integrity and assess complex ecosystem processes, structure and function that may be too difficult to measure or clearly understand. Indicators can show trends, measure progress, and identify problems. They are not, however, designed to provide explanations or draw conclusions about cause and effect.

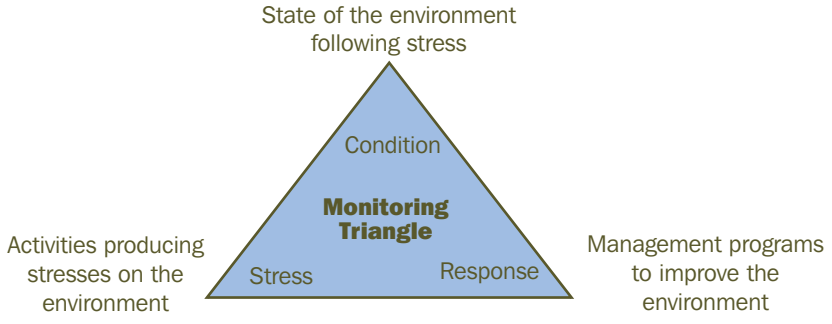
There are literally thousands of potential indicators that could be considered. The indicators used in this report have a number of key features. They:

- Quantify information, making its significance more apparent.
- Simplify information about complex ecosystem functions to improve understanding and communication between the public and decision-makers.
- Are cost-effective and accurate, providing an alternative to monitoring infinite individual processes.
- Have been implemented within time frames for State of the Environment reporting.
- Assess environmental health in terms of stress, condition, or agency response.
- Match the scale of the phenomenon being measured.
- Contain data that allows comparison through time as well as space.

The stress-condition-response model (S-C-R) is used in this report to categorize each of the indicators (see Stress-Condition-Response Model).

- *Stress* indicators measure activities that can negatively influence the condition of the environment.
- *Condition* indicators are used to illustrate the environmental state at any point in time or as a trend.
- *Response* indicators represent the management programs and planning activities implemented to improve the state of the environment.

**Stress-Condition-Response Model**




This first indicator-based Saskatchewan SOE report is an important departure from the more generalized environmental reporting format used in past SOE reports. It is a step towards measuring and reporting on the province's environmental health. Improved monitoring of the environment, information sharing and refined analysis of data will bring about improvements to the use and application of indicators in future SOE reports. Feedback from readers of the document will also help to shape, refine and improve future SOE reports.

The stress-condition-response model is used to categorize each of the indicators in the report. At the beginning of each indicator section, the monitoring triangle is used to highlight whether the indicator measures the stress to, the condition of, or response to, environmental health.

**An example of how the Stress-Condition-Response model works:** Cattle grazing in an environmentally sensitive area, such as the shoreline of a river system, may cause *stress* on the environment. This stress can change the *condition* of the environment. Addressing this stress with altered management practices would be the *response*. To monitor the situation, cattle grazing could be assessed by tracking the number of animals grazing within the sensitive area over a designated time period, or more simply by noting whether an area is grazed or not. Similarly, vegetation could be assessed and tracked through various measurements of composition and structure to assess the condition. Noting any improvements to condition, based on changed management practices, could affect the response.

1

# Water Quality and Quantity

**Present State**

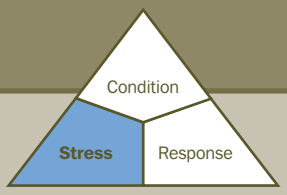
Saskatchewan is fortunate to have an abundant supply of fresh water. The province holds almost seven per cent of the fresh water in Canada or nearly 1.5 per cent of all the freshwater in the world. However, Saskatchewan's water supplies range from plentiful in much of the north to limited in some southwestern watersheds (Saskatchewan Watershed Authority, 2004).

Saskatchewan residents rely on water for virtually all aspects of their daily lives, from drinking and domestic uses to support in agriculture, industry, and recreation. Human consumption and recent droughts have had a noticeable affect on surface water supply from the Rocky Mountains and ground water in shallow aquifers. Balancing the water consumption with the natural supply is the key to sustaining this abundant resource in Saskatchewan.

**Issue**

Water management ensures that the right amount of water is available when and where it is needed. Managing water is a complex science of balancing today's needs against the projected needs of tomorrow. As everyday users of water, Saskatchewan residents must be aware, involved and committed to water conservation and stewardship to safeguard this critical resource.

The issues of water quality and quantity are integrally linked. Conserving water helps to preserve water quality because instead of requiring water treatment after use, it remains in the natural system. In turn, conserved water reduces the costs associated with municipal pumping and treatment, freeing up monies for infrastructure renewal or replacement and protection of supply sources. With less wastewater entering the sewage treatment plant, the treatment becomes more effective because it is dealing with less contaminant at lower concentrations (Environment Canada, n.d.).




# Indicator of Water Quantity: **Measured by Water Consumption**

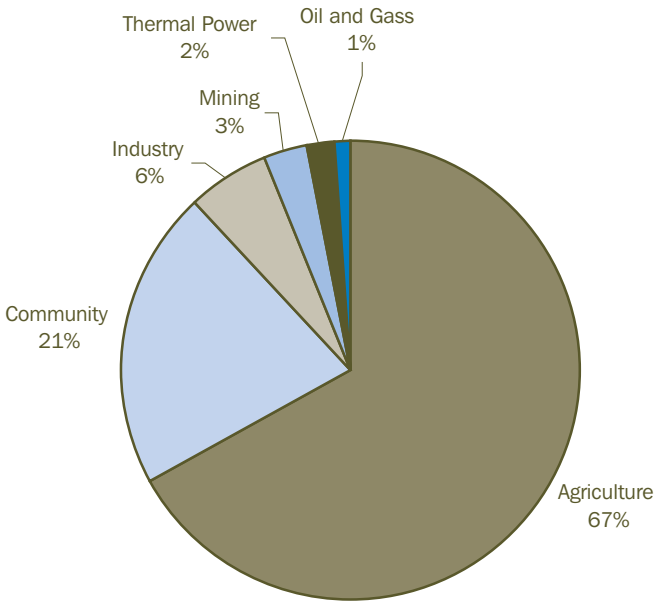
## Importance

Canadians are the second highest water users in the world. While the high water use reflects aspects of our economy, it also shows that there is significant potential to conserve water. Canadians, at least in urban centres, use much more water for domestic purposes than most developed countries. The average urban Canadian uses 343 litres per capita per day residentially. In Saskatchewan, average residential daily per capita use was 293 litres per day in 2003. When considering all community uses (commercial, recreational and industrial systems found within a municipality) the average use for 2003 was 375 litres per capita per day (Saskatchewan Watershed Authority, 2004). Water is essential to Saskatchewan residents for agriculture (irrigation, livestock), power generation (hydroelectric, cooling), mining, oil and gas production, municipal and domestic use.

Water availability varies significantly in Saskatchewan. In the north, where human population is low and precipitation is higher than the south, water supplies are generally abundant. In drier southwestern watersheds no new surface water allocations are being made due to supply constraints. On a smaller scale, water supplies can vary significantly within watersheds. In areas where there is a high water demand and low supply, conservation measures are more widely accepted than in areas of relative water abundance. Water conservation, regardless of location and water abundance, benefits the ecosystem, quality of life and the economy (Saskatchewan Watershed Authority, 2004).

## Status and Trends

**Figure 1.1. Freshwater Withdrawals in Saskatchewan by Sector**
*Source: Saskatchewan Watershed Authority, 2004.*



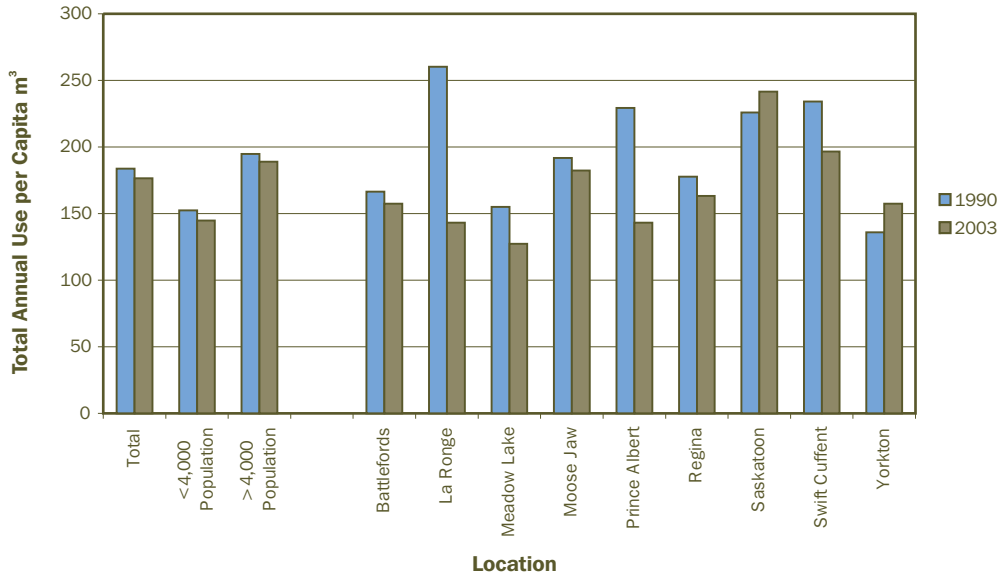

Note: When considering water use by sector, it is important to keep in perspective that generally the intensity of water use is low in Saskatchewan, meaning that water supply by far exceeds water use.

**Table 1.1. Surface Water Availability in Saskatchewan by Major Basin (million cubic metres)**
*Source: Saskatchewan Watershed Authority, 2004.*

| River Basin | Allocation[1] | Losses[2] | Supply[3] | Intensity Use[4] |
|---|---|---|---|---|
| Souris | 32.5 | 55.9 | 182 | 0.18 |
| Missouri | 74.0 | 25.3 | 131 | 0.56 |
| Cypress Hills | 27.1 | 6.0 | n/a | n/a |
| Old Wives | 73.7 | 41.5 | n/a | n/a |
| Qu'Appelle | *56.6 | 145.0 | 123 | 0.46 |
| South Saskatchewan | 1,187.9 | 72.1 | 5,340 | 0.22 |
| North Saskatchewan | 142.2 | 86.1 | 7,390 | 0.02 |
| Saskatchewan | 23.8 | 388.5 | 15,100 | < 0.01 |
| Assiniboine | 3.5 | 23.4 | 144 | 0.02 |
| Lake Winnipegosis | 3.4 | 33.5 | 825 | < 0.01 |
| Churchill | 13.3 | 157.2 | 21,300 | < 0.01 |
| Athabasca | 4.1 | 0.3 | 20,000 | < 0.01 |

[1]Domestic water use not officially allocated. Diversion (licensed amount) = Allocation + Losses
[2]Primarily reservoir losses
[3]Estimated Median Annual Flow
[4]Ratio of allocation/supply
*water diverted from the South Saskatchewan River makes up the difference between the water losses and supply in the Qu'Appelle.

**Figure 1.2. Per Capita Water Use in Some Saskatchewan Communities, 1990 and 2003**
*Source: Saskatchewan Watershed Authority.*



**What You Can Do**

- Reduce the amount of water you use, either by eliminating wasteful practices and habits, or by improving the efficiency of water using fixtures and devices.
- Nearly 65 per cent of household water use occurs in the bathroom, which makes it a good place to start reducing water consumption. Try retrofitting fixtures with water conserving models (A five-minute shower with a standard showerhead uses 100 litres of water. A five-minute shower with a low-flow showerhead uses only 35 litres of water).
- Plant drought tolerant plants on your property to reduce the need for watering. During the summer, about half of all treated water is sprayed onto lawns and gardens.
- Whether watering domestic gardens or agricultural crops, choose irrigation methods that minimize water loss.

**Interpretation**

Table 1.1 provides an indication of the supply and intensity of use of water in the province's major drainage basins. In general, supplies are good, and are very large in more northern basins, compared to water use. However, flows in our major rivers can fluctuate significantly between wet and dry years. In years of less than median flow, intensity of use is higher. When considering the water use by sector in Figure 1.1, it is important to keep in perspective that generally, the intensity of water use is low in Saskatchewan, meaning that water supply by far exceeds water use.

Measured water-use data for Saskatchewan communities highlights several apparent trends (Figure 1.2). Overall, community water use per capita dropped between 1990 and 2003, indicating that Saskatchewan residents are willing to implement water conservation measures. La Ronge shows the largest drop in water use per capita. This might partially be attributed to poor census data in 1990, which estimated the town's population as lower than actual. Per capita water use in larger communities declined significantly during the 1990s but shows an increasing per capita use since 2000. Saskatoon had consistently high water use relative to other communities and the provincial average.

Agriculture is by far the single largest user of water in the province, with community use second (Figure 1.1). These two sectors consume almost 90 per cent of the fresh water used in the province. Conservation efforts in the agricultural and community sectors will have the most influence on the overall success of water conservation efforts in the province (Saskatchewan Watershed Authority, 2004).

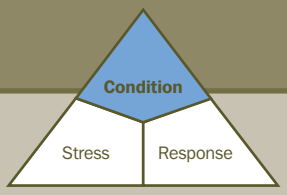
The major water use by agriculture is for irrigation. Irrigation is used on about 137,000 hectares of land in Saskatchewan. Water withdrawals are metered on some irrigation projects, but not on others. The province maintains data on water allocations, irrigated areas and type of irrigation, which allows for water diversion estimates. About 550 million cubic metres of water, or two-thirds of total water withdrawals in the province, are diverted for irrigation. Demand for irrigation is expected to grow both because it significantly increases output per hectare of land and because it provides more economic stability for farmers and farm communities (Saskatchewan Watershed Authority, 2004). Water consumption by large livestock operations is also a significant water use and is expected to increase in the future (Saskatchewan Watershed Authority, 2004).

**Actions**

- The Canadian Water Resources Association (Saskatchewan Branch), Saskatchewan Watershed Authority and Saskatchewan Education manage a partnership to deliver Project WET in Saskatchewan. The program is designed and targeted at school-aged children and addresses a variety of water-related topics, including water use.
- The Canada-Saskatchewan Irrigation Diversification Centre (CSIDC) promotes crop diversification and sustainable irrigation practices to Saskatchewan producers and industry. Through market-driven research and demonstration projects, CSIDC responds to farmer and industry needs to improve the sustainability and profitability of farms (www.agr.gc.ca).
- Irrigation development and operation is administered by Saskatchewan Agriculture, Food and Rural Revitalization (SAFRR) through *The Irrigation Act, 1996*. The act states that all individuals wishing to develop a new irrigation project must obtain an Irrigation Certificate, which confirms that the land to be developed is suitable for irrigation from a specified water source (www.agr.gov.sk.ca/docs/crops/irrigation/IrrigationCert04.pdf).
- Licensing for irrigation is a compulsory requirement from the Saskatchewan Watershed Authority. Individuals interested in establishing irrigation practices on their land must first contact SAFRR for guidance through the process. Saskatchewan Agriculture, Food and Rural Revitalization assists by ensuring the appropriate licenses, irrigation flow rates and design for the proposed irrigation system.
- Saskatchewan Watershed Authority consultations are underway to develop a Saskatchewan Water Conservation Plan.

**Related Indicators**

Saskatchewan Water Quality Index (Page 9)
Aquifer Levels (Page 13)




# Indicator of Water Quality:
# Measured by Saskatchewan Water Quality Index

## Importance

The protection and monitoring of source water quality is necessary to provide safe drinking water, healthy aquatic habitat for wildlife, irrigation water for agriculture and livestock and unpolluted lakes and rivers for recreation.

Surface water monitoring in Saskatchewan is conducted and evaluated using the Saskatchewan Water Quality Index (SWQI). The SWQI combines lab and field analysis results for a variety of chemicals and organisms including fecal coliforms, dissolved oxygen, toxic metals, and pesticides and compares them to water quality guidelines. The index summarizes large amounts of water quality data into a single measure. It is used to indicate whether the quality of water at a particular site is suitable for desired uses.

The index can be used to convey relative differences in water quality between sites (spatial comparison) or over time (temporal comparison).

