

# **Little Saskatchewan River Watershed Water Quality Report**

**August, 2007**

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**State of the Watershed Report**  
**Little Saskatchewan River - Water Quality Component**

Surface water quality data have been collected by the Water Quality Management Section, Manitoba Water Stewardship, to address various issues within the Little Saskatchewan River watershed. Surface water quality data are collected primarily to: 1) assess long-term, ambient water quality trends at routinely monitored sites, and 2) assess ambient water quality through short-term, intensive studies and activities. Results of water chemistry collected from the Little Saskatchewan River watershed represent data that were generated from both the long-term water quality site, and from short-term, issue-driven studies. While water quality samples have been collected fairly consistently from a long-term site, other data collections on the Little Saskatchewan River are not as continuous or consistent in either date range, or chemistry. For the purposes of this State of the Watershed Report, the following data and/or comparisons have been analyzed and presented:

- Long-term trends in total nitrogen and total phosphorus (1973 to 1996)
- Water Quality Index from 1991 to 2005
- Long-term water quality data from 1973 to 2006
- Water quality data from Lake Wahtopanah 1990 to 1991
- Microbiological data from Lake Wahtopanah 2004 to 2006
- Macroinvertebrate summary data 1995 to 2005

While other reviews of water quality in the Little Saskatchewan River have been previously documented (Green, 1997, Currie and Williamson 1995), this report references updated data and trends.

**Long-Term Trends - Surface Water Quality**

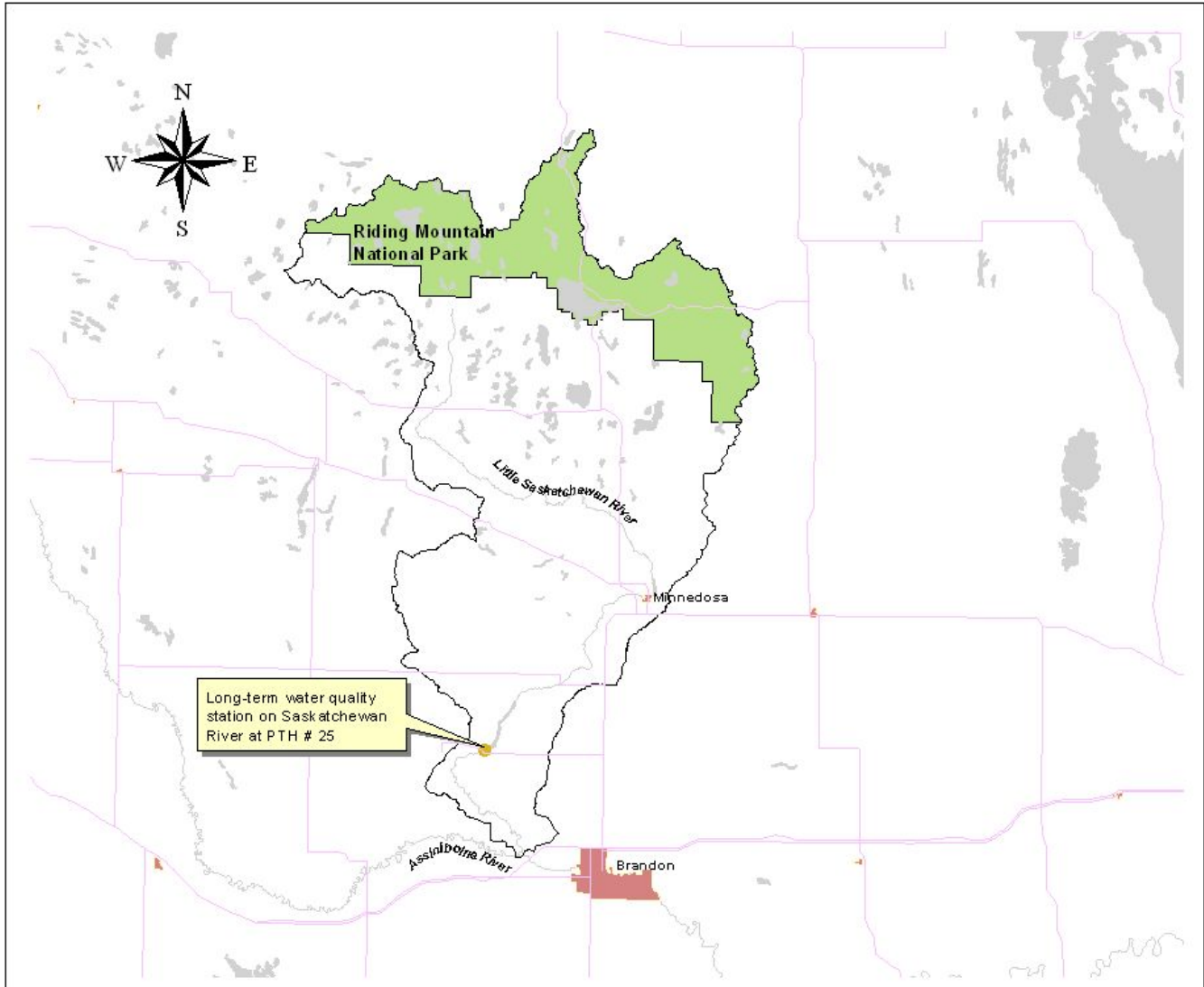
The Little Saskatchewan River watershed has one long-term water quality station located on PTH # 25 just downstream of the Lake Wahtopanah (east of Rivers). While sampling at this location began in 1973 at a frequency of one sample every 3 months, there is a 3 year data gap from 1984 to 1988. The frequency of sampling reflects the purpose of monitoring water chemistry for long-term changes and trends over the period of record. Water samples were collected and analyzed for a wide range of water chemistry variables at the long-term monitoring station including pesticides, metals, nutrients, general chemistry and bacteria.

In 2001, total phosphorus (TP) and total nitrogen (TN) from the long-term water quality station were analyzed for trends using a relatively complex statistical model (Jones and Armstrong 2001). The model identified trends in concentrations of TP and TN after accounting for variations due to river flow. Total phosphorus showed a statistically significant increasing trend ( $p < 0.0018$ ) in concentration from 1973 to 1996 (Figure 2).