At this time, the index evaluates water quality in four categories:
1. Protection of Aquatic Life
2. Irrigation
3. Livestock Watering
4. Recreation

(Saskatchewan Environment, 2004).

The SWQI identifies risks to source water quality. This is the first step in developing strategies and actions for water protection. The index provides a simple numerical value, which indicates the quality of surface water for the intended use. Numerical values indicating water quality range as follows: excellent (95-100), good (80-94), fair (65-79), marginal (45-64) and poor (0-44).

## Status and Trends

**Figure 1.3. Saskatchewan Water Quality Index (SWQI) - Protection of Aquatic Life - for the South Saskatchewan River, 1990-2000**

*Source: Saskatchewan Environment.*

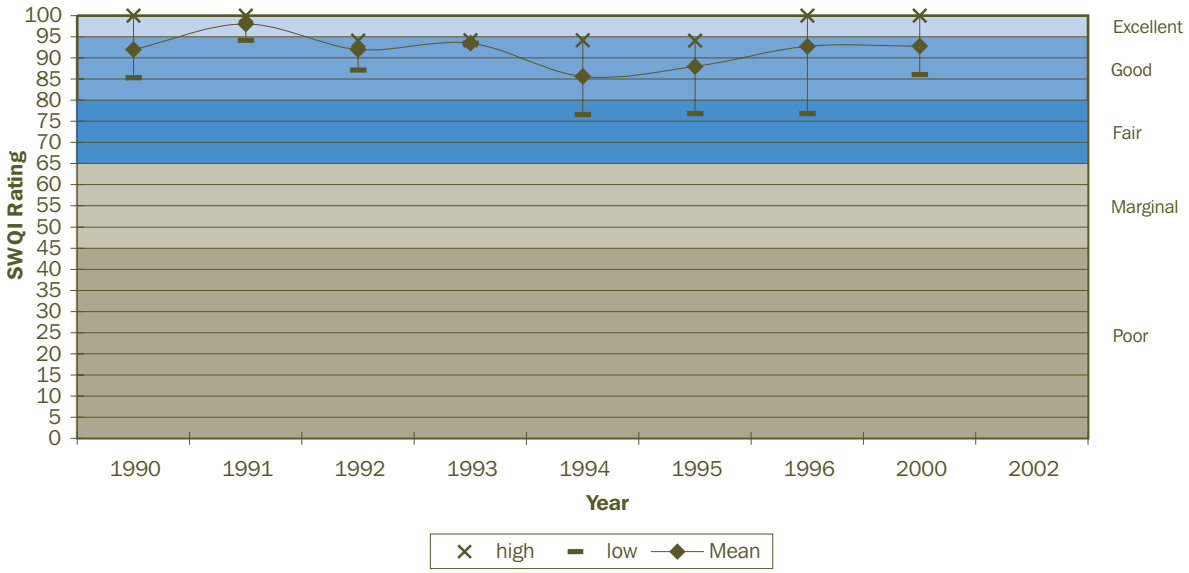


**Figure 1.4. Saskatchewan Water Quality Index (SWQI) - Protection of Aquatic Life - for the North Saskatchewan River, 1990-2002**

*Source: Saskatchewan Environment.*

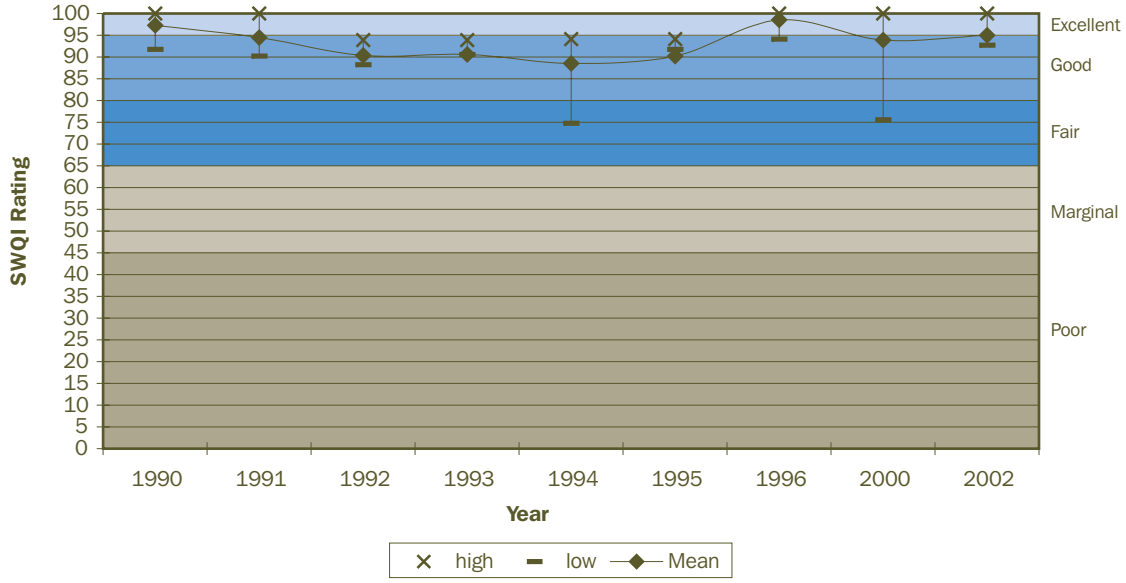



**Figure 1.5. Saskatchewan Water Quality Index (SWQI) - Protection of Aquatic Life - for the Qu'Appelle River, 1990-2002**

*Source: Saskatchewan Environment.*

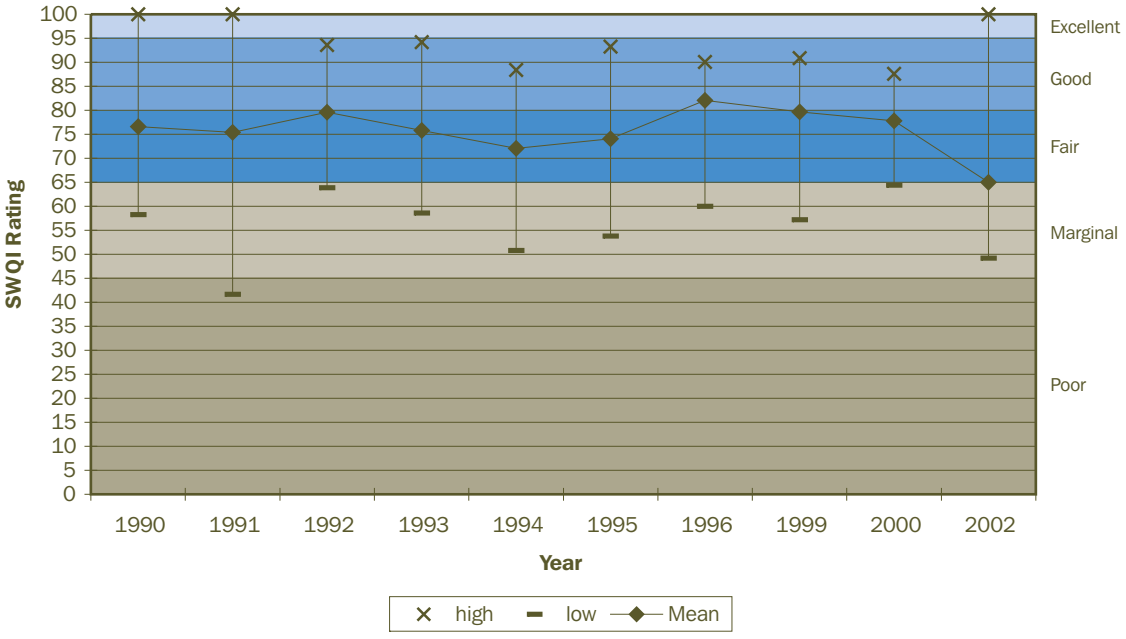
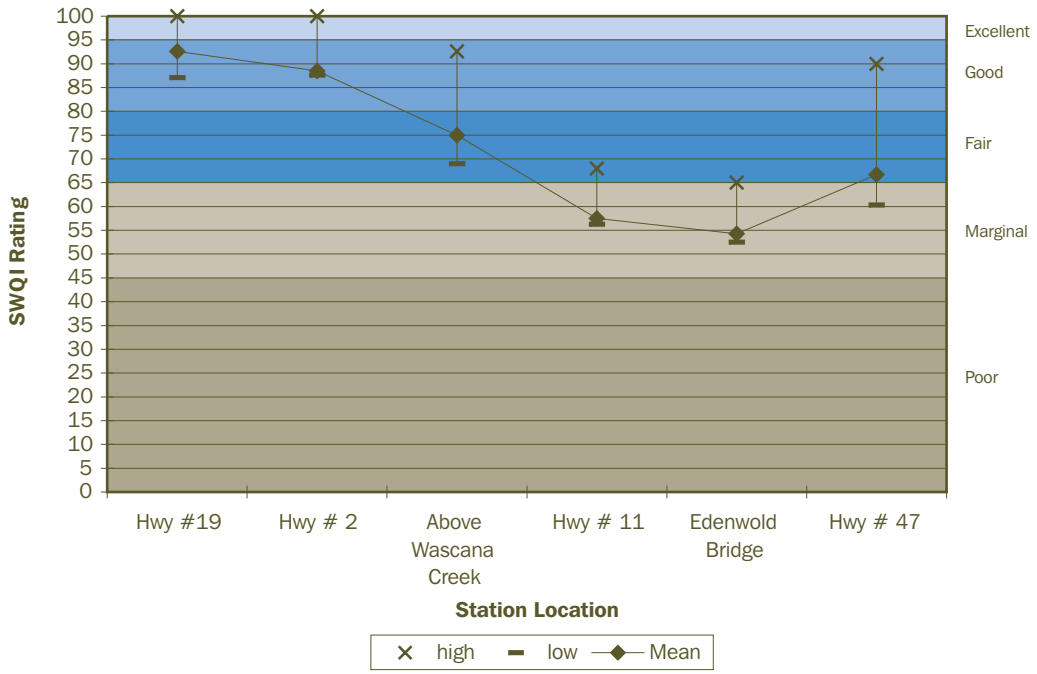


**Figure 1.6. Saskatchewan Water Quality Index (SWQI) - Protection of Aquatic Life - Along the Qu'Appelle River, 2002**
*Source: Saskatchewan Environment.*




**Interpretation**

As stated previously, the SWQI evaluates water quality in four categories: protection of aquatic life, irrigation, livestock watering and recreation (Saskatchewan Environment, 2004). The "protection of aquatic life" category of the SWQI measures a wide range of parameters that are necessary to support fish, insect and plant life. In order to simplify the presentation of water quality information for this report, only this category of the index is presented. The protection of aquatic life category is more stringent than those applicable to other water uses. This is because aquatic organisms undergo most, if not all, of their life functions while exposed to the constituents in the water. If the most sensitive use is protected, we assume that all other less-sensitive uses will also be protected. If the water quality should deteriorate, the impact of this would be expected to show up in aquatic life first. The SWQI for the protection of aquatic life was applied to the three major rivers in Saskatchewan. The graphs show SWQI average, minimum and maximum for the length of each river for each of the years represented.

The evaluation of SWQI ratings for the protection of aquatic life category over a period of 12 years for the North Saskatchewan River (1990-2002) and 10 years for the South Saskatchewan River (1990-2000) show typical seasonal variation and generally good water quality. The water quality was assessed as being "good" to "excellent" on both the South and North Saskatchewan rivers (Figures 1.3 and 1.4 respectively). These ratings indicate that these aquatic systems are not being significantly impaired over the time period that data was available.

The Qu'Appelle River SWQI ratings for the protection of aquatic life was assessed as being "fair" to "good," but ranges from "marginal" to "excellent" (Figure 1.5) over a 12-year period (1990-2002). The higher level of variability for the SWQI on the Qu'Appelle River warrented the inclusion of a more detailed graph of index readings along the course of the river. When comparing the ratings spatially on the Qu'Appelle River (Figure 1.6) large changes can be seen from the headwaters at Highway #19 to the stations just below the cities of Moose Jaw (station Above Wascana Creek), and Regina (stations at Highway #11 and Edenwold Bridge). The index represents a decrease in the quality of water for the protection of aquatic life at these sites. It is important to note that the quality of the water in the Qu'Appelle improves further downstream. The SWQI rating in the Qu'Appelle River watershed is expected to improve as a result of enhanced effluent treatment for the City of Regina and other long-term watershed planning efforts led by Saskatchewan Watershed Authority.

**What You Can Do**

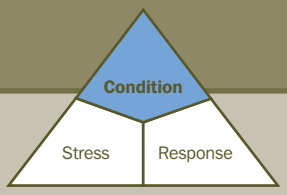
- Safely dispose of hazardous products, out-dated drugs or used oil. Do not dump them down the drain, toilet or a storm sewer.
- Set up a rain barrel to catch extra water for watering the garden.
- Use environmentally friendly cleaning products.

**Actions**

- Watershed planning has been initiated for seven watersheds in the province (Qu'Appelle, South Saskatchewan, North Saskatchewan, Souris, Assiniboine, Beaver, Churchill).
- There were 514 inspections of sewage works performed by Saskatchewan Environment during 2004 to identify risks to source waters.
- The assessment of all Saskatchewan major surface waters is a long-term project. Preliminary discussions are underway with the federal government to enter into a water monitoring network agreement.
- Saskatchewan Environment is working with the City of Regina to ensure that an enhanced effluent treatment facility is constructed to improve the quality of water downstream of Regina.

**Related Indicators**

Water Consumption (Page 6)
Aquifer Levels (Page 13)




# Indicator of Water Quantity: **Aquifer Levels**

**Importance**

Groundwater occurs everywhere beneath the earth's surface. Useable supplies of groundwater occur in aquifers. Aquifers are saturated geological units that are permeable enough to yield economic quantities of water to wells. An aquifer may be a layer of gravel or sand, a layer of sandstone or even a large body of massive rock, such as fractured granite, with small openings. In terms of storage, groundwater is the largest single supply of fresh water available. Groundwater is a renewable resource, but it is not unlimited. Recharge to aquifers at the surface and at shallow depths is limited due to the semi-arid climate of the province. Replenishment to the deeper aquifers is limited because of the variable permeability of tills and clays, which separate aquifers.

Groundwater is fed by precipitation, but depending on use patterns, local climate and geology, use may exceed the speed at which an aquifer is replenished, resulting in the decline of water levels. Evaluating groundwater aquifers is important to ensure the long-term quality and quantity of Saskatchewan's water supplies because much of our water comes from aquifers. Uses include domestic potable water, industry and agriculture.

Currently, there are 72 active observation wells located throughout Saskatchewan. Of the 72 wells, 54 are monitored by the Saskatchewan Research Council (SRC) and 18 by the Saskatchewan Watershed Authority (SWA). The observation well network was initially established in 1964 by the SRC. The majority of the observation wells were constructed between 1964 and 1970. The objective of the network was to measure natural fluctuations in groundwater levels in areas that are remote from influences of groundwater production and artificial recharge. In 1988, SWA began to monitor wells located in areas affected by pumping. The network provides long-term information on the impacts of withdrawals from aquifers located throughout Saskatchewan. As of April 1, 2005, all observation wells in the network will be operated by SWA.

**Status and Trends**

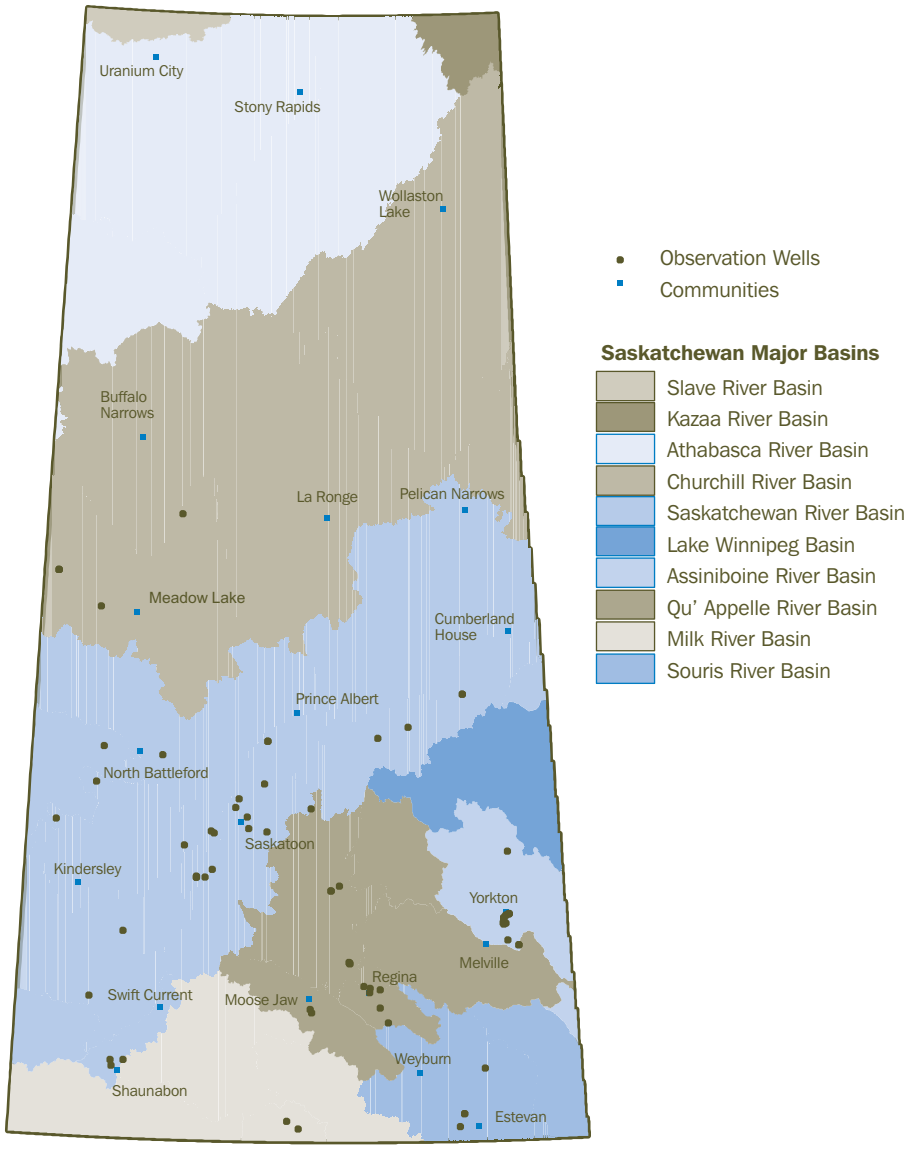
At any point in time an aquifer water level reflects seasonal fluctuations superimposed on long-term trends. Within the seasonal fluctuations are shorter-term water level changes, for example, those caused by changes in barometric pressure. Human influences such as those due to pumping and artificial recharge (*e.g.,* injection wells, reservoirs, canals), and changes in land use, are again superimposed on these natural fluctuations and in some cases may mask the shorter-term changes.

Basically, three types of trends are possible:

- When the water-level trend is rising, it means that the input to the system is greater than the output, the storage in the hydrologic system is increasing and the discharge from the system is increasing.
- When the water-level trend is downward, it means that the input is less than the output, the storage in the hydrologic system is decreasing, and the discharge from the system is decreasing.
- When the water-level trend is horizontal, it means that the input to the system is equal to the output, the input is greater than zero, the storage is constant, and the discharge from the system is constant.

The complexity of data in some cases may require detailed examination and statistical analysis before conclusions can be reached. Figure 1.7 shows the locations of the 72 wells within the monitoring network and provides an initial assessment, which differentiates wells that may show some degree of decline. This provides an initial scan and further statistical analysis would be required to determine the significance of any apparent changes. The results of any single well record cannot be used to draw general conclusions about the status of regional groundwater resources, or water use in that region. Furthermore, the number of monitoring wells in Saskatchewan is relatively low and their distribution is patchy. While most of Saskatchewan's aquifers have been mapped, little is known about potential well yields and water quality.

**Figure 1.7. Observation Well Network Locations on Saskatchewan Water Basin Map**
Note: Due to the proximity of some well sites, not all of them can be illustrated.
*Source: Saskatchewan Watershed Authority, Saskatchewan Research Council.*




## Interpretation

Aquifer water elevations are determined by a number of factors including aquifer depth, hydrogeology, weather, climate and the extent of human use. Also, landscape change (e.g., wetland drainage) has the potential to change recharge rates. Water level fluctuations in shallow aquifers tend to be greater than in deep aquifers.

The interpretation of long-term aquifer water level data assessed two main components: the repeating annual scale variability in water level (seasonal maximum and minimum) and decadal scale average elevations (systematic direction or long-term trends). In unexploited aquifers, these should reflect natural variations as a result of climatic variation, to degrees determined by the geologic setting of the aquifers. For example, the effects of the wet-dry cycles over the past decades can be distinguished. The recent drought is obvious in some aquifer records.

Continuous and discontinuous exploitation effects are superimposed upon these natural elevation regimes. Thus, patterns may range from abrupt, large extractions for short-term industrial use, to lesser but longer-term uses (e.g., potable water), where influence may be variable.

**What You Can Do**

- Practice water conservation by changing your water use habits and by improving the efficiency of your water-using appliances and fixtures.
- For gardens or crops, utilize irrigation methods that minimize water loss.

Without knowing the full history of an aquifer, patterns can be difficult to interpret. The SRC provided information on which wells represent aquifers known to have human use. Figure 1.7 shows the distribution of the 72 groundwater wells for which information is available to 2004, this initial assessment indicates:

- Fifty-three cases (74 per cent) showed no evidence of systematic change over their entire record periods. Fifty-eight per cent of these aquifers are designated as having human use.
- Seven cases (10 per cent) showed some degree of systematic increase. These positive changes all occurred in shallow to mid-depth aquifers (13 to 38 metres), except one. Systematic increases may suggest recovery from former use or increased recharge (e.g., flood irrigation). Seventy-one per cent of these aquifers are currently designated as having human use.
- Twelve cases (16 per cent) showed some degree of negative change. Eighty-three per cent of these aquifers are designated as having human use:
  - Eight records were associated with a longer-term trend, or systematic level change. These cases were all in shallow to mid-depth aquifers (10 to 50 metres) except one. Systematic changes ranged from -1 to -3.6 metres. However, only six of these records extend to 30 years. The other two records extend 10 years or less, and so cannot reliably reveal a trend in the presence of recent drought.
  - Four records were associated with abrupt, short-term use (i.e., one to three years). These cases were all deep aquifers (>88 metres) and included the highest change values of all records (-37, -25, -10, -4 metres). However, it is important to stress that recovery is occurring for the two aquifers with the largest change: their current deficits are around -8 metres, and extrapolation of the recharge rate indicates a further 15 to 20 years to restore pre-pumping levels.

**Actions**

- Information on the observation well network and groundwater levels are available to the public. A brief description and hydrographs of the wells are provided on the SWA web site at: www.swa.ca/WaterManagement/Groundwater.asp?type=ObservationWells#.
- The groundwater branch of the Saskatchewan Watershed Authority has initiated a series of regional groundwater assessments to better understand potential well yields and water quality.
- The primary focus of these regional assessments is to provide summaries of the geology and hydrogeology, water quality, yield, use and potential contamination sources for individuals, rural and urban municipalities and industry. A general understanding of long-term impacts of groundwater resources is included in the reports along with a basis for the evaluation of these resources at the regional scale.
- A summary of the groundwater resources has been completed for the area within the Rural Municipalities of Carmichael, Piapot, Webb, and Gull Lake. Evaluation of groundwater resources studies are being undertaken for the area within the Rural Municipalities of Makwa, Meadow Lake, and Pierceland as well as for aquifers in the Yorkton area.
- The Saskatchewan Watershed Authority is responsible for administering the regulatory approval process for construction and operation of wells and other groundwater works. *The Saskatchewan Watershed Authority Act* and *The Ground Water Conservation Act* and Regulations provide details for the requirements and processes in obtaining an approval.
- Approvals are required to ensure proposed projects are sustainable and do not cause adverse impacts to the environment or other users. An approval is required for all groundwater use except for domestic purposes. Domestic purposes are water used for watering stock (non-intensive), non-commercial lawns and gardens and household and sanitary purposes. Examples of works requiring approval include municipal, industrial (including groundwater de-watering), intensive livestock operations, and irrigation (Saskatchewan Watershed Authority, n.d.).

**Related Indicators**

Water Consumption (Page 6)
Saskatchewan Water Quality Index (Page 9 )

2

# Prairie Biodiversity

**Present State**

Most of the southern half of Saskatchewan lies in the Prairie Ecozone. While much of the Prairie Ecozone is open grassland, there are also wetlands, saline land, shrubs, bluffs and even forested tracts. Each of these ecological communities is a unique habitat for plants, animals and microorganisms. Since European settlement, the state of the Prairie Ecozone has changed dramatically. Prairie fires have been suppressed. Seventy-five per cent of native prairie has been converted to agricultural land. Only 21 per cent (five million hectares) of the original Prairie Ecozone remains in its native state (Hammermeister et al., 2001).

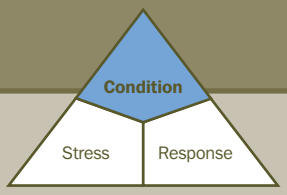
**Issue**

The loss of native prairie and its biodiversity is of concern for several reasons.

When native prairie is lost, or the quality of existing prairie ecosystems are negatively impacted, we are all affected because the “wholeness” that supports ecosystem functioning is compromised. It is like weakening or actually removing a portion of a house foundation. A healthy, naturally functioning system is less susceptible to disturbances and stresses such as drought and disease.

Saskatchewan's agricultural economy should be built around a healthy prairie ecosystem. Beef and grain produced in Saskatchewan provides food for Canadians and for export. The prairie landscape is the cultural and recreational cornerstone of southern Saskatchewan.

Maintaining healthy ecosystems and conserving existing natural areas is key to the conservation of biodiversity.




# Indicator of Prairie Diversity:
# **Measured by Type of Land Cover**

## Importance

Monitoring prairie biodiversity often focuses on management and protection of native prairie. While this is important in order to maintain the amount and quality of native prairie that remains, another important indicator of prairie biodiversity is the health of the 66 per cent of the Prairie Ecozone that is taken up by cropland.

While many agricultural inputs and management practices negatively affect biological diversity, some farming techniques may improve the condition of cropland and thus potentially sustain biodiversity.

Increasing and improving permanent cover over soils is one way in which landowners can enhance prairie biodiversity.

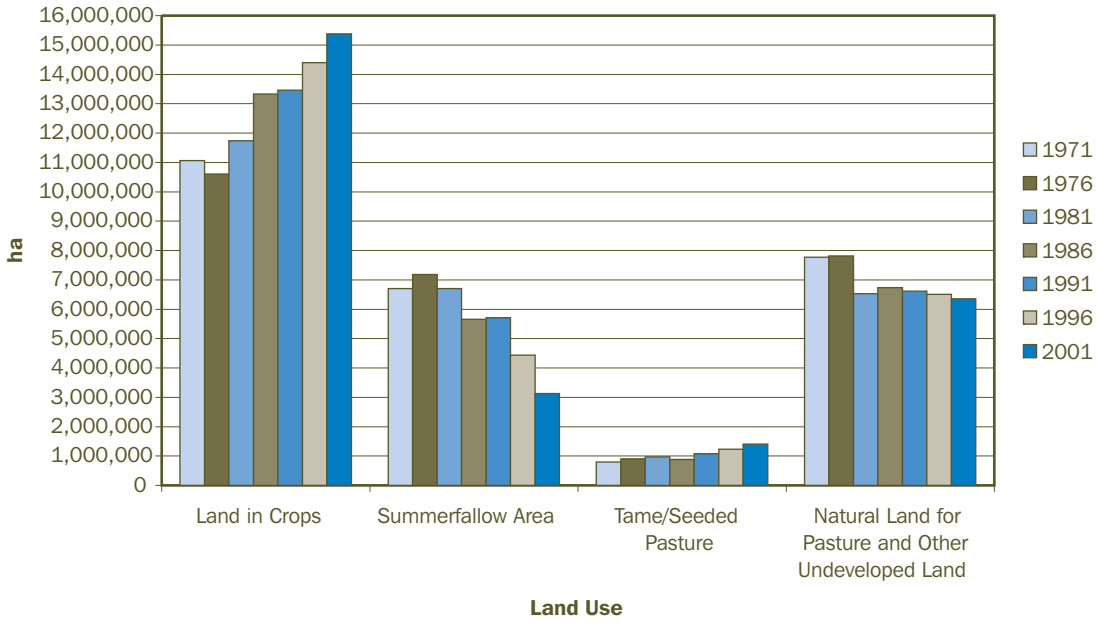
Good soil cover:

- Offers protection against wind and water erosion. The canopy of permanent cover (crop and crop residues), protect the soil from wind and water erosion and reduces moisture loss.
- Adds organic matter to the soil. The residues of dead plants and animals return to the soil and decompose, adding carbon to the soil. Soils with adequate levels of carbon supply plants and soil organisms with nutrients and water.
- Promotes carbon sequestration in the soil. Plants take in carbon dioxide from the air and use it to build vegetative and root matter. A portion of the carbon remains stored in the soil when plants decompose. This helps build soil fertility and reduce levels of carbon dioxide, an important greenhouse gas, in the atmosphere.
- Provides better wildlife habitat, which helps to support more biodiversity. Invertebrates, such as insects, rise in number under the protection of permanent covers. Species of birds that prey on invertebrates increase as a result (McRae et al., 2000).

## Status and Trends

**Figure 2.1. Changes in Saskatchewan Agricultural Land Base during 1971-2001**

Note: Tame/Seeded Pasture - Defined as improved pasture prior to 1996.
Natural Land for Pasture and Other Undeveloped Land - Includes natural pasture, wetlands, woodlands, building sites.
*Source: SAFFR, 2004.*



**What You Can Do**

Agricultural producers can enhance the biodiversity and sustainability of their land by:

- Reducing tillage. Excessive tillage leads to the reduction of soil organic matter. Conservation tillage, including no-till, leaves more crop residue on the soil surface.
- Converting marginal cropland to perennial forage.
- Conserving existing native habitat.
- Managing livestock access to mitigate damage to watercourses.
- Planting shelterbelts.
- Participating in the Environmental Farm Planning and the National Farm Stewardship Programs.

**Interpretation**

In the 30-year period between 1971 and 2001, the area of land in summerfallow has been reduced by half from 6,701,761 hectares to 3,131,752 hectares (Statistics Canada, 2001). The practice of summerfallowing has declined in part because it is now recognized that leaving the soil bare contributes to erosion and other forms of soil degradation.

In the same time period, Figure 2.1 shows land area seeded to tame/seeded pasture doubled from 792,480 to 1,405,785 hectares (Statistics Canada, 2001). Forages such as grasses and alfalfa provide good soil cover. Although they are not necessarily native prairie plants, they have distinct benefits over annually tilled croplands in terms of biodiversity.

From 2001-03, more than 400,000 hectares of land previously in annual cropping were converted to perennial forage cover under Saskatchewan's Conservation Cover Program (SAFRR, 2004). An additional 56,800 hectares of marginal cropland were converted under the federal government's Greencover Program in 2003 and 2004. The Greencover Canada program is a five-year, $110 million Government of Canada initiative to help producers improve grassland management practices, protect water quality, reduce greenhouse gas emissions and enhance biodiversity and wildlife habitat (PFRA/AAFC, personal communication).

The expansion of forage area and livestock numbers is a positive indicator of biodiversity conservation. Forage production, especially on grazing lands, is a much less intensive level of land use, with infrequent tillage and limited use of fertilizer or pesticides. Forage lands also reduce risks to wetlands and other natural areas from the intensive cultivation associated with annual cropping.