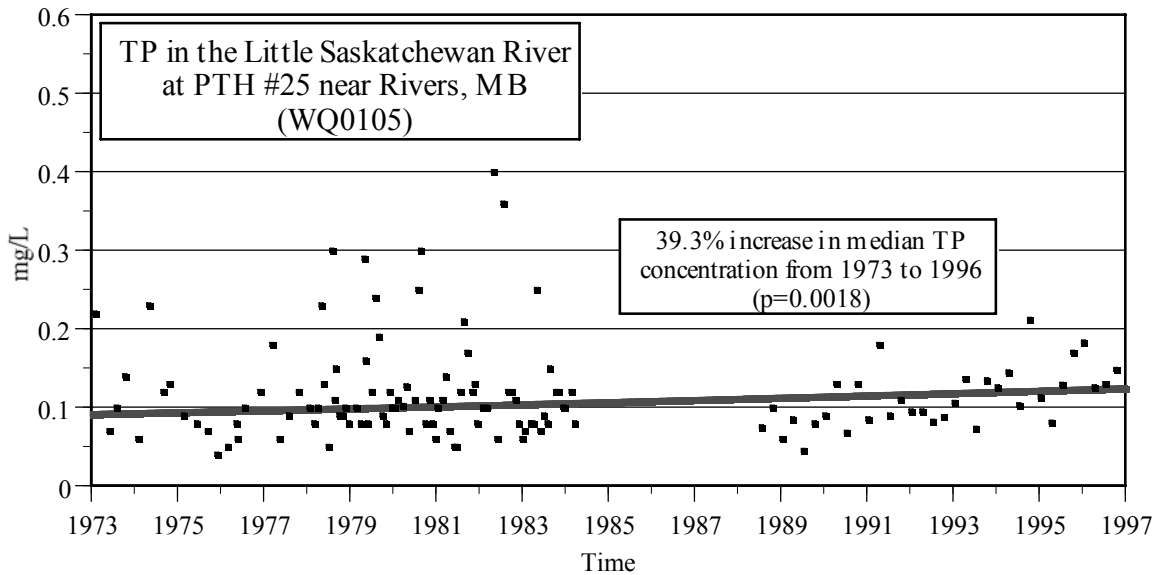
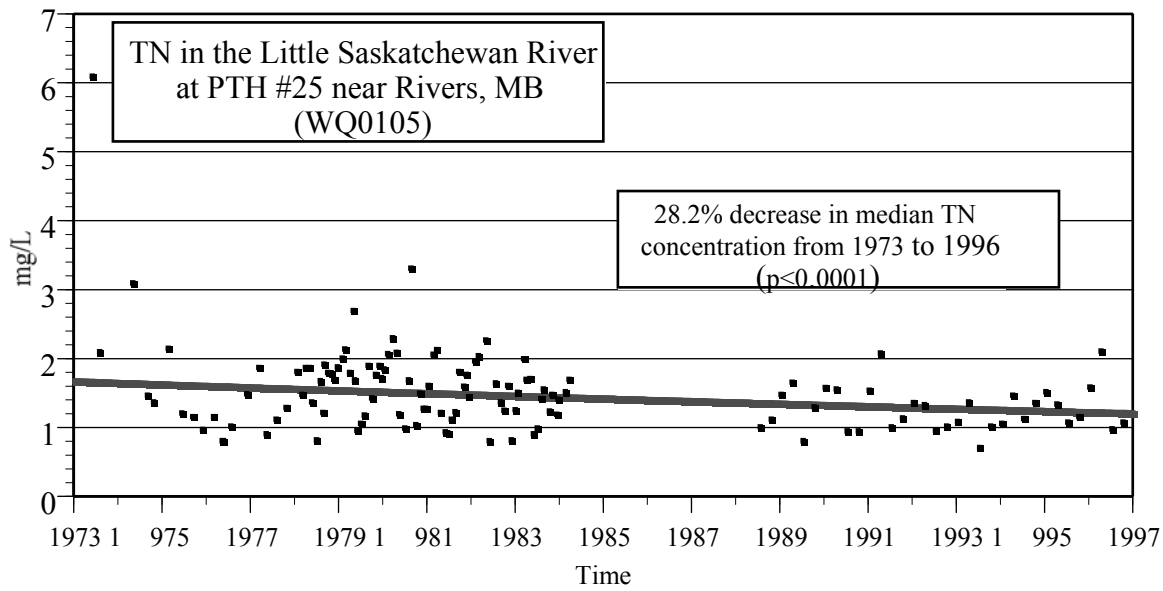
**Table 1. Long term surface water quality monitoring stations within the watershed area.**

<b>Station</b>	<b>Location</b>	<b>EMS</b>	<b>Period</b>	<b>Frequency</b>
Little Saskatchewan River	Highway #25 D/S of Lake Wahtopanah	MB05MFS098	1973 to 2006	4 times/yr

**Figure 1. Location of the long-term water quality station on the Little Saskatchewan River at PTH # 25, just east of Rivers, Manitoba.**



**Figure 2. Total Nitrogen (TN) and Total Phosphorus (TP) at PTH #25 (WQ0105) (after Jones and Armstrong 2001). The % change in median concentration refers to the median concentration of the flow-adjusted trend line.**



In contrast, TN declined significantly from 1973 to 1996 (Jones and Armstrong, 2001). While the trend of increasing TP could be attributed to increased non-point source and point source loading from land-use practices such as agricultural activities and municipal lagoon discharges, the cause of nitrogen decline is largely unknown. Jones and Armstrong (2001) speculate that the controlled outlet of Lake Wahtopanah may influence nutrient concentrations at the long-term sampling site immediately downstream of the lake.

### Water Quality Index:

Data from the long-term water quality station can be used to calculate a Water Quality Index for the Little Saskatchewan River. The Canadian Council of Ministers of the Environment (CCME) Water Quality Index is used to summarize large amounts of water quality data into simple terms (e.g., good) for reporting in a consistent manner. Twenty-five variables are included in the Water Quality Index (Table 2) and are compared with water quality objectives and guidelines contained in the Manitoba Water Quality Standards, Objectives, and Guidelines (Williamson 2002 and Table 2).