**Actions**

- In 2004, the Saskatchewan Agri-Environmental Advisory Council endorsed the Canada - Saskatchewan Environmental Farm Plan (EFP) program. Under the EFP program, farmers assess their operation's environmental performance and create action plans for improvement. Cost-shared incentives will be available to encourage the adoption of beneficial management practices. Participation is voluntary and confidential. This program will be reported on in future Saskatchewan SOE reports.
- To help ensure the agriculture industry becomes a leader in environmentally responsible production while improving air, water and soil quality and conserving biodiversity, the Government of Canada has established the National Agri-Environmental Health Analysis and Reporting Program (NAHARP). The National Agri-Environmental Health Analysis and Reporting Program consists of three components:
  1) Agri-environmental indicators that will provide information to decision-makers on how and why the sector is performing as it is and how it will evolve in the future.
  2) Integrated economic/environmental modelling and analysis that will evaluate existing programs related to environmental performance, and the potential performance of proposed programs.
  3) Agri-environmental valuation techniques which will estimate the non-market value of agri-environmental costs and benefits (Agriculture and Agri-Food Canada, 2004).
- The Prairie Conservation Action Plan (PCAP), a partnership of 25 federal and provincial government and non-government agencies, promotes sustainable uses of native prairie. The goals of the PCAP include sustaining a healthy native prairie grazing resource, promoting complementary sustainable use of native prairie, and increasing awareness and understanding of native prairie and its values (PCAP, n.d.).

**Related Indicators**

Water Consumption (Page 6)
Organic Agriculture (Page 32)
Greenhouse Gas Emissions (Page 40)
Indicators Under Development (Page 53)

3

# Forest Biodiversity

**Present State**

More than 50 per cent of Saskatchewan is covered in forest. Trees are an important part of a forest, but beneath a forest canopy, hundreds of other plants and a variety of mammals, birds and microorganisms find a place to live. Although some inventories of plants and wildlife have been conducted in Saskatchewan's forests, the status of their biodiversity is largely unknown. Gaps in information about Saskatchewan's boreal ecosystems are partly being addressed through enhanced monitoring, data collection and analysis, which will be available in the future. If forests are maintained in a healthy state, the natural variety of life found in them is also maintained. Healthy forests are resilient to natural influences such as fire, insects and diseases that bring about regeneration and succession. In broad terms, a healthy forest is one that maintains and sustains ecosystem functions and processes and natural disturbance regimes.

Forest biodiversity provides a wide array of goods and services, from timber and some non-timber forest resources, to playing an important role as a carbon sink in mitigating climate change. At the same time, it provides livelihoods and jobs for thousands of people in the province. Forest management tries to balance the long-term health of our forest ecosystems with the need to provide economic, social and cultural opportunities.

**Issue**

Forest biodiversity and natural forest cycles can be affected by human activities such as poor forest practices and fire suppression. The composition of the forest in some areas of Saskatchewan has been influenced by poor historic logging practices that have not properly renewed the forest in harvested areas.

Fire suppression and human caused fire has altered forest patterns, particularly in the southern portion of Saskatchewan's boreal forest. Portions of the forest are older than they would be naturally, making them more susceptible to insects and disease infection.

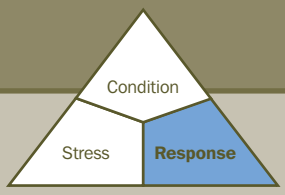
To maintain forest biodiversity and health we must adapt silviculture practices to more closely emulate natural patterns and processes. Long-term forest planning must ensure that the appropriate range of forest types (pure stands and mixed woods) and patch sizes are maintained to provide the mosaic of forest cover that all species depend upon. Residual green forest islands and dead trees must be retained in harvest blocks to serve as reservoirs of diversity for recolonization of harvested areas. These retained islands of undisturbed forest also provide crucial habitat for birds, mammals, insects and other species and emulate patterns found in natural burned-over forest. The amount and distribution of harvesting must be managed to provide the diversity of stand ages found in a healthy forest. In order to manage Saskatchewan's forests in this way, improved monitoring and data analysis are required.

Harvested areas can be reforested either through natural means or by planting to ensure renewal of the forest and the future supply of habitat. It is essential that the role of forest harvest be matched by the role of forest renewal.

Monitoring is important to ensure that stands regenerating following harvest provide similar habitat to forests regenerating after natural disturbances such as fire. Protected areas, including the Representative Area Network (RAN) sites will be important in the long term to provide the opportunity to compare managed forests to natural forest, so that practices can be modified to maintain biodiversity.

Roads through forested areas expose formerly remote areas to potential invasion by exotic species and can upset predator and prey relationships, as well as increase the harvest of wildlife. Road crossings over streams must also be properly installed and maintained to minimize impacts to water quality and to fish movement.

# Indicator of Forest Diversity:
# Measured by Forest Renewal in Not Sufficiently Reforested Areas of the Pasquia-Porcupine Forest




## Importance

The goal of forest renewal is to ensure that all harvested forests are satisfactorily regenerated to maintain the ecological, social and economic sustainability of Saskatchewan's forests. Forests that are not sufficiently reforested (NSR) require additional management.

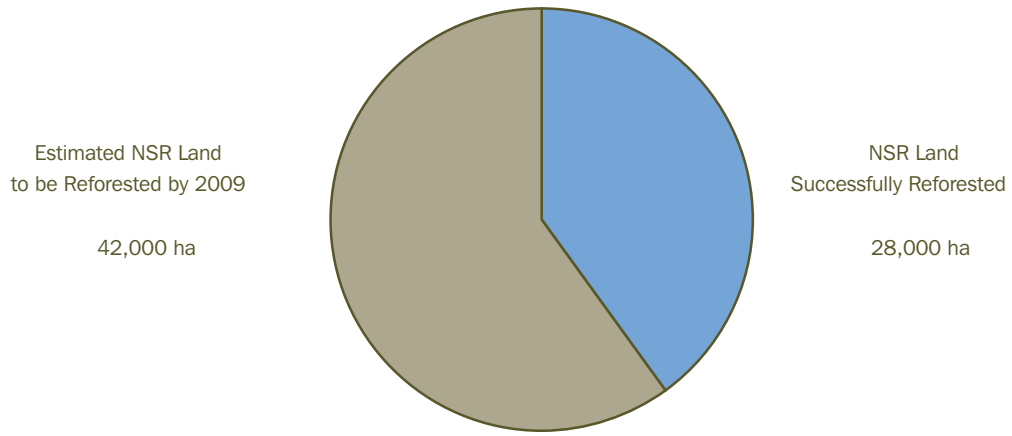
Some areas of the provincial forest were harvested in the past and left without any renewal efforts. These areas were predominantly coniferous forest prior to harvest and in some cases have regenerated to shrubland or deciduous forest. Biodiversity is affected because conifer species have been removed from the ecosystem through logging and a very different ecosystem has become established. There are not necessarily fewer species on these altered sites, but there is a definite shift away from conifers and the species dependent on the coniferous forest.

In 2004, new regeneration standards were established by Saskatchewan Environment to provide clear criteria for determining whether a forest is satisfactorily regenerated following harvest. These new standards focus on tree survival and growth rather than just how many tree seedlings are planted. This enhanced monitoring of seedling survival will bring us closer to the achievement of the desired future forest condition.

The Pasquia-Porcupine Forest demonstrates commitment to restore NSR lands. This is a costly, but important program to restore forest biodiversity in previously harvested NSR areas.

## Status and Trends

**Figure 3.1. Forest Renewal in Not Sufficiently Reforested Areas of the Pasquia-Porcupine Forest**
*Source: Saskatchewan Environment.*



**What You Can Do**

- Participate in public consultations for the development of Forest Management Plans.
- Familiarize yourself with Saskatchewan's Forest Environmental Policy. Visit www.sk.gov.ca/forests
- Learn about fire prevention and do your part to prevent forest fires.

**Interpretation**

The Pasquia-Porcupine Forest covers nearly 2,000,000 hectares including the Porcupine Forest, the Pasquia Hills and part of the Cumberland House area. Although forest renewal programs by the government were initiated as far back as the 1930s, the level of forest renewal by government and the forest industry did not keep pace with the amount of area harvested. A significant portion of the areas that were harvested before 1999 in this area are therefore not sufficiently reforested.

In 1999, Saskatchewan Environment signed a Forest Management Agreement (FMA) with Saskfor MacMillan Ltd. Partnership for the Pasquia-Porcupine area. The company assumed full responsibility to ensure reforestation of areas harvested after 1995. In the fall of 1999, Weyerhaeuser Canada Ltd. purchased the Saskfor MacMillan mills, and took over all responsibilities associated with their FMA. Saskatchewan Environment committed to restoring a softwood component on 70,000 hectares of pre-1995 harvested area. Significant portions of the pre-1995 harvested lands have been surveyed to determine their regeneration status.

Of the historically harvested lands surveyed, 28,000 hectares are sufficiently restocked with a softwood component, contributing to the 70,000 hectare commitment. A substantial area was found to be sufficiently restocked, but are pure hardwood and do not contribute to the 70,000-hectare commitment. An additional 42,000 hectares must still be reforested to meet the commitment.

To date, Saskatchewan Environment has planted 77 million trees in the Pasquia-Porcupine Forest. The forest industry has planted 36 million trees.

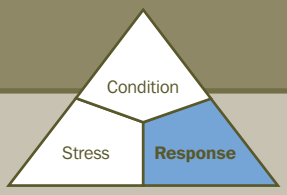
**Actions**

- By 2009, the re-establishment of a softwood component in the 70,000 hectares of historically over-harvested area in Pasquia-Porcupine will be accomplished. Saskatchewan Environment is committed to fulfill the remaining 42,000 hectares and will be conducting additional regeneration surveys, planting and tending to establish more trees. Additional surveys need to be conducted to determine current forest cover and the cost effectiveness of treatment of the remaining historically harvested areas in Pasquia-Porcupine.
- Additional environmental indicators will be added to demonstrate the success of forest renewal from a broader Saskatchewan perspective. The new standards will focus on tree survival and growth so that the achievement of the desired future forest condition is ensured. Because regeneration surveys are conducted four to five years after harvest and again eight to 14 years after harvest, it will be several years before this data can be applied or reported on.
- Reforestation of current and future harvested areas is funded through trust funds that have been established for FMA and Term Supply License (TSL) areas in the province. The forest industry is responsible for reforestation of harvested lands.
- Saskatchewan Environment manages a public campaign aimed at fire prevention education. Examples of program initiatives are advertisements through radio, television, newspapers, highway signage, a direct mail campaign, and the Smokey Bear program presentations which targets school groups and public events.

**Related Indicators**

Area of Provincial Forest Under Forest Management Agreement with a Forest Management Plan (Page 24)

# Indicator of Forest Diversity:
# Measured by Area of Provincial Forest Under Forest Management Agreement with a Forest Management Plan




## Importance

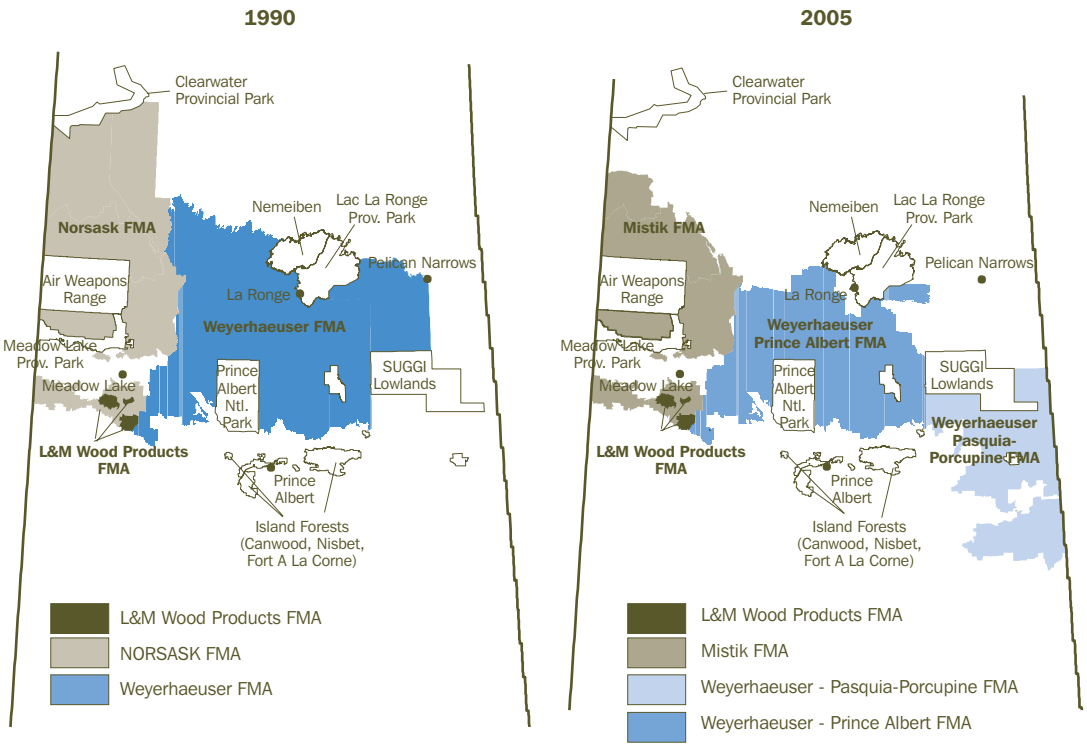
Forest Management Agreements are long-term licenses held by forest companies. The licensee assumes responsibility for sustainable forest management of the licensed area. Licensees must complete a 20-year Forest Management Plan (FMP) every 10 years. The FMP sets out the licensee's long term plans for management of the forest, including inventory, harvesting, renewal, protection and road development. Each licensee's FMP is subject to an Environmental Impact Assessment (EIA). Under FMAs, forest companies assume a much more significant role in forest management and forest sustainability, but ultimately the responsibility is on Saskatchewan Environment's Forest Service Branch to review and approve these plans.

Improving forest management through agreements such as FMAs is desirable in that it seeks to achieve a balance between ecological, social and economic interests and improves the sustainability of Saskatchewan forests.

## Status and Trends

**Figure 3.2. Area of Provincial Forest with Forest Management Agreements and Forest Management Plans, 1990 and 2005**

*Source: Saskatchewan Environment.*



**What You Can Do**

- Participate in public consultations for the development of Forest Management Plans.
- Familiarize yourself with Saskatchewan's Forest Environmental Policy. Visit www.sk.gov.ca/ forests

**Interpretation**

Approximately 58 per cent of the 12,221,911 hectares of potentially commercial provincial forest in Saskatchewan is currently allocated in FMAs with approved Forest Management Plans and Environmental Impact Assessments. While this is not a strong proxy for monitoring forest biodiversity, more direct measures of sustainability are being collected in the Forest Management Effects Monitoring Program discussed later under the Indicator Development Section.

**Actions**

- Implement the Forest Management Effects Monitoring Program on all areas subject to commercial forest harvest to determine the ecological results of forest management practices.
- Implement the Forest Management Effects Monitoring Program in the Representative Areas Network to determine baselines for indicators that can be compared to results on the managed landscape. The Representative Areas Network conserves more than five million hectares, or just over eight per cent, of the province's varied landscapes and waterways.
- A new results-based Forest Planning Manual will be implemented in 2005. This manual will provide direction for the development of Forest Management Plans and other levels of planning in Saskatchewan.
- Ensure the implementation of the Saskatchewan Forest Vegetation Inventory Standard, which was published in July 2004. This will provide a consistent vegetation inventory for FMP development and other levels of planning.
- Continue development of the Landscape Standards, which will address targets for stand age, forest cover type, forest patch sizes, and tree retention in harvested areas.
- As data is collected through the monitoring program, begin analysis and use the results to evaluate and modify management practices.

**Related Indicators**

Forest Renewal in Not Sufficiently Reforested Areas of the Pasquia-Porcupine Forest (Page 22)
Greenhouse Gas Emissions (Page 40)
Indicators Under Development (Page 53)

4

# Invasive Exotic Species

### Present State

Invasive exotic species are non-native species that maintain themselves or recurrently appear and negatively affect natural biodiversity within the region, generally by out-competing native species or by altering ecological communities or ecosystem processes.