**Table 2. Water quality variables and objectives or guidelines (Williamson 2000, Williamson 1988) used to calculate Water Quality Index (CCME 2000).**

Variables	Units	Objective Value	Objective Use
Fecal Coliform MF	Bacteria/100mL	200	Recreation
Ph	Ph Units	6.5-9.0	Aquatic Life Greenhouse
Specific Conductivity	uS/cm	1000	Irrigation
Total Suspended Solids	mg/L	25 (mid range)	Aquatic Life
Dissolved Oxygen	mg/L	5 (mid range)	Aquatic Life
Total or Extractable Cadmium*	mg/L	Calculation based on Hardness (7Q10)	Aquatic Life
Total or Extractable Copper*	mg/L	Calculation based on Hardness (7Q10)	Aquatic Life Drinking Water, Health
Total Arsenic	mg/L	0.025	Calculation based on Hardness (7Q10)
Total or Extractable Lead*	mg/L	0.1 for pH >6.5	Aquatic Life
Dissolved Aluminum	mg/L	Calculation based on Hardness (7Q10)	Aquatic Life
Total or Extractable Nickel*	mg/L	Calculation based on Hardness (7Q10)	Aquatic Life
Total or Extractable Zinc*	mg/L	Calculation based on Hardness (7Q10)	Aquatic Life Drinking Water, Aesthetic
Total or Extractable Manganese	mg/L	0.05	Drinking Water, Aesthetic
Total or Extractable Iron	mg/L	0.3	Aquatic Life
Total Ammonia as N	mg/L	Calculation based pH	Drinking Water, Health
Soluble or Dissolved Nitrate-Nitrite	mg/L	10	Nuisance Plant
Total Phosphorus	mg/L	0.05 in Rivers or 0.025 in Lakes	Growth
Dicamba	ug/L	0.006 where detectable	Irrigation
Bromoxynil	ug/L	0.33	Irrigation
Simazine	ug/L	0.5	Irrigation
2,4 D	ug/L	4	Aquatic Life
Lindane	ug/L	0.01	Aquatic Life
Atrazine	ug/L	1.8	Aquatic Life
MCPA	ug/L	0.025 where detectable	Irrigation
Trifluralin	ug/L	0.2	Aquatic Life

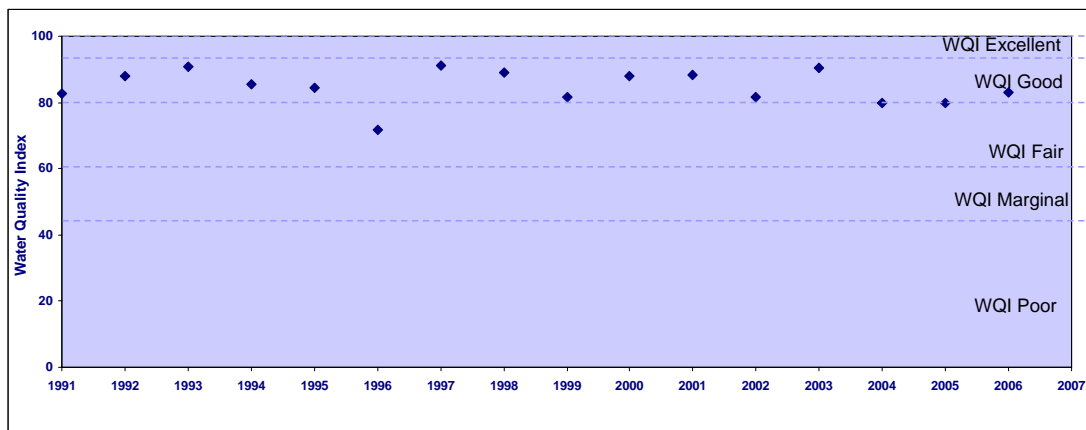
The Water Quality Index combines three different aspects of water quality: the 'scope,' which is the percentage of water quality variables with observations exceeding guidelines; the 'frequency,' which is the percentage of total observations exceeding guidelines; and the 'amplitude,' which is the amount by which observations exceed the guidelines. The basic premise of the Water Quality Index is that water quality is excellent when all guidelines or objectives set to protect water uses are met virtually all the time. When guidelines or objectives are not met, water quality becomes progressively poorer. Thus, the Index logically and mathematically incorporates information on water quality based on comparisons to

guidelines or objectives to protect important water uses. The Water Quality Index ranges from 0 to 100 and is used to rank water quality in categories ranging from poor to excellent.

- **Excellent (95-100)** - Water quality never or very rarely exceeds guidelines
- **Good (80-94)** - Water quality rarely exceeds water quality guidelines
- **Fair (60-79)** - Water quality sometimes exceeds guidelines and possibly by a large margin
- **Marginal (45-59)** - Water quality often exceeds guidelines and/or by a considerable margin
- **Poor (0-44)** - Water quality usually exceeds guidelines and/or by a large margin

While water chemistry has been monitored at this site since 1973, certain pesticides that are required to calculate the WQI were not monitored prior to 1991. Therefore, the WQI has been calculated from 1991 to present and these indices are represented on Figure 3.

**Figure 3. Water Quality Index calculated from 1991 to 2006 for the Little Saskatchewan River at Highway # 24.**



In general, the WQI in the Little Saskatchewan River fell within the category of 'Good' (Figure 3) indicating that water quality is protected with only a minor degree of threat or impairment; and that conditions rarely depart from natural or desirable levels. While numerous variables are used to calculate the overall Water Quality Index, the percentage of variables that exceeded their objective in the Little Saskatchewan River from 1990 to 2006 ranged from 8 per cent to 21 per cent.

### Macroinvertebrates

Another indicator of water quality is the density, abundance, and diversity of macroinvertebrates (organisms without backbones, such as insects and snails, representing a variety of taxa). A number of measurements are used to assess the quality of an aquatic site as being 'non-impaired', 'slightly impaired', 'moderately impaired' or 'severely impaired'. These designations, or biological conditions, depend upon characteristics of the dominant species that are present at the site. Some organisms are intolerant of poor water quality and thus would not be present in severely impacted water while others can tolerate poor water quality.