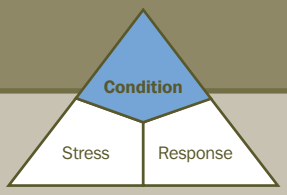
Invasive exotic species are widely considered to be among the greatest threats to global biological diversity and native species decline. The threat of invasive exotic species is so great because of the wide range of impacts they have upon ecosystems. Invasive exotic species can threaten ecosystem function, impede natural succession and prevent the establishment of native species, damage water and water ecosystems, impact human health and threaten resource availability. In the Prairie Ecozone, some invasive exotic species have contributed to the decline of rare plant species and rare habitats. Further, the economic impact of invasive exotic species is great in terms of resource revenue loss and the cost of chemical treatments used to control their spread. (Natural Resources Canada, 2002). Invasive exotic species are a growing threat to natural systems in Saskatchewan, but this threat has yet to be well defined or quantified.

Invasive exotic species in Saskatchewan include plants, fungi, animals including insects and molluscs, fish, bacteria and viruses. Examples of invasive exotic species to Saskatchewan are leafy spurge, purple loosestrife and wild boar.

### Issue

Increased trade, travel and climatic change have the potential to increase the introduction, dispersion and establishment of exotic invasive species. Saskatchewan's native prairie is particularly vulnerable to invasion by exotic species because of the fragmented nature of remaining natural areas and the predominance of exotic species in adjacent lands. Aquatic ecosystems are also at high risk because so little is known about the natural workings of those systems. Currently, there is very limited information about the number, abundance, dispersal, distribution and spread of invasive exotic species in Saskatchewan (Espie, et al., 2002).

Monitoring and management of exotic invasive species has been piecemeal and typically focused on those species that are seen to have a significant detrimental economic impact, such as leafy spurge and Dutch elm disease.




# Indicator of Exotic Species Invasion: **Measured by Dutch Elm Disease**

**Importance**

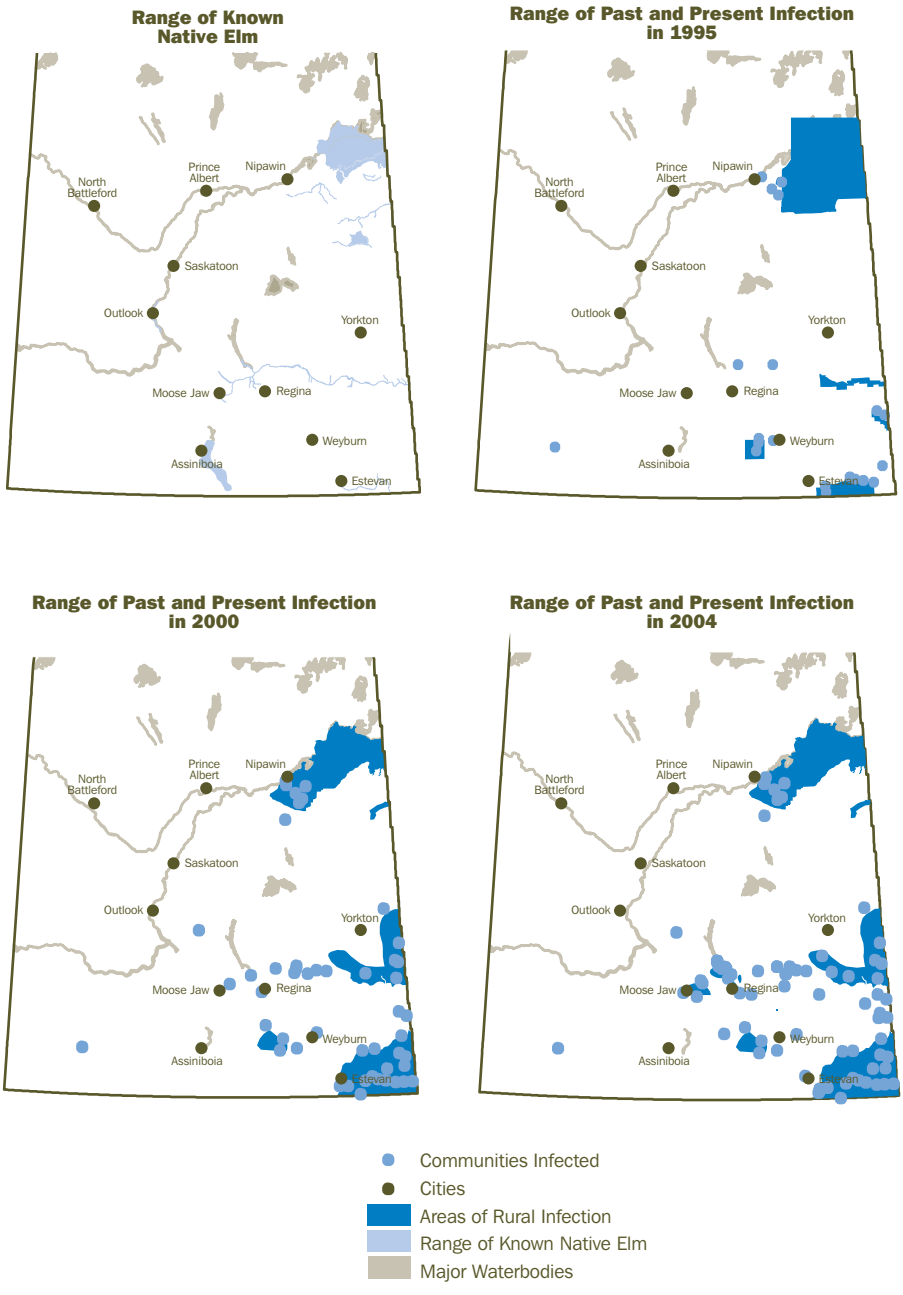
Dutch elm disease (DED) can be used as one example of the speed at which an invasive exotic species can spread. The very public nature of this invasion provides a case study to demonstrate the problems associated with trying to prevent, monitor and control the spread of invasive exotic species. While the data presented here are specifically about DED, as an indicator it highlights the overall significance of the extent and severity of the problem of invasive exotic species.

Dutch elm disease is a fungus that kills elm trees by blocking the flow of water inside the tree and causing death in as little as two weeks. The disease can be spread between trees through root transmission and by beetles. In some parts of Canada, DED is transmitted by the smaller, exotic European elm bark beetle. In the prairie provinces, the disease is carried to elm trees by the native elm bark beetle. The fungus itself is the exotic species and is reported to have entered North America in the 1930s. Since that time, a more virulent strain of the fungus has evolved and DED has rapidly spread in native and urban elm populations throughout North America (Kansas State University, 1995).

In Saskatchewan, natural native elm stands can be found in the Souris, Qu'Appelle, Saskatchewan, and Carrot River Valleys and in the Cumberland Delta. The majority of these areas are heavily infested with DED. The most westerly extent of natural elm populations is around Outlook, which is still free of DED. The range of native elm has been artificially expanded through urban and shelterbelt reforestation. Most healthy elm populations are now centred in southern communities and are susceptible to infection. American elm trees are most prone to DED and are one of the most valued, shade producing deciduous trees in Saskatchewan's urban, rural and recreational settings (Saskatchewan Environment, n.d.).

**Figure 4.1. Range of Native Elms in Saskatchewan and Spread of Dutch Elm Disease, 1995, 2000 and 2004**

*Source: Saskatchewan Environment.*



**What You Can Do:**

- Do not transport or store elm or buy elm firewood.
- Keep elm trees healthy and properly pruned. Prune at the appropriate time of year because fresh wounds attract beetles. Avoid pruning from April 1 to August 31.
- Report any observations to 1-800-SASK ELM. Public assistance in identifying and reporting possible DED cases is an important part of controlling the spread of the disease in Saskatchewan (Saskatchewan Environment, n.d.).
- Participate in programs such as the Saskatchewan Purple Loosestrife and Invasive Species Project by properly removing invasive exotic plants such as Common Tansy, Dame's Rocket and Purple Loosestrife from your garden.
- When returning from travel abroad, be sure to adhere to the Canada Customs regulations regarding importing live plants and animals.

**Interpretation**

Between 1976 and 1980 a multidisciplinary DED advisory committee was formed and DED was declared a pest under *The Pest Control Act*. In 1981, the first case of DED was found in a single tree in Regina. The tree was removed and the disease eradicated at that time. By 1990, DED was confirmed in Woodlawn Regional Park to the south of Estevan. By 1995, the disease had continued to spread throughout the entire Souris River basin in the southeast, along the Qu'Appelle River drainage and up the Cumberland Delta and Carrot River areas in the north. By 2000, DED had spread throughout the whole southeastern corner of Saskatchewan with pockets occurring to the west of Weyburn. In the east central region, DED had spread along the whole Qu'Appelle River drainage including the City of Regina and as far west as Buffalo Pound Provincial Park near Moose Jaw. In the north, DED was found along the Little Red Deer River drainage and through the Carrot River and Cumberland Delta drainages as far west as Nipawin. Dutch elm disease continued to spread west in all areas and by 2004 extended throughout the entire range of contiguous native elms in Saskatchewan. Only solitary elm populations in the Assiniboia and Outlook areas remain DED free in Saskatchewan.

**Actions**

Through the province's Biodiversity Action Plan:

- Identify and introduce measures to prevent the introduction of invasive exotic species including interaction with federal agencies to aid the development and implementation of import standards and protocols. Develop critical pathways analyses to guide risk assessment and action plans for high-risk invasive exotic and new species.
- Develop a strategy to direct and carry out research and monitoring to develop early detection systems and evaluate the distribution and dispersal of invasive exotic species within the province. Initiate biennial reporting on the status of invasive exotic species in the province.
- Identify and introduce measures to control populations of invasive exotic species existing in the province.
- Establish and maintain a province-wide committee to develop and implement provincial invasive exotic species strategies.
- Work inter-jurisdictionally to manage exotic species within the province (Saskatchewan Environment, 2002).

**Specific DED Actions**

- Provincial DED budget for integrated management program provides:
  - Surveillance program, which includes surveys, firewood searches and extension services in 43 communities.
  - Diagnostic services to confirm disease.
  - Large communities protected by buffer zones.
  - Sanitation through tree removal in priority areas.
  - Research into improved beetle trapping and monitoring systems.
  - Education and extension including operation of the 1-800-SASK ELM phone lines and community partnerships.
- Dutch elm disease Regulations have been strengthened in 2005 under *The Forest Resources Management Act, 1998* (FRMA).

**Related Indicators**

Type of Land Cover (Page 18)

5

# Agricultural Activity

**Present State**

By virtue of its sheer scale, agriculture has an enormous impact on Saskatchewan's environment. There are 26.3 million hectares of farmland in Saskatchewan with 15.4 million hectares in annual cultivation and most of the remainder is used for livestock and forage production (SAFRR, 2004a). In the period 1998 to 2002, cash receipts (excluding government payments) directly from farming in the province averaged about $5.2 billion annually (SAFRR, 2004b).

Efforts are underway to reduce the less beneficial aspects of agriculture. For example, since the mid-1980s the widespread adoption of conservation tillage, the conversion of marginal cropland to perennial forage, decreased summerfallow and improved liquid manure storage and handling systems have helped to reduce agriculture's impact on the environment.

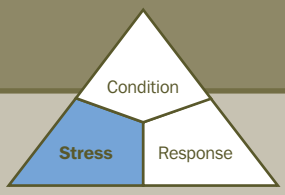
**Issue**

The Saskatchewan Agri-Environmental Scan, completed in 2004, provided a preliminary assessment of agricultural impacts on soil, air, water and biodiversity. The scan indicated that 44 per cent of cropland in the province has a low risk of soil erosion, 43 per cent moderate and 13 per cent high potential for erosion. In terms of susceptibility to impacts on water resources from agricultural practices, 46 per cent of the grain belt has low, 26 per cent moderate and 28 per cent has high susceptibility to impacts. In terms of biodiversity, the assessment indicated that 27 per cent of agricultural areas score as a low priority, 27 per cent moderate and 46 per cent are a high impact on biodiversity (AAFC and SAFRR, 2004).

The major agri-environmental issues are:

- The impacts of nutrients, pathogens and pesticides on soil and water resources.
- The conservation of water.
- The maintenance of soil organic matter.
- The prevention of soil erosion by wind, water and tillage.
- The control of emissions, odours and greenhouse gases into the atmosphere.
- The balance of maintaining biodiversity with agriculture.

# Indicator of Agricultural Activity Prairie Biodiversity: **Measured by Organic Agriculture**




**Importance**

Along with agricultural management practices like reduced tillage and conversion of annual cropland to perennial cover, organic agriculture can improve the condition of cropland and potentially sustain biodiversity.

Organic agriculture involves a holistic approach to farming that integrates biological and cultural management techniques. Organic farming offers Saskatchewan producers an alternative system of crop and livestock production, focusing on natural production practices and record keeping in compliance with acceptable standards (SAFRR, n.d.a).

In organic farming, cultivation for weed control, rather than use of herbicides, and the removal of fertilizer application can have impacts on soil erosion and soil fertility. Both conventional and organic farming can use other control practices including crop rotation, improved varieties, clean seed, varied seeding dates and seed depth.

Organic production aims to capture the growing niche of higher-priced markets for organic products. It is important that the organic sector have national standards and an accreditation system in place in order to be recognized by the European markets.

The organic phenomenon supports rural sustainability through smaller farm size and higher margins. It also addresses the growing environmental and animal welfare concerns. The opportunity for the Saskatchewan agriculture industry lies in the fact that Saskatchewan offers production related advantages over many competing production regions. Lower cost of production, with less disease and pest pressures, provide Saskatchewan producers with an opportunity to capitalize on a seemingly strong world-wide consumer trend.

**Figure 5.1. Number of Certified Organic Producers in Saskatchewan**
*Source: Macey, 2004.*

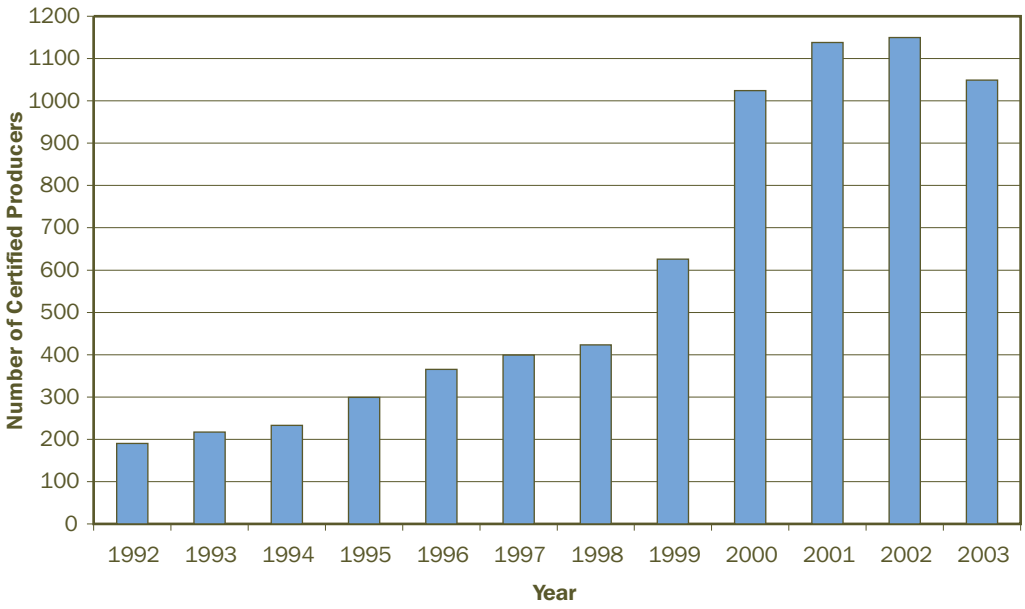
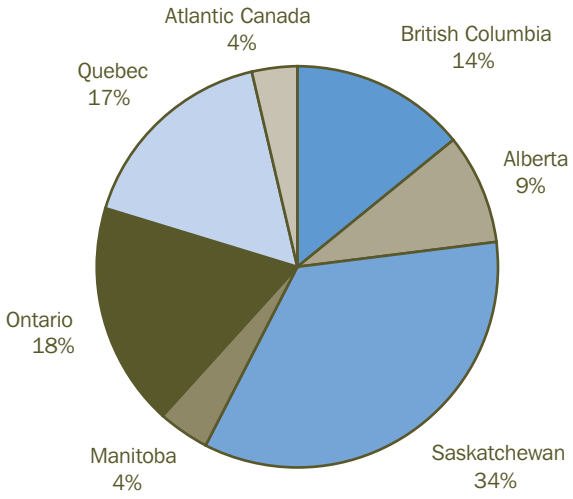



**Figure 5.2. Percentage of Organic Farmers by Province or Region**
*Source: Statistics Canada, 2001.*



**What You Can Do**

- Buy food from stores that sell locally grown organic produce.
- Support organic producers at farmer markets.
- Check food labels in grocery stores. Labels that read, "certified organic" tell the consumer the food has been produced from land that has not been exposed to synthetic insecticides, fungicides, herbicides or fertilizer for at least three years.
- Consider converting your farm to organic production.
- Garden organically.

**Interpretation**

Saskatchewan leads the country in terms of the number of organic farms. There are over 1,000 certified organic producers in the province, including approximately 30 that are also organic processors. Canadian organic retail sales growth is expected to rise from $0.7 billion in 1997 to $3.1 billion in 2005, which equates to an average growth of 20 per cent annually. The industry's market share will increase to 10 per cent of the Canadian retail market by 2010 (SAFRR, n.d.b).

Saskatchewan has the largest acreage of organic crop production in Canada at 227,233 hectares (SAFRR, 2004). Some of the organic crops grown in Saskatchewan include cereal grains such as barley, durum, oats, rye, wheat; grasses such as alfalfa and hay; oilseeds such as flax and mustard; pulse crops such as field peas and various lentils; as well as vegetable crops including carrots, cucumbers, lettuce, melons, peppers, and sweet corn.

**Actions**

- Saskatchewan Agriculture, Food and Rural Revitalization (SAFRR) is committed to meet the production, processing and marketing challenges of all production systems, including organics and alternative agriculture. SAFRR will target research and resources to address both environmental and economic sustainability. Recent activities in organic-related research include:
  - Support for the development of a national standard and accreditation system.
  - A major industry needs assessment that provides funding guidance for production and marketing research.
  - In excess of $2 million in funding for a variety of organic related projects.
  - A Marketing and Processor Directory, various marketing studies and production-related fact sheets.
  - Assistance and facilitation of business related opportunities.
  - Co-hosted international trade missions.
- The Organic Agriculture Centre of Canada and the National Organic Strategic Plan provide information and encourage the development of organic farming in Saskatchewan (Organic Agriculture Centre of Canada, n.d.).

**Related Indicators**

Type of Land Cover (Page 18)
Indicators Under Development (Page 53)

6

# Non-Renewable Resource Activity

**Present State**

Mining and oil and gas development are examples of non-renewable resource developments. Saskatchewan is the second-highest oil-producing province and the third-highest natural gas-producing province. In 2003, the oil and gas industry contributed 6.9 per cent to Saskatchewan's gross domestic product. Non-metallic mineral mining, which includes uranium and potash, makes up 3.8 per cent of the province's gross domestic product (Saskatchewan Bureau of Statistics, 2004a).

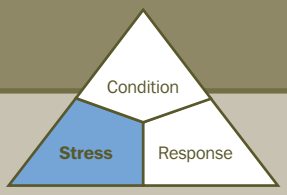
Mining is the province's third largest industry and a significant contributor to the provincial economy spending more than two billion annually on wages, goods and services. Mining has been identified as one of the key growth sectors for the Saskatchewan economy (Saskatchewan Mining Association, n.d).

In 2004, mining contributed over 53 million dollars in exploration expenditures, significantly increasing from the 31 million dollars invested in 2003 (Calvert, 2005).

While the income generated through resource activity provides major benefits to the province, there can also be environmental stresses associated with these developments. Resource activities should be managed so environmental impacts are minimized and mitigated.

**Issue**

Efficient and environmentally sustainable use of Saskatchewan's non-renewable resources is essential if we are to continue to enjoy the economic benefits they provide. For resource companies, having a good corporate reputation is key to their ability to operate and expand. A cooperative environment, supported by sound environmental regulations, monitoring and adaptive management is critical to environmentally sustainable resource development.




# Indicator of Non-Renewable Resource Activity: **Measured by Oil and Gas Well Density**

## Importance

Oil and gas and mining activities are core elements of Saskatchewan's economy. From 1990 to 2003, the value of oil sales increased almost three fold and the value of potash sales doubled (Saskatchewan Bureau of Statistics, 2004b and 1997).

The drilling and production of oil and gas wells can have a potential impact on the environment through such things as spills and casing gas vent leaks, which can result in surface or groundwater contamination. The oil and gas industry in the province is highly regulated to minimize the potential for these incidents. Oil and gas well operations are required to incorporate multiple built-in containment and protection systems to mitigate potential impacts to air, land and water. Conscientious attention to safety ensures that spills and gas leaks are very rare events.

Resource exploration and development roads and trails are of concern because of their potential to contribute to habitat fragmentation and loss of biodiversity. Fragile and/or native habitats are particularly vulnerable to concentrated activity. As such, the density of oil and gas wells within a particular area can be considered as a good proxy measure of overall potential impact.

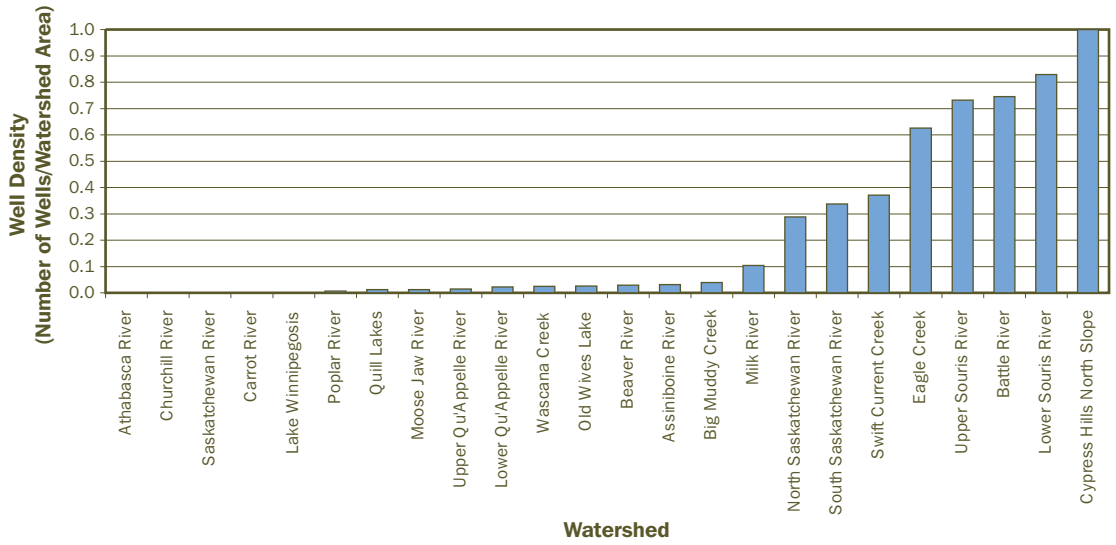
Mining is a temporary, site specific activity, with a high impact on a small area (from ten to several hundred hectares). Environmental impacts from mining are addressed throughout the mine cycle. Each mine development proposal must undergo a review and approval under the provincial Environmental Impact Assessment (EIA) process, administered by Saskatchewan Environment, before the project may proceed to construction and operation. Numerous other approvals are also required. The EIA addresses the environmental impact on land, air, water, vegetation, and wildlife throughout the mine cycle including construction, operation, closure and reclamation. This includes the permanent storage of waste rock (tailings). Reclamation is guaranteed by a financial surety posted by the mining company. Continuous monitoring by the mining company, provincial and federal governments, and in the north, by the Environmental Quality Committee composed of local residents, ensures that environmental standards are met and enforced.

## Status and Trends

In order to calculate the density of oil and gas wells, the number of wells drilled in each watershed is divided by the area ($km^2$). Well density for 2004 is displayed below in watersheds to which they apply.

**Figure 6.1. Oil and Gas Well Density in Saskatchewan, 2004**

*Source: Saskatchewan Watershed Authority adapted from Saskatchewan Industry and Resources.*



**What You Can Do**

- Conserve energy by buying energy efficient stoves, refrigerators, furnaces, washers, and dryers.
- Turn down the thermostat in your home at night.
- Drive more energy efficient vehicles.
- Report any suspected oil and gas related environmental infractions to the TIP line operated by Saskatchewan Environment 1-800-667-7561.

**Interpretation**

This indicator demonstrates large differences in the relative abundance of oil and gas among Saskatchewan watersheds, with the southwest and southeast regions of the province having much higher well densities. While the potential for spills and leaks are of concern everywhere, the potential for impact from resource trails and roads is greatest in watersheds where there is extensive native habitat, such as the Cypress Hills north slope.

**Actions**

- There is a comprehensive set of provincial standards, regulations, and guidelines in place to manage environmental impacts of the oil and gas industry. Many of the guidelines were developed through the Saskatchewan Petroleum Industry/Government Environmental Committee (SPIGEC). These environmental regulations and guidelines are available from Saskatchewan Industry and Resource's website[1]. Some of the more relevant documents include:
  1) Waste Management Guidelines for the Saskatchewan Upstream Oil and Gas Industry (SPIGEC, 1996).
  2) Restoration of Well Sites and Associated Facilities on Cultivated Lands in Saskatchewan (SPIGEC, 1999).
  3) Restoration of Spill Sites on Saskatchewan Agriculture and Pasture Land (SPIGEC, 1999).
  4) Saskatchewan Upstream Petroleum Sites Remediation Guidelines (SPIGEC, 2000).
  5) Environmental Site Assessment Procedures for Upstream Petroleum Sites (SPIGEC, 1999).
  6) Environmental Operating Guidelines for the Upstream Petroleum Industry (2001).
  7) Saskatchewan Drilling Waste Management Guidelines (1999).
  9) Saskatchewan Hydraulic Fracturing Fluids and Propping Agents Containment and Disposal Guidelines (2000).
  10) Saskatchewan Interim Industrial Landfill Waste Acceptance Criteria for Upstream Petroleum Industry (2000).
  11) Saskatchewan Upstream Petroleum Industry Storage Standards (2002).
  12) Appendix 6 of S-01 Draft NORM Storage Requirements (2003).
  13) Minimum Standards for Flare Tanks during Drilling and Servicing Operation (2002).
  14) Gas Migration Testing Guidelines.
- Oil and gas activities are regulated primarily by Saskatchewan Industry and Resources to ensure protection of air quality, clean air and proper waste management. Saskatchewan Environment and Saskatchewan Agriculture, Food and Rural Revitalization are also responsible for regulating these activities on Crown lands to ensure protection of habitat, endangered species and biodiversity.
- Compliance by oil and gas companies with provincial regulations and guidelines (those enforced by Saskatchewan Environment and Saskatchewan Industry and Resources) is high.
- Through the Saskatchewan Petroleum Industry and Government Environment Committee (SPIGEC), industry and government work together to identify and resolve environmental issues associated with oil and natural gas development. Since being established in 1992, this committee has been very successful at improving communication between industry and government, has developed six different sets of guidelines to guide development and minimize environmental impact for different aspects of the industry, and in 2002 re-wrote the Canadian Association of Petroleum Producers publication "Environmental Operating Practices for the Upstream Petroleum Industry - Saskatchewan" to address current issues and technology.

[1]The guidelines can be found on Saskatchewan Industry and Resource's web page at: www.ir.gov.sk.ca/Default.aspx?DN=3891,3620,3384,2936,Documents

**Related Indicators**

Type of Land Cover (Page 18)
Greenhouse Gas Emissions (Page 40)

7

# Climate Change

**Present State**

Climate change is the change in the "average weather" occurring at a variety of scales, from regional to global. Average weather includes temperature, wind patterns and precipitation (Environment Canada, n.d.).

It is a challenge to actually define the present state of climate change in Saskatchewan or anywhere because it is such a long-term process and much of it is based on models. We do know that Saskatchewan is contributing to climate change through its relatively high per capita greenhouse gas (GHG) emissions. Our GHG emissions are high because we have a relatively small population spread over a large geographical area and transportation demands are considerable. We also have an extreme climate that requires energy for heating in winter and cooling in summer and we generate most of our electricity from coal, which is a high emitter of GHGs (Saskatchewan Government, 2002). Saskatchewan, however, is in the unique position of having large areas of agricultural and forestry lands that can store carbon thereby reducing the amounts retained in the atmosphere.

**Issue**

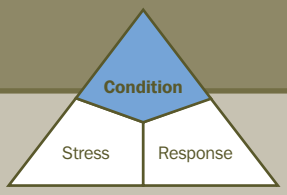
We are concerned about climate change because of potential risks to Saskatchewan's existing ecosystems and economic sectors. Climate change may impact where and how we live and work in the future. Some climate change models predict that, over the next 100 years, Canada may see an increase in annual mean temperatures in some regions of more than five degrees along with altered wind patterns, changes in the amount and type of precipitation and increased types and frequency of extreme weather (Environment Canada, n.d.).

Saskatchewan, along with the entire world, faces two key challenges in responding to climate change. First, is the need to mitigate impacts of climate change by reducing emissions of GHGs. Second, is the need to prepare and adapt to future climate change.

Slowing down, stabilizing and reversing climate change will require significant changes to our current energy-dependent lifestyles. Addressing these challenges requires a long-term international approach. The Kyoto Protocol, an international agreement adopted in December 1997 in Japan, entered into force on February 16, 2005. The Protocol sets binding targets for developed countries to reduce GHG emissions on average 5.2 per cent below 1990 levels, in order to begin to address climate change. Canada is committed to reduce GHG emmissions to six per cent below 1990 levels. The challenge for the future will be to forge an agreement that includes all the major emitting countries. Among the core issues yet to be addressed are future climate change commitments and whether they will require more specific long-term targets. Other issues are equity, cost, the interaction between climate efforts and international trade and how best to integrate climate concerns with development needs (Pew Centre on Global Climate Change, n.d.).

In terms of adapting to climate change, Saskatchewan faces many challenges. Increases in temperature are likely to be greater in Saskatchewan than a comparable location located near the ocean or other large body of water (Climate Change Saskatchewan, n.d.).

Higher temperatures increase evaporation rates. Without a corresponding increase in moisture from precipitation, dry areas get drier. Having enough water, in the right places and at the right times, may be the greatest challenge that climate change presents, particularly in southern Saskatchewan. Saskatchewan's agriculture, forestry, and tourism sectors could be the areas most affected (Climate Change Saskatchewan, n.d.). A challenge for Saskatchewan with regard to electrical generation is that coal is relatively inexpensive to produce, but is a relatively high GHG emitter.




# Indicator of Climate Change:
# **Measured by Greenhouse Gas Emissions**

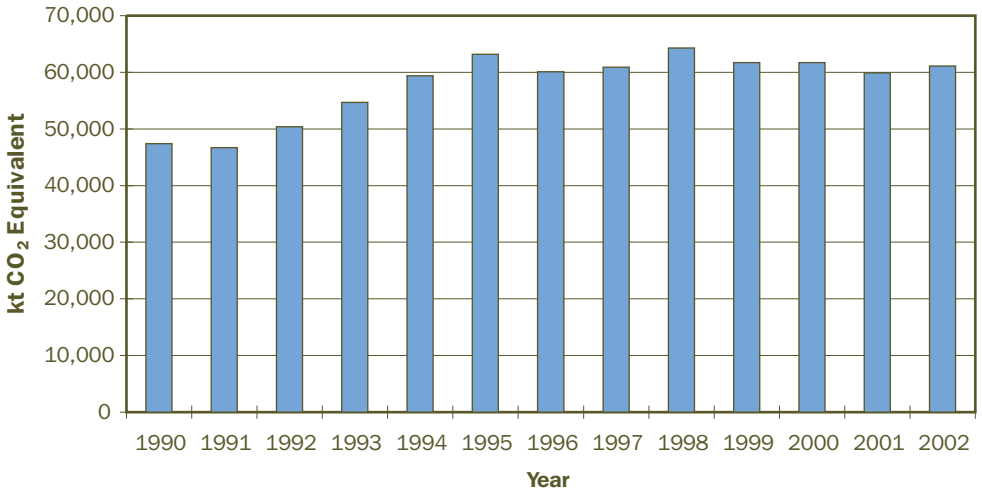
## Importance

The buildup of GHGs in the earth's atmosphere is believed to be contributing to global climate change. Some GHGs occur naturally in the atmosphere, but are elevated through human activities, while others are present purely as a result of human activities such as industrial processes. Canadian GHG emissions are about 78 per cent carbon dioxide, 13 per cent methane and eight per cent nitrous oxide, with other compounds making up the remainder (Saskatchewan Environment, 2003). In Saskatchewan, total emissions are an indicator of the province's contribution to global GHG. Total emissions are also a tool to monitor the overall effectiveness of the province's efforts to reduce GHG emissions.