Macroinvertebrates were collected at the long-term water quality site near Rivers, Manitoba from 1995 to 2004. Overall biological condition varied from slight impairment to no impairment

**Table 4. Overall biological condition of the Seine River in reference to biotic stream assessments from 1995 to 2004 ( Hughes 2007, in prep.).**

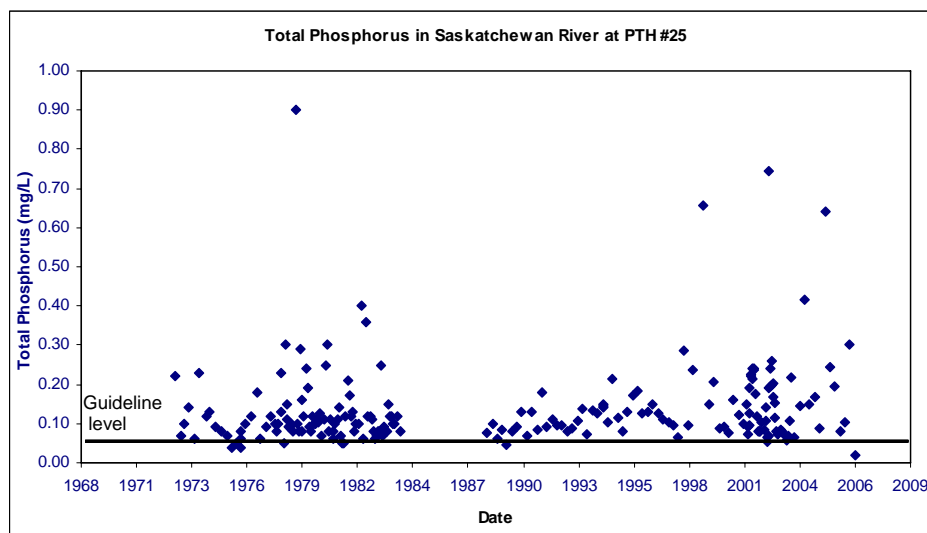
Year	Biological Condition Category	CCME WQI
1995	Slight Impairment	Good
1996	No Impairment	Fair
1997	Moderate Impairment	Good
1998	Slight Impairment	Good
1999	Slight to No Impairment	Good
2000	Moderate Impairment	Good
2001	Slight Impairment	Good
2002	Slight Impairment	Good
2003	Slight Impairment	Good
2004	Slight Impairment	Fair near Good

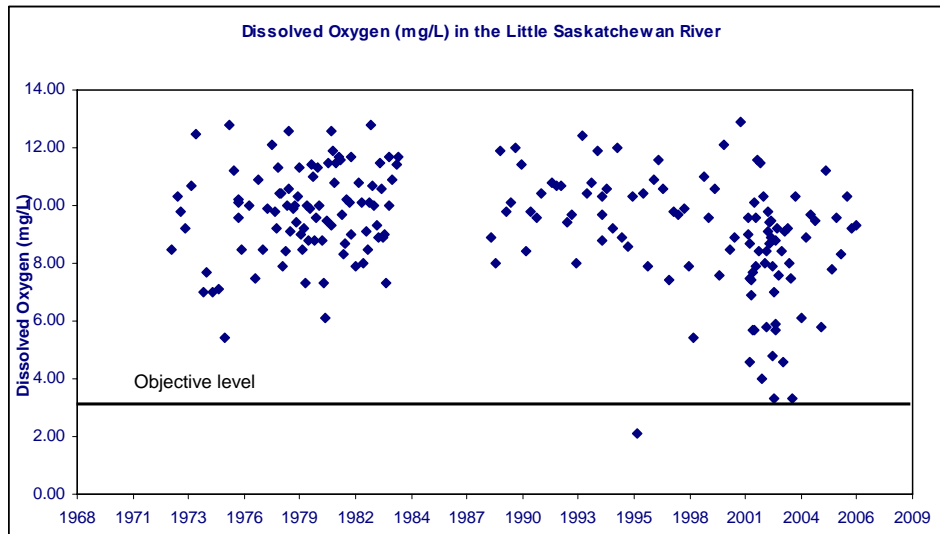
**Long-term data from 1971 to 2006**

Total phosphorus consistently exceeded the narrative guideline of 0.05 mg/L (Figure 4). The province-wide narrative phosphorus guideline of 0.05 mg/L provides general guidance on phosphorus concentrations but will need to be replaced with more ecologically-relevant objectives (See below in Nutrient Section). Other nutrients (ammonia and nitrate/nitrite nitrogen) were within guidelines for the entire period of record. While some water bodies including the Little Saskatchewan River contain naturally elevated concentrations of nutrients due to watershed characteristics, human alterations also impact nutrient loading to this river.

The amount of dissolved oxygen in the Little Saskatchewan River rarely declined to below the Manitoba water quality objective ( Figure 4). Low dissolved oxygen can result from the decomposition of organic material such as algae and plants and is exacerbated during ice cover, a time when dissolved oxygen concentrations are less likely to be replenished. Critically low concentrations of dissolved oxygen can result in fish kills and foul smelling water.

**Figure 4. Total phosphorus (mg/L) and Dissolved Oxygen (mg/L) concentrations from 1971 to 2006 collected from the Little Saskatchewan River at the PTH #25.**

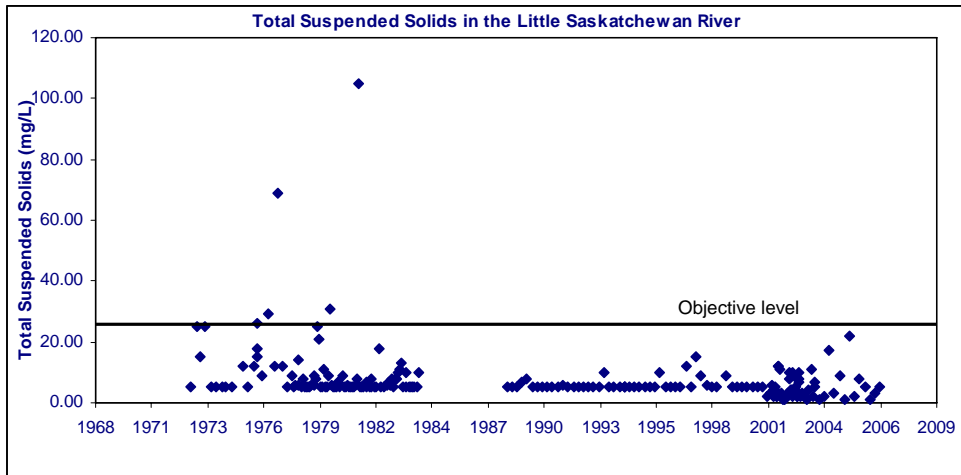




No pesticide exceeded water quality guidelines in the Little Saskatchewan River and most pesticides had concentrations below detectable levels for the entire period of record. Quinalofop, pentachlorophenol, and MCPA were the only pesticides that were detected. However, these detections were rare. Total suspended sediments exceeded the objective occasionally during the 1970's (Figure 5) but have subsequently remained at or below the objective. Total suspended sediments increase after spring runoff and after summer precipitation events. Overland runoff carries soil, silt, and organic debris, all of which will increase the concentration of suspended sediments. Bank erosion will also contribute to increased suspended sediments. Poor land-use practices such as removing vegetated buffer strips from along rivers and smaller tributaries will also increase the overland movement of soil and other debris into the river.

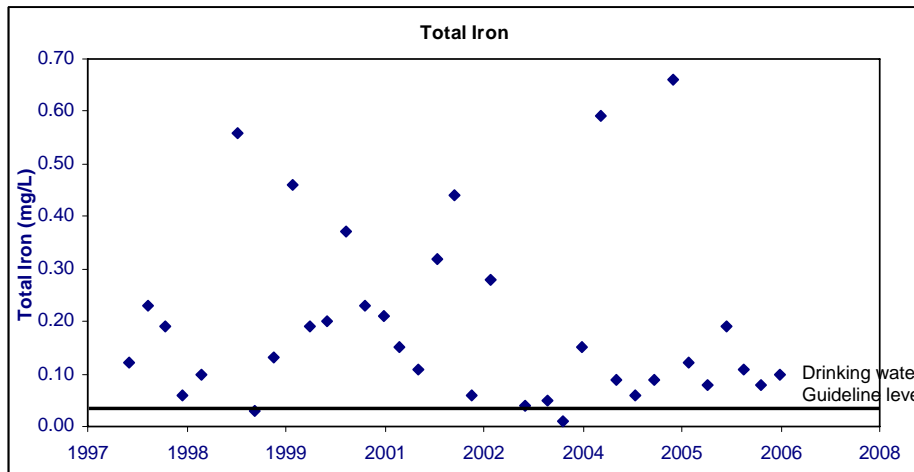


**Figure 5. Total suspended solids (mg/L) from 1972 to 2006 collected from the Little Saskatchewan River at PTH #25. Line indicates the Manitoba Water Quality objective.**



Except for iron and manganese, most of the metals either rarely, or did not, exceed their water quality objectives or guidelines. Iron and manganese exceeded the aesthetic guideline for drinking water in numerous samples over the period of record (Figure 6). Iron is naturally released to surface waters through weathering of iron bearing minerals but significant amounts are also released through industrial processes, corrosion of iron and steel, and discharges from mining operations. Iron can impart a metallic taste and produce a yellow precipitate in water. Manganese is strongly associated with iron in water and is also naturally found in water from weathering of minerals. High concentrations of manganese can impart an unpleasant taste. Exceedence of the iron and manganese aesthetic guidelines is quite common in surface waters across southern Manitoba.

**Figure 6. Total iron (mg/L) and extractable manganese (mg/L) from 1997 to 2006 collected from the Little Saskatchewan River at PTH #25.**



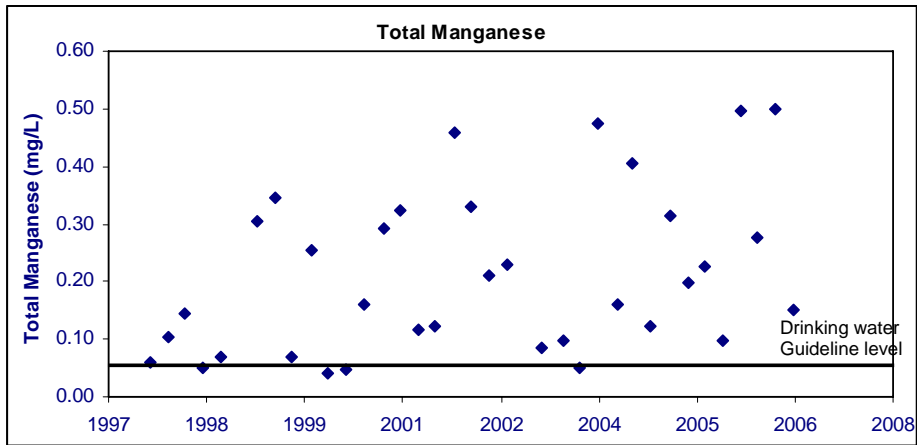
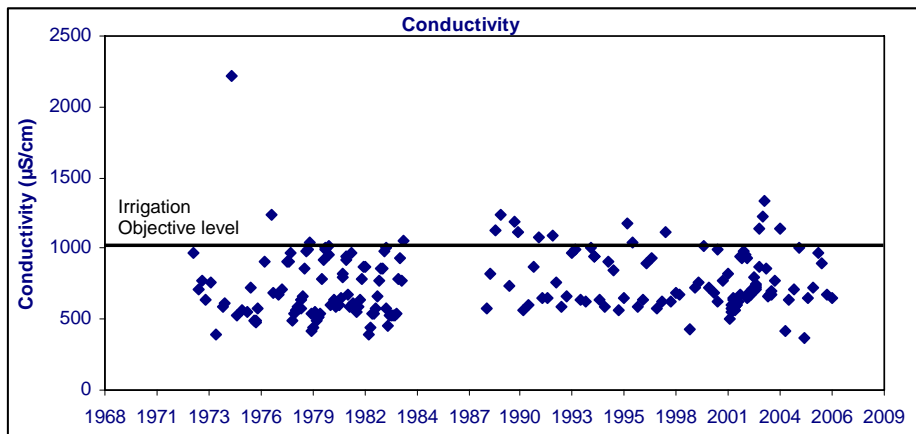


Figure 7. Conductivity ( $\mu\text{S}/\text{cm}$ ) from 1997 to 2006 collected from the Little Saskatchewan River at PTH #25.