Saskatchewan's natural ecosystems and agricultural soils present an opportunity to remove carbon dioxide from the atmosphere. Soil carbon sinks can be enhanced through reduced tillage, conversion of cropland to perennial forage cover, decreased areas of summerfallow and improved grazing practices. The ongoing adoption of soil conservation management practices will help to reduce net emissions of greenhouse gases.

## Status and Trends

**Figure 7.1. Saskatchewan Net Greenhouse Gas Emissions, 1990-2002**
*Source: Environment Canada, 2004.*




## Interpretation

Saskatchewan generated 61,100 kilotonnes of GHGs in 2002. This represents into 8.4 per cent of Canada's total, an increase of 29 per cent over the 1990 base year and a 1.9 per cent increase compared to 2001 (Matin et al., 2004). Overall, Saskatchewan's GHG emissions peaked in 1998. Since then, they have declined by five per cent. The decline in Saskatchewan's GHG emissions since 1998 is greater than that of any other province. The decrease in Saskatchewan's emissions has resulted primarily from changes in agricultural practices such as the wide-spread adoption of zero tillage farming, which stores carbon dioxide in the soil.

Saskatchewan's emission contribution per sector (see Energy Consumption Indicator) shows an increasing portion of energy-related emissions and a decreasing portion of agricultural emissions. The energy sector (including transportation) accounts for 80.1 per cent, the agriculture sector accounts for 14.3 per cent and the industrial processes sector account for 2.1 per cent. These three key sectors combined account for over 96 per cent of the provincial total (Matin et al., 2004).

**What You Can Do**
The actions of individuals account for about 28 per cent of Canada's total greenhouse gas emissions.

You can:
- Take the One Tonne Challenge: www.climatechange.gc.ca/onetonne/english/index.asp (Government of Canada, 2005).
- Purchase new items such as appliances or even light bulbs.
- Shop for energy efficient products (look for the EnergyStar label).
- Drive more energy efficient vehicles.
- Recycle.

**Actions**
Saskatchewan is addressing climate change on several fronts, including public education and information, energy conservation, alternative energy, research and development of new energy technology, adaptation to the impacts of climate change and research regarding carbon dioxide ($CO_2$) sinks.

Public Education and Information:
- Climate Change Saskatchewan is providing information to the public and developing climate change modules for the grade K -12 curriculum for Saskatchewan schools.

Energy Conservation and Alternate Energy:
- The Saskatchewan government is supporting development of the provincial ethanol industry through a requirement to blend ethanol and gasoline. New ethanol plants are being constructed in Weyburn and Lloydminster.
- The Office of Energy Conservation (OEC), created in 2002, encourages action by the public and industry by facilitating the development and implementation of cost-effective energy conservation initiatives, including public information and application of energy conservation measures.
- SaskPower has developed a Green Power Portfolio, which ensures they will use innovations such as increased wind power generation to meet the electrical needs of Saskatchewan customers until 2010 without adding GHG emissions (SaskPower, n.d.). Beyond the Green Power Portfolio, SaskPower is investing in researching better technologies with respect to GHG emission avoidance and capture (SaskPower, n.d.).
- SaskPower is undertaking a variety of projects to improve the efficiency of existing electrical generating stations.

Research and Development of New Energy Technology:
- The International Test Centre for Carbon Dioxide Capture at the University of Regina leads research in the development of climate change technology related to methods of separating and storing large volumes of carbon dioxide from the gases emitted by facilities such as coal-fired electricity generating facilities.
- The Weyburn Project uses waste $CO_2$ for enhanced oil recovery, and to study the behaviour of the $CO_2$ in depleted oil and gas wells. It is one of the largest scale emissions-reduction projects to date.

Adaptation to the Impacts of Climate Change:
- The Prairie Adaptation Research Collaborative (PARC) in Regina is the lead agency linking groups studying climate change impacts and adaptation strategies that may be most suitable for dealing with climate change on the prairies.
- SaskPower and Saskatchewan Environment have entered into a carbon sequestration agreement to undertake forest renewal and establish a Forest Carbon Reserve.
- The Saskatchewan Forestry Centre in Prince Albert is working with the Saskatchewan Research Council to study potential to increase the carbon uptake of forest soils and plants.
- Federal and provincial agriculture programs in Saskatchewan are supporting soil conservation research and programs, which are having positive results in increasing permanent cover on agricultural soils and greatly enhancing the carbon sequestering abilities of agricultural lands.
- Federal, provincial and non-governmental programs in Saskatchewan support conservation of native ecosystems such as wetlands and prairie, which are having positive results in retaining permanent natural cover.

**Related Indicators**
Type of Land Cover (Page 18)

8

# Waste Management

**Present State**

Solid waste is generated by nearly everything we do - at home, at work and as we travel. Reducing the amount of waste that we produce is the best solution for mitigating the impact of human waste on the environment. Diverting waste before it reaches landfills is an important way of reducing its impacts.

The provincial Centenary Fund has provided funding to eight Regional Waste Management Authorities for improvement or closure of inefficient, poorly located and operated landfills; the development of environmentally engineered and operated landfills and transfer stations; the development of material recycling facilities; and drop-off depots. The recycling systems have cut in half the waste going to Saskatchewan landfills.

The eight existing funded Regional Waste Management Authorities serve 12 per cent of the total population of Saskatchewan. If waste management services provided by cities are considered as the equivalent of service provided by regional authorities (as they provide waste disposal opportunities to the city and surrounding communities) at least 61 per cent of the provincial population can be considered to have access to a regional solid waste management facility.

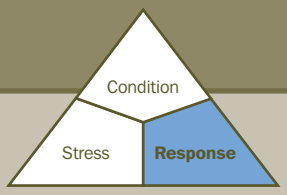
Saskatchewan has one of the highest return rates of recyclable plastic, aluminium and glass containers in North America. This is primarily due to the incentive of the deposit return system. During the 2003-04 fiscal year, SARCAN collected and recycled approximately 237 million designated beverage containers. The overall recovery rate for all non-refillable, designated beverage containers for 2003-04 was approximately 87 per cent.

Three Saskatchewan stewardship programs are instrumental in administering other recycling programs in the province. The Saskatchewan Scrap Tire Corporation, the Saskatchewan Association for Resource Recovery Corporation and the Pesticide Container Management Program collect and recycle tires, oil and oil filters and pesticide containers, respectively. Many of the scrap tires collected in the province are reprocessed into higher value products at a plant in Assiniboia. Large quantities of waste paper are processed into value-added products at a plant in Swift Current.

**Issue**

Waste stresses landfills, pollutes air, land and water and generates significant costs to manage. Much of the material we throw away can be diverted to other uses, decreasing the pressures on landfills and lessening the impact of waste on the environment.

# Indicator of Waste Management:
# **Measured by Materials Recycled**




**What You Can Do**

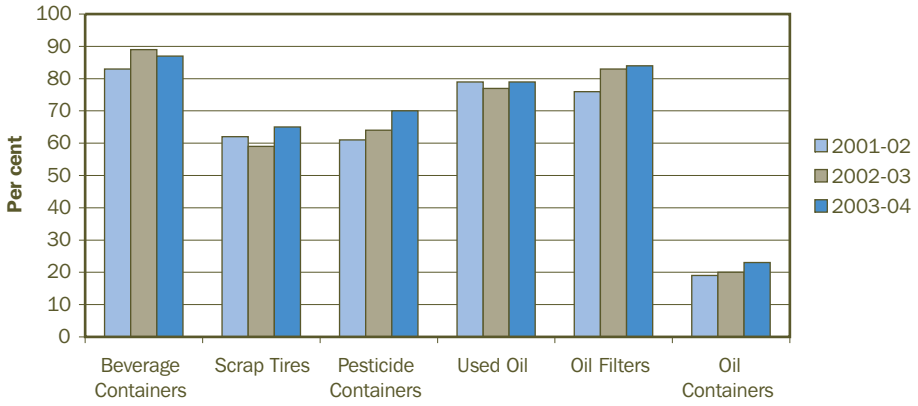
- Buy only what you need.
- Avoid unnecessary or excessive packaging when making purchases and let manufacturers and retailers know that you are rejecting a product because it is environmentally inappropriate.
- Reuse items and pass on items you no longer need.
- Divert waste from landfills by recycling and composting.

## Importance

Much of the waste disposed of in landfills could be used for manufacturing other materials. Metals can be used to manufacture aluminum cans and steel pipe; plastics are converted into non-food bottles, polyester clothing and carpeting; glass is made into new bottles, reflective beads for highway striping and fiberglass insulation; juice boxes are converted into paper products and aluminum foil; and milk jugs are converted into non-food containers. Using waste materials from manufacturing is a more sustainable alternative to creating products from new materials.

## Status and Trends

**Figure 8.1. Per Cent of Products Recovered through Provincial Recycling Programs**
*Source: Saskatchewan Environment.*




## Interpretation

The number of beverage containers, tires, pesticide containers and the amount of used oil materials recycled have generally been increasing with some fluctuations. This rather steady increase indicates that provincial recycling programs are effective in diverting a significant portion of material from landfills. The success of these recycling programs shows that Saskatchewan residents are willing to participate in waste diversion programs.

Challenges limiting the success of recycling programs include the high cost of properly managing recycling operations, which is at odds with accessible, low cost access to unregulated landfills. This, combined with challenges in marketing recycled materials, has limited the success of some municipal recycling initiatives.

There are also many other recycling initiatives for items such as paper products, copper, steel, concrete, carpeting, etc. operated by municipalities, private companies and industry for which data is not currently available.

## Actions

- Saskatchewan currently has provincial recycling programs for beverage containers, scrap tires, pesticide containers, used oil, oil filters and oil containers.
- Saskatchewan Environment will lead consultation regarding a provincial solid waste management strategy and is currently helping to develop an industry-led electronic waste recycling program and an industry-led paint recycling program.
- Support regionalized waste management initiatives and ensure consistent enforcement and compliance activities of waste disposal facilities in the province.

## Related Indicators

Greenhouse Gas Emissions (Page 40)
Population Density (Page 46)

9

# Human Population

**Present State**

Over the past 20 years, Saskatchewan's population has remained stable at approximately 980,000. Saskatchewan's population peaked at 1.01 million in 1986. In the last national census in 2001, Saskatchewan's population was estimated to be 978,935 (Saskatchewan Bureau of Statistics, 2004a). In October 2004, the population of the province was estimated to be 996,194 (Saskatchewan Bureau of Statistics, 2004b). Saskatchewan's population fluctuations are small in comparison to other provinces such as Alberta.

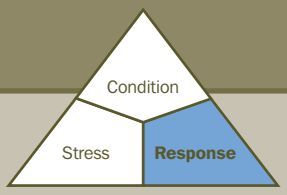
Saskatchewan is often referred to as a rural economy and society; however, recent demographic trends show otherwise. Between 1966 and 2001, the population growth has increased in urban areas. During this 35-year period, the urban population has increased 34.3 per cent while the rural population has declined by 28.2 per cent. Nearly two-thirds of Saskatchewan's population now live in urban areas compared to slightly less than half in 1966. Most urban dwellers live in the census metropolitan areas of Saskatoon and Regina, which constitute 42 per cent of the provincial population (Parsons, 2003).

Residents of Saskatchewan occupy a land area of 570,000 $km^2$, which yields a population density of 1.8 persons per square kilometre, as compared with 3.0 for Canada, 2.3 for Australia and 239.4 for the United Kingdom (Fung, 1999).

**Issue**

Human activities have impacts on the environment. Regions with higher population densities use more resources and produce more waste, increasing stress on the environment.

Urbanization is one of the most important demographic trends of the twenty-first century. As urban centres expand, the interaction between humans and the environment intensifies.




# Indicator of Human Population: **Measured by Population Density**

## Importance

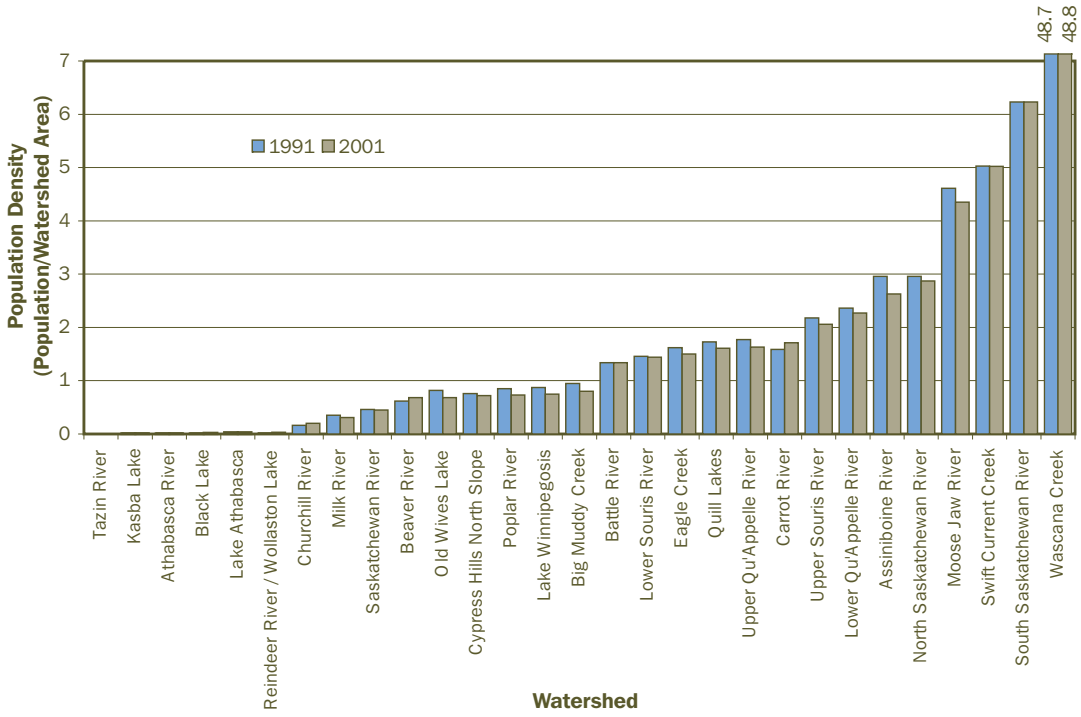
Humans - through their numbers, distribution, and behaviour - significantly impact the environment around the world. In turn, environmental change is radically affecting human populations. An understanding of how population variables are changing and the dynamic relationships between human populations and the environment is necessary to identify and treat the underlying causes of environmental problems (United Nations, 2001).

## Status and Trends

**Figure 9.1. Population Density in Saskatchewan, 1991 and 2001**[1]

[1]Statistics Canada Census data by blocks or Census Sub-Division from 1991 to 2001.

*Source: Saskatchewan Watershed Authority adapted from Statistics Canada*




The spatial distribution of the human population in Saskatchewan can be shown using a measurement of population density. To calculate the density of human population, the number of people living in each watershed is divided by the area within each watershed ($km^2$). Human population density from 1991-2001 is displayed by watershed.

## Interpretation

This indicator may be interpreted in two ways:

1. The rate of increase in population density over time indicates where growth is occurring and may signal increased risks of impact. Provincially, the population density did not increase in Saskatchewan watersheds from 1991-2001. Black Lake, Churchill River, Beaver River and Carrot River had an overall increase in population density.
2. Watersheds with high human population densities have potentially higher risk of impacts than those with lower human population densities. For example, human population is more of a potential issue to the Wascana Creek and Assiniboine watersheds where density is high than the Black Lake and Churchill River watersheds that experienced significant population growth, but have a low population density.