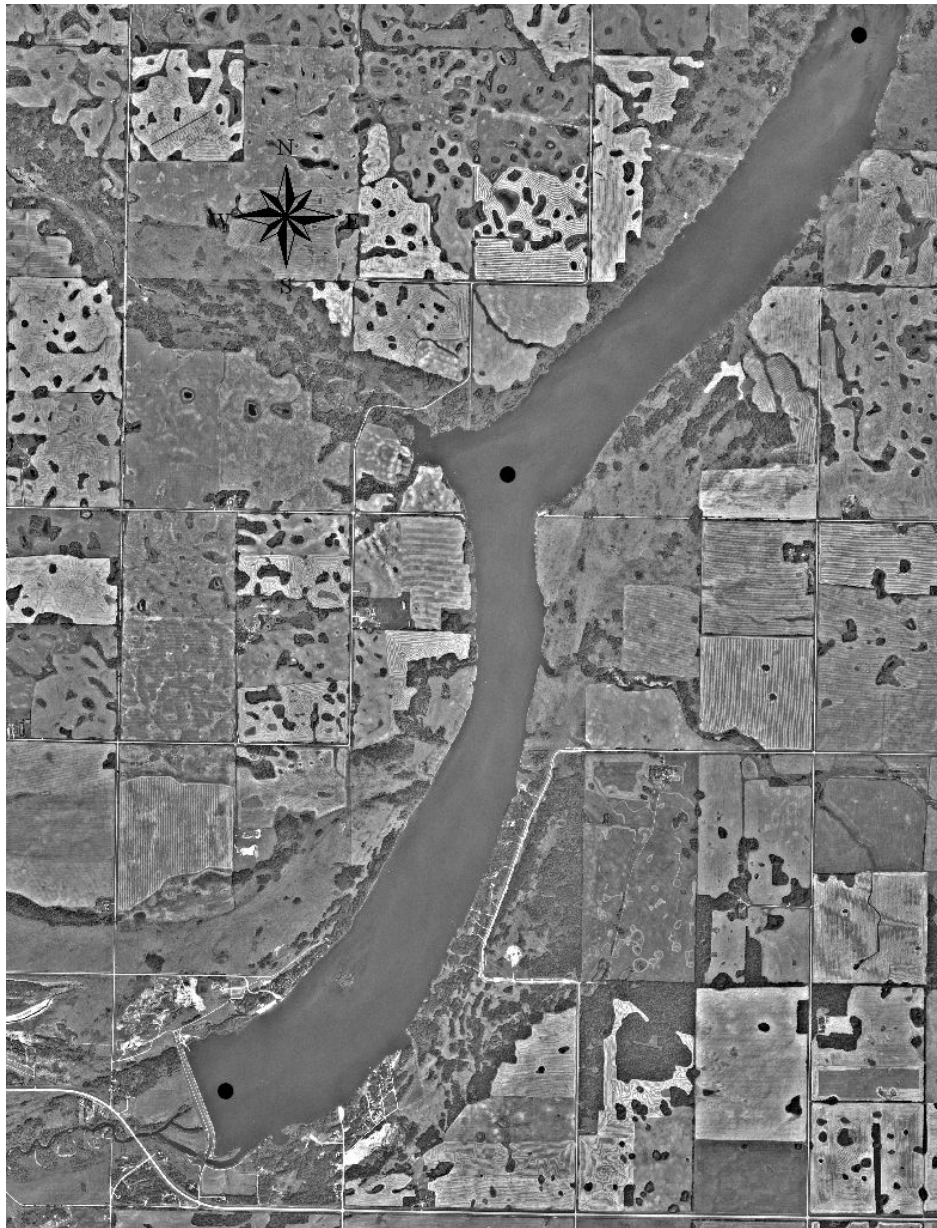
Conductivity occasionally exceeded the water quality objective for irrigation. Specific conductance, or conductivity in water is a measure of the amount of dissolved salts and minerals such as chloride, nitrate, sulphate, sodium, calcium, iron, etc. Conductivity is mostly influenced by soil characteristics of the watershed. Rivers and streams that run through primarily clay soils tend to have higher conductivity because of the presence of materials that ionize when washed into the water. Discharges to rivers and streams, such as municipal discharge, can change the conductivity due to higher levels of sulphate, chloride, and nitrate.

Densities of fecal coliform or *Escherichia coli* remained consistently below the Manitoba water quality objective of 200 organisms per 100 mL of water for all but three measurements during the period of record. These measurements occurred in the fall sampling of 1992, 1994, and 1995. Fecal coliform or *E. coli* in surface water are an indication of contamination from a warm-blooded animal. However, these data do not qualify the source.

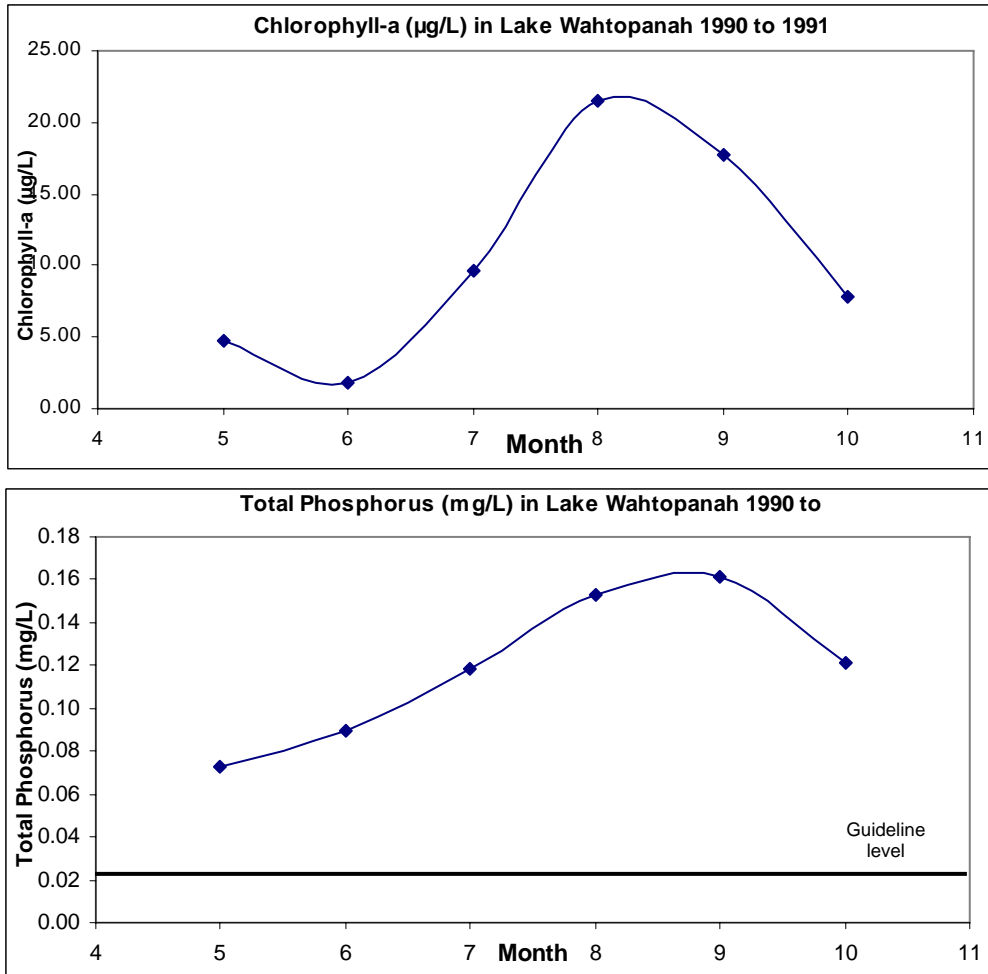
### Other Water Quality Studies

Manitoba Water Stewardship (formerly Manitoba Environment) worked with *The Friends of Rivers Reservoir* who volunteered to collect water samples from three locations in Lake Wahtopanah (Figure 8). Samples were collected during 1990 and 1991. These data were collected from two open water seasons in the early 1990's. No statistically significant differences were found in nutrient concentrations between sites. However, total phosphorus concentrations increased significantly from early spring to late fall. Total phosphorus concentrations increased steadily throughout the summer, very likely contributing to the steady increase in algal growth as measured by concentrations of chlorophyll-*a* (Figure 9).

**Figure 8. Location of the water quality stations on Lake Wahtopanah sampled during 1990 and 1991.**



**Figure 9. Pooled total phosphorus data and chlorophyll-a data from Lake Wahtopanah during 1990 to 1991.**



### Nutrients

Nutrient enrichment or eutrophication is one of the most important water quality issues in Manitoba. Excessive levels of phosphorus and nitrogen fuel the production of algae and aquatic plants. Extensive algal blooms can cause changes to aquatic life habitat, reduce essential levels of oxygen, clog fisher's commercial nets, interfere with drinking water treatment facilities, and cause taste and odour problems in drinking water. In addition, some forms of blue-green algae can produce highly potent toxins.

Studies have shown that since the early 1970s, phosphorus loading has increased by about 10 per cent to Lake Winnipeg and nitrogen loading has increased by about 13 per cent. A similar phenomenon has also occurred in many other Manitoba streams, rivers, and lakes.

Manitobans, including those in the Little Saskatchewan River watershed, contribute about 47 % of the phosphorus and 44 % of the nitrogen to Lake Winnipeg (Bourne *et al.* 2002, updated in 2006). About 15 % of the phosphorus and 6 % of the nitrogen entering Lake Winnipeg is contributed by agricultural activities within Manitoba. In contrast, about 9 % of the phosphorus and 6 % of the nitrogen entering Lake Winnipeg from Manitoba is contributed by wastewater treatment facilities such as lagoons and sewage treatment plants.

As part of Lake Winnipeg Action Plan, the Province of Manitoba is committed to reducing nutrient loading to Lake Winnipeg to those levels that existed prior to the 1970s. The Lake Winnipeg Action Plan recognizes that nutrients are contributed by most activities occurring within the drainage basin and that reductions will need to occur across all sectors. Reductions in nutrient loads across the Lake Winnipeg watershed will benefit not only Lake Winnipeg but also improve water quality in the many rivers and streams that are part of the watershed including the Little Saskatchewan River.

Nutrient reduction targets under the Lake Winnipeg Action Plan are interim targets that reflect the need to take immediate action to reduce nutrient loads to Lake Winnipeg. Manitoba Water Stewardship is working to develop long-term, ecologically-relevant objectives for nutrients in Lake Winnipeg and its contributing basins such as the Little Saskatchewan River. Long-term, ecologically-relevant objectives will also replace narrative guidelines that are currently applied across Manitoba. However, reducing nutrients across Manitoba, the Little Saskatchewan River watershed, and the Lake Winnipeg watershed is a challenge that will require the participation and co-operation of all Manitobans and will involve:

- Implementing expensive controls on nutrients in municipal and industrial wastewater treatment facilities.
- Developing scientifically-based measures to control the application of inorganic fertilizers, animal manure, and municipal sludge to agricultural lands.
- Reducing nutrient contributions from individual cottagers and homeowners.
- Working with our upstream neighbours.

Individual Manitobans can help by taking the following steps:

- Maintain a natural, riparian buffer along waterways. Natural vegetation slows erosion and helps reduce the amount of nitrogen and phosphorus entering lakes, rivers and streams.
- Value and maintain wetlands. Similar to riparian buffers along waterways, wetlands slow erosion and help reduce nutrient inputs to lakes, rivers, and streams. Wetlands also provide flood protection by trapping and slowly releasing excess water while providing valuable habitat for animals and plants.
- Don't use fertilizer close to waterways. Heavy rains or over-watering your lawn can wash nutrients off the land and into the water.
- Use phosphate-free soaps and detergents. Phosphates have been prohibited from laundry detergents but many common household cleaners including dishwasher detergent, soaps, and other cleaning supplies still contain large amounts of phosphorus. Look for phosphate-free products when you are shopping.
- Ensure that your septic system is operating properly and is serviced on a regular basis. It's important that your septic system is pumped out regularly and that your disposal field is checked on a regular basis to ensure that it is not leaking or showing signs of saturation.

#### **Microbiological Data (Lake Wahtopanah Beach)**

Since 2004, Manitoba Water Stewardship has been collecting water samples at the public swimming area of Lake Wahtopanah as part of the provincial beach monitoring program. Densities of the indicator organism *Escherichia coli* are regularly collected from bathing water to assess risk of illness to bather health.