**What You Can Do**

- Support urban development policies that encourage energy-efficient buildings (both private and industrial) and public transportation systems to decrease our currently high levels of private automobile use.
- Support creation of green urban environments like parks, playgrounds and tree-lined streets.
- Reduce, reuse and recycle.

**Actions**

- Human population density does not in itself cause environmental impacts; however, it serves as a proxy for many activities that do. For example, increased human population density results in increased resource consumption and waste production. Becoming aware of the spatial distribution of humans within Saskatchewan can aid organizations such as Saskatchewan Watershed Authority and Saskatchewan Environment to focus their stewardship, education and management programs toward areas most influenced by humans.
- Communities of Tomorrow, incorporated in December 2003, is supporting the development, adoption, and adaptation of best practices and technology to create sustainable communities. For example, in collaboration with the Saskatchewan Science Centre, an education outreach program has been developed that builds awareness about sustainable development and encourages individuals, schools and businesses to reduce the size of their ecological footprint by giving them practical ways to do so.
- The Craik Sustainable Living Project, an initiative of the Town and Municipality of Craik, is a long-term project in search of ways of living that address the issue of sustainability and rural revitalization through physical demonstration of viable solutions.

**Related Indicators**

Water Consumption (Page 6)
Greenhouse Gas Emissions (Page 40)

10

# Stewardship

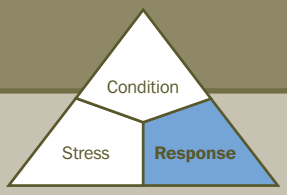
**Present State**

Stewardship means accepting the personal responsibility to conserve a resource. People all across Saskatchewan spend time taking care of the environment. They recycle, conserve water, limit energy use, observe best management practices and participate in programs that conserve wild species and their habitats and improve the quality of habitat through restoration activities.

**Issue**

Most of the land in southern Saskatchewan is owned and/or managed by private individuals. As a result, private stewardship activities play an important role in the health of the environment, preserving the biodiversity of native habitat and the maintenance of natural ecosystem cycles.

The general assumption is that more stewards equate to a broader commitment to the environment. Several organizations including Saskatchewan Watershed Authority (SWA), Saskatchewan Environment and Prairie Farm Rehabilitation Association (PFRA) have stewardship programs that provide people with information on how to conserve the environment.




# Indicator of Stewardship:
# Measured by Number of Stewards

## Importance

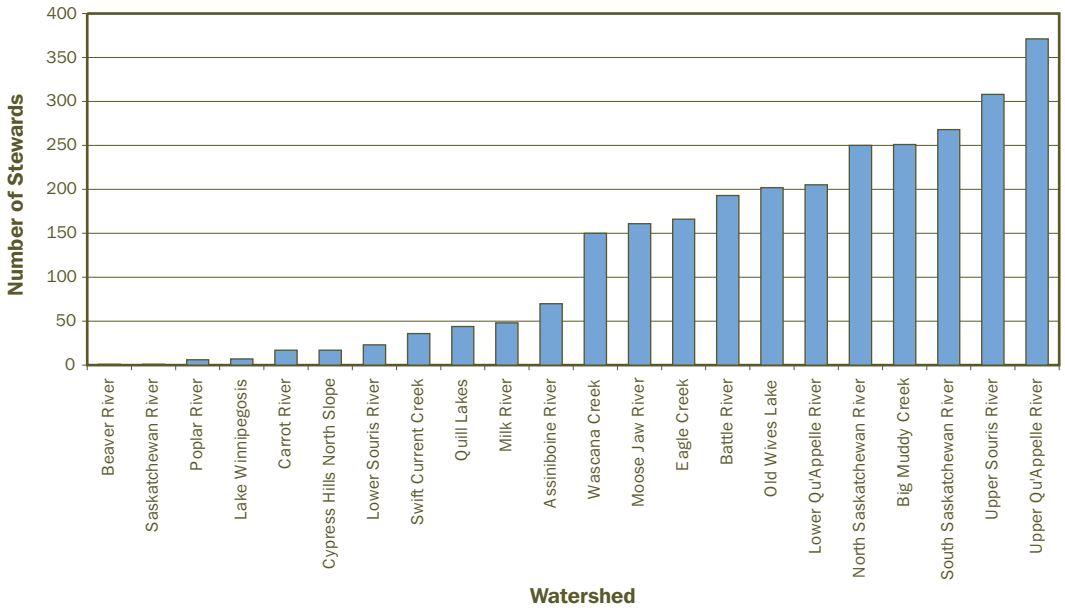
People enrolled in Saskatchewan Watershed Authority's Prairie Stewardship Program receive information on how to conserve healthy watersheds.

The number of stewards is an indication of how stewardship may be having a positive influence on the environmental health of each watershed in Saskatchewan. In the future application of this indicator, it would be beneficial to look at trends in the number of all types of environmental stewards for each watershed and also look at what these stewards are actually doing to improve environmental health.

## Status and Trends

**Figure 10.1. Number of voluntary stewards per watershed enrolled in Saskatchewan Watershed Authority's Prairie Stewardship Program, 2004**

*Source: Saskatchewan Watershed Authority.*




## Interpretation

The average number of Prairie Stewardship Program stewards per watershed is 127, with the total in Saskatchewan now 2,795. Since the program started in 1997, the number of stewards in Saskatchewan has increased at an average rate of 170 new stewards per year.

The Upper Qu'Appelle accounts for 13 per cent of all Prairie Stewardship Program stewards in the province and has a large number of recreational and agricultural users with a vested interest in participating in stewardship activities.

The number of stewards per watershed is influenced by the amount of activity Saskatchewan Watershed Authority has undertaken in planning activities within a watershed and by the number of stewards available in the watershed. For example, a relatively few individuals manage large areas as part of their farm or ranch operations in southwestern Saskatchewan. In the future, this indicator could be improved by considering the percentage of a watershed managed by stewards involved in various stewardship programs.

**What You Can Do**

- Join or support one of the many non-government environmental organizations.
- Participate in stewardship programs and local sustainable community projects.
- Plant native trees and shrubs that produce berries and seeds for wildlife.
- Learn more about the natural environment in Saskatchewan. Take in exhibits or interpretive programs at a variety of locations including provincial parks, Redberry Lake Biosphere Reserve, the Royal Saskatchewan Museum and the Chaplin Western Hemisphere Shorebird Reserve.

**Actions**

- Saskatchewan Watershed Authority encourages stewardship through many information and education programs, including demonstration projects, extension visits and field days.
- Project WET, Project WILD and Focus on Forests promote the understanding of ecosystem functioning and responsible environmental citizenship.
- Several agencies offer conservation easements. Conservation easements are voluntary legal agreements between a landowner and a conservation agency in which the landowner agrees to conserve the property's natural values and features through a restriction on the amount and type of development that can take place on the land in return for financial benefit. Organizations that offer conservation easements include Home Place Conservancy of Saskatchewan, Inc., Meewasin Valley Authority, Nature Conservancy of Canada, Saskatchewan Environment, Saskatchewan Watershed Authority, Saskatchewan Wildlife Federation and Ducks Unlimited Canada.
- The Living by Water Project offered through Nature Saskatchewan focuses on the conservation of shorelines along rivers, lakes and ponds. The project provides programs and materials to promote stewardship of shorelines.
- The Saskatchewan Wildlife Federation, a nonprofit, non-government, charitable organization, supports and encourages the preservation of habitat for fish and wildlife through the Wildlife Tomorrow program, Habitat Trust and the Habitat Enhancement program.
- The Native Plant Society of Saskatchewan develops handbooks, posters, conservation guidelines and educational materials related to conservation of native plants and their habitats. It holds workshops and tours that increase awareness of native plant conservation and managing native plant habitats.
- The Prairie Conservation Action Plan, a partnership of 25 federal and provincial government and non-government agencies, is committed to promoting sustainable uses of native prairie.

**Related Indicators**

Type of Land Cover (Page 18)
Organic Agriculture (Page 32)
Population Density (Page 46)

# Indicators Under Development

This State of the Environment report is a first attempt by Saskatchewan at using environmental indicators to report on the state of the environment. Through the process of determining the set of indicators to use, both challenges and opportunities presented themselves. These challenges and opportunities highlight the need for continued work on improving the indicators used and developing new ones. Challenges lie in the fact that many monitoring frameworks are just getting off the ground and data has not been collected for a long enough period to show trends. Gaps in the data being collected also persist.

Improved inter-agency cooperation is an opportunity that must be embraced to develop and monitor indicators in the future. It is important to keep in mind that indicator development will be an ongoing process. Some indicators are well understood and widely applied, while others continue to evolve as data and application become more accepted. As new indicators are identified, others may be set aside, at least temporarily. Following are descriptions for a number of indicators that have potential for use in future Saskatchewan SOE reports.

**Forest Management**

A Forest Management Effects Monitoring Program (FMEMP) has been developed for Saskatchewan in consultation with independent scientific expertise to determine if ecological values of the forest are being maintained. Stands regenerating after harvest need to be compared to stands regenerating after natural disturbances such as fire. In addition, the effects of harvesting riparian areas and salvage logging following fire need to be evaluated. Implementation of the FMEMP by the forest industry and government began in 2003, however, no results are yet available. The program includes landscape and stand level vegetation indicators, soils, bird monitoring and aquatic insects. Information from this program may be used in future Saskatchewan SOE reports.

This monitoring program is an important tool to evaluate forest management practices to determine if objectives such as site productivity and biodiversity conservation are being met. Without a monitoring program, inappropriate harvest or renewal practices would continue without their impacts being known. If objectives are not being met under the monitoring program, forestry practices will be modified accordingly.

The FMEMP will be applied on all areas subject to commercial forest harvest to determine the ecological effects of forest management practices. The program will also be implemented in the northern Representative Areas Network to determine baselines for the indicators, and to use as a comparison for the results on the human-managed landscape.

**Air Quality**

Limited information is known regarding the ambient air quality of the province. Poor air quality can negatively affect human and ecosystem health. In order to understand and manage air quality, concentrations of components found in the air need to be monitored. This information can help us make better decisions about air quality management, the factors that affect air quality and trends in air quality issues.

To be more effective in identifying and managing air quality issues, Saskatchewan Environment is endorsing the establishment of an Airshed Program. An airshed is a geographic area that is identified for the purpose of managing air quality issues. Airshed boundaries are determined by using a combination of factors such as pollutant types, meteorological factors and soils.

Saskatchewan Environment will be approaching industries, government agencies and other key stakeholders to begin discussions regarding the formation of Airshed Associations. The focus of the associations will be to collect credible, continuous air quality data and to communicate relevant information to the government and the public.

To date, Saskatchewan Environment has developed an airshed map of the province identifying distinct management areas. Air quality issues will be managed within the context of these areas.

**Soil Quality**

Saskatchewan Environment is working with Environment Canada and Saskatchewan Agriculture, Food and Rural Revitalization to choose soil quality indicators and to develop an environmental soil quality index. The index is planned to be finalized in 2005. Similar to water and air quality indices, an environmental soil quality index could be used in future SOE reports, synthesizing soils data, rating soils for specific objectives and developing management options.

The potential impact of stressors including acid rain, soil erosion, emission of chemicals from industries, leakage of underground fuel storage tanks, chemical spills, use of sewage sludge and other industrial wastes on land and tailings from various mines can result in the deposition of chemicals that affect the quality of soils. The change in soil quality in some cases can be large enough to impact future land uses or affect human health or the health of ecosystems.

Although soil monitoring can provide data on different variables, soil quality indicators with some numerical guidelines, criteria or natural range of variation are required to interpret such data. Soil quality indicators are also required for developing the environmental soil quality index.

**Environmental Farm Planning**

Environmental Farm Plan (EFP) programming is a major new stewardship initiative under the federal-provincial Agricultural Policy Framework. Environmental Farm Planning is a voluntary and confidential process used by producers to identify environmental strengths of, and risks to, their farming operations. It is a whole-farm approach in which the farm manager assesses all existing management practices for their potential impact and develops an action plan to deal with those areas where improvements are warranted. Once the plan is completed, the producer can qualify for cost-shared incentives for the adoption of beneficial management practices (BMPs).

While the EFP program is new to the province, it has much potential for improving awareness of agri-environmental issues and for encouraging positive and effective action. Participation in the EFP program involves producers attending two facilitated workshops, using the EFP workbook to complete a risk assessment and action plan for their operation, and a review of the plan by a peer committee. Once the plan has been reviewed and endorsed, funding is available to share the cost of improvements in 30 BMP categories including improved manure management, riparian area management, grazing management, improved pest management, and enhancing wildlife habitat and biodiversity.

The level of producer participation in environmental farm planning will serve as a meaningful indicator of improved agri-environmental management practices. Participant numbers could be a proxy for expected improvements to the health of Saskatchewan's soil, air, water and biodiversity.

### Agricultural Inputs

Saskatchewan has a large and important agricultural sector with more than 26 million hectares in the southern portion of the province being used for crop and livestock production. Fortunately, temperature extremes and low annual precipitation assist in keeping many pest populations within a manageable range. Producers also use a range of techniques such as crop rotation, seedbed preparation, and seed treatments as well as variance in seeding dates and depth to help control weeds, insects and disease. They also use insecticides, herbicides, and fungicides when these cultural practices and the natural checks are not adequate.

With food safety and environmental stewardship as important issues, there is increased scrutiny on agricultural practices. Consumers are demanding increased food safety and producers are looking for sustainable, cost-effective methods to meet these demands. Prairie producers are struggling to produce food at a cost that provides a reasonable income to them.

Producers can reduce pesticide use through Integrated Pest Management (IPM), which refers to crop production that uses a range of techniques, both chemical and non-chemical, to suppress pests effectively, economically and in an environmentally sound manner. Greater awareness of IPM benefits, including reduced input costs, will further enhance the stewardship of our land and increase the market appeal for our products. Future SOE reports will be looking at trends in the adoption of IPM and in the overall use of pesticides and fertilizers in the province.

### Watersheds

The Saskatchewan Watershed Authority (SWA) has undertaken State of the Watershed Reporting (SOWR) as one of the primary components of their source water protection activities. Measuring and reporting on watershed health demonstrates agency accountability for source water protection, and provides direction to the targeting of programs and services. Integral to this process is the development of indicators relevant to watershed health. The Saskatchewan Watershed Authority is developing such indicators within the stress-condition-response framework used in this report. Saskatchewan Watershed Authority is also producing a technical document for scientific audiences. This document will be available for public review on the SWA website (www.swa.ca) in 2005.

### A Work In Progress

The challenge of managing complex systems is immense. The best we can do is apply the knowledge we have today and be prepared to adapt our management as new information becomes available. The indicators in this report, and others under development, provide a starting point for indicator-based environmental reporting in Saskatchewan.

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# Reader Survey

**Saskatchewan State of the Environment Report 2005**

Your response to this survey will help us improve the quality of future Saskatchewan State of the Environment Reports.

1. Your affiliation? Please check () the most appropriate category.

_____ Education Student

_____ Education Teacher

_____ Government

_____ Industry (Please specify: _____ )

_____ Private business

_____ Environmental organization

_____ Other organization (Please specify: _____ )

_____ Individual

_____ Other (Please specify: _____ )

**Evaluation**

Please circle the appropriate number to answer the question. On the scale, 1 is poor, and 5 indicates excellent.

| | | | | | | |
|---|---|---|---|---|---|---|
| 1. | How well did the report help you understand trends over time with established or emerging environmental issues? | 1 | 2 | 3 | 4 | 5 |
| 2. | Are you better informed on the condition of the provincial environment than you were before reading this publication? | 1 | 2 | 3 | 4 | 5 |
| 3. | How well did the report help you understand specific environmental issues? | 1 | 2 | 3 | 4 | 5 |
| 4. | How well did the report help you understand what is being done to address environmental issues? | 1 | 2 | 3 | 4 | 5 |

**Mail-In Evaluation**

Indicators

Which indicators did you find most useful?

_____

_____

_____

Are there additional indicators or issues you would like to see included in a future State of the Environment report?

Do you have other suggestions to improve this report?

**Thank you for your time.**

Please send your comments to:

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