**Table 3. Geometric means of *Escherichia coli* densities taken at the public beach at Rivers Provincial Park (Lake Wahtopanah) during 2004 to 2006.**

Rivers Reservoir	Geometric Mean	Exceedence
4-Aug-04	23	Beach Acceptable
6-Aug-04	11	Beach Acceptable
17-Aug-04	13	Beach Acceptable
2-Sep-04	10	Beach Acceptable
31-May-05	17	Beach Acceptable
27-Jun-05	31	Beach Acceptable
26-Jul-05	27	Beach Acceptable
9-Aug-05	10	Beach Acceptable
23-Aug-05	24	Beach Acceptable
30-Aug-05	198	Beach Acceptable
30-May-06	11	Beach Acceptable
27-Jun-06	10	Beach Acceptable
25-Jul-06	51	Beach Acceptable
22-Aug-06	11	Beach Acceptable

Since 2004, *E. coli* has been above the recreational water quality objective of 200 *E. coli* per 100 ml of water in all samples collected. While results indicate that the beach is safe for recreational activities, additional precautions can be taken by bathers to further reduce their risk of ingesting disease-causing organisms. These include:

- Washing hands before handling food
- Avoiding swallowing lake water
- Staying away from the water if you are experiencing digestive or intestinal problems

### **Nutrient Management Regulation**

Manitoba is proposing a Nutrient Management Regulation under *The Water Protection Act*. The purpose of the proposed regulation is to protect water quality by encouraging responsible nutrient planning, regulating the application of materials containing nutrients and restricting the development of certain types of facilities in environmentally sensitive areas. When nitrogen and phosphorus are applied to land surfaces in greater amounts than can be used by growing plants, excess nutrients can leach into groundwater or run-off into surface water with heavy rainfall, floods, and melting snow.

Manitoba's landscape has been separated into five zones. Zones N1, N2, and N3 consist of land that ranges in agricultural productivity while Zone N4 is generally unproductive land that represents a significant risk of nutrient loss to surface and groundwater. Zone N4 land consists of Canada Land Inventory soil classification 6 or 7 or unimproved organics. Zone N5 consists of urban and rural residential areas.

The proposed regulation also describes a Nutrient Buffer Zone with widths outlined below:

Water Body	A <sup>(1)</sup>	B <sup>(1)</sup>
o a lake or reservoir designated as vulnerable	30 m	35 m
o a lake or reservoir (not including a constructed stormwater retention pond) not designated as vulnerable	15 m	20 m

○ a river, creek or stream designated as vulnerable		
○ a river, creek or stream not designated as vulnerable	3 m	8 m
○ an order 3, 4, 5, or 6 drain or higher		
○ a major wetland, bog, swamp or marsh		
○ a constructed stormwater retention pond		

(1) Use column A if the applicable area is covered in permanent vegetation. Otherwise, use column B.

Under the proposed regulation, no nitrogen or phosphorus can be applied within Zone N4 or the Nutrient Buffer Zone.

More information on the proposed *Nutrient Management Regulation* is available at <http://www.gov.mb.ca/waterstewardship/wqmz/index.html>.

### **Drainage**

Although it is recognized that drainage in Manitoba is necessary to support sustainable agriculture, it is also recognized that drainage works can impact water quality and fish habitat. Types of drainage include the placement of new culverts or larger culverts to move more water, the construction of new drainage channels to drain low lying areas, the draining of potholes or sloughs to increase land availability for cultivation and the installation of tile drainage. Artificial drainage can sometimes result in increased nutrient (nitrogen and phosphorus), sediment and pesticide load to receiving drains, creeks and rivers. All types of drainage should be constructed so that there is no net increase in nutrients (nitrogen and phosphorus) to waterways. To ensure that drainage maintenance, construction, and reconstruction occurs in an environmentally friendly manner, the following best available technologies, and best management practices aimed at reducing impacts to water quality and fish habitat are recommended.

The following recommendations are being made to all drainage works proposals during the approval process under *The Water Rights Act*:

- There must be no net increase in nutrients (nitrogen and phosphorus) to waterways as a result of drainage activities. Placement of culverts, artificial drainage and construction and operation of tile drains can sometimes result in increased nutrient (nitrogen and phosphorus), sediment and pesticide loads to receiving drains, creeks and rivers.
- Synthetic fertilizer, animal manure, and municipal wastewater sludge must not be applied within drains.

### **Culverts**

- Removal of vegetation and soil should be kept to a minimum during the construction and the placement of culverts.
- Erosion control methodologies should be used on both sides of culverts according to the Manitoba Stream Crossing Guidelines for the Protection of Fish and Fish Habitat.
- A strip of vegetation 1 to 3 metres wide should be maintained along drainage channels as a buffer. This will reduce erosion of channels and aid in nutrient removal.
- The proponent should revegetate exposed areas along drainage channels.

### **Surface Drainage**

- Surface drainage should be constructed as shallow depressions and removal of vegetation and soil should be minimized during construction.

- Based on Canada Land Inventory Soil Capability Classification for Agriculture (1965), Class 6 and 7 soils should not be drained.
- There should be no net loss of semi-permanent or permanent sloughs, wetlands, potholes or other similar bodies of water in the sub-watershed within which drainage is occurring.
- Erosion control methodologies outlined in Manitoba Stream Crossing Guidelines for the Protection of Fish and Fish Habitat should be used where the surface drain intersects with another water body.
- A strip of vegetation 1 to 3 metres wide should be maintained along surface drainage channels as buffers. These will reduce erosion of channels and aid in nutrient removal.
- The proponent should revegetate exposed areas along banks of surface drainage channels.

### **Tile Drainage**

- Discharge from tile drainage should enter a holding pond or wetland prior to discharging into a drain, creek or river.

Manitoba Water Stewardship is working towards the development of an environmentally friendly drainage manual that will provide additional guidance regarding best management practices for drainage in Manitoba.

### **Other Measurements of Interest:**

Number of Wastewater Treatment Facilities in the Watershed	8
Number of Intensive Livestock Operations (>300 AU) in the Watershed	8
Number of Waste Disposal Grounds in the Watershed (Class I to III and Transfer Stations)	2

### **Summary**

1. Long-term trend data indicate that total nitrogen decreased from 1973 to 1997 whereas total phosphorus significantly increased during that same time frame.
2. While most water quality variables were well below their provincial guideline or objective for the period of record, total phosphorus remained elevated. Concentrations of total phosphorus were consistently above the Manitoba Water Quality Guideline of 0.05 mg/L for rivers and streams for the entire period of record.
3. The Water Quality Index, which uses numerous variables in the calculations and provides an overall indication of water quality, was generally 'Good' in the Little Saskatchewan River from 1991 to 2006.
4. Elevated concentrations of total phosphorus in Lake Wahtopanah most likely resulted in frequent, and sometimes severe, algal blooms.
5. Recreational water quality at Rivers Provincial Park is excellent.
6. Measures of biological condition of the Little Saskatchewan River indicate that the River is generally 'slightly impaired'.

### **Contact Information**

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And visit the Department's web site: <http://www.gov.mb.ca/waterstewardship>

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