CHAPTER TEN

THE SASKATCHEWAN RIVER SUB-BASIN

Figure 10.1. *The Saskatchewan River Sub-basin*

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THE SASKATCHEWAN RIVER SUB-BASIN

The Saskatchewan River sub-basin begins at the confluence of the North and South Saskatchewan rivers (The Forks), southeast of Prince Albert, Saskatchewan. The sub-basin extends generally eastward through Nipawin and Cumberland House to Manitoba. Crossing into Manitoba, it continues east through The Pas and joins Lake Winnipeg near Grand Rapids. The most significant northern tributaries of the Saskatchewan River are the Torch and Sturgeon-Weir rivers. The Torch River rises on the boreal plain and flows east to Cumberland Lake.

Sub-basin Summary

Characteristics

- boreal transition to boreal shield
- length – 642 km
- gross drainage area – 81 680 km^2
- effective drainage area – 76 384 km^2
- Saskatchewan River Delta – 190 km-long, 9950 km^2 in area

Hydrology

- reliable flow on mainstem and on tributaries
- regulated mainstem

Water Quality

- \- fair to good throughout the sub-basin

Biodiversity

- riparian zones healthy
- drying of Saskatchewan River Delta affects waterfowl
- lake sturgeon important

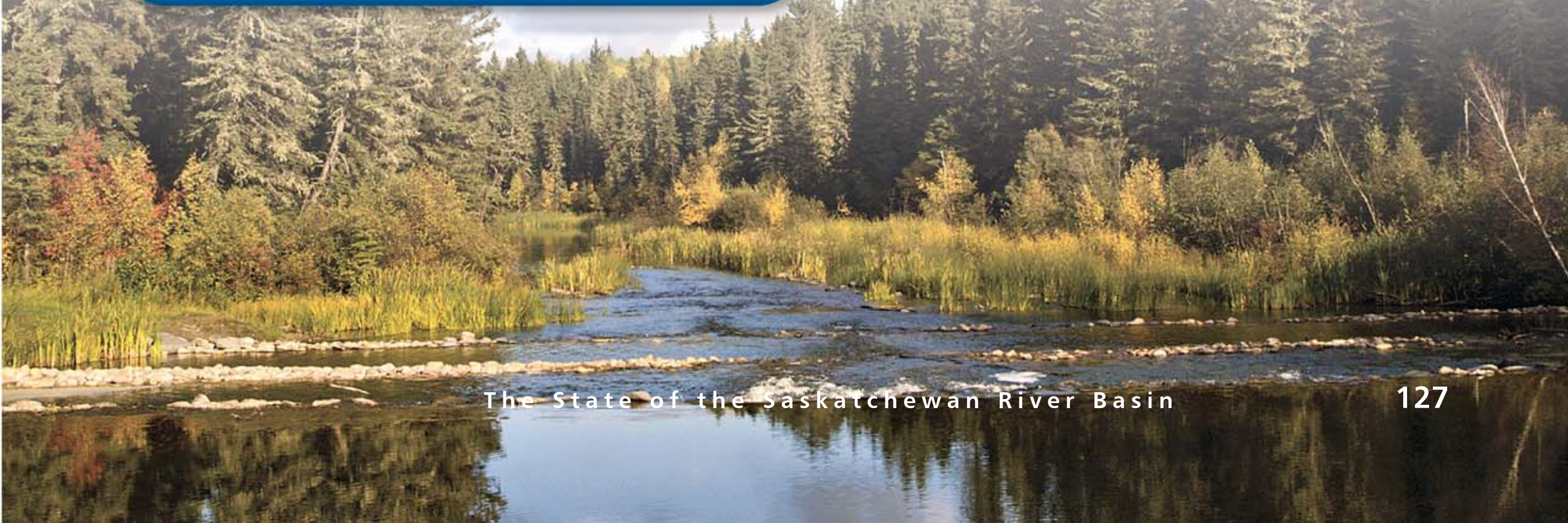
Key Issues

- ecological integrity of the Saskatchewan River Delta
- effects of river regulation
- nutrient and contaminant loading to Lake Winnipeg

The Carrot River, the most significant southern tributary, rises in the boreal plain and flows east to join the Saskatchewan River near The Pas. Some tributaries of the Carrot River rise in the Pasquia Hills, as does the Pasquia River, which also joins the Saskatchewan River near The Pas. Figure 10.1 shows the entire sub-basin.

The Saskatchewan River sub-basin lies almost entirely in the boreal plain ecozone. A portion of the northern headwaters of the sub-basin lies in the boreal shield.

The upper portion of the sub-basin, from The Forks to the head of the Saskatchewan River Delta, is a hummocky to kettled plain, covered in glacial till and relatively level lacustrine deposits. This part of the sub-basin forms the transition from farmland to deciduous forest. There are a large number of small lakes, ponds, and sloughs occupying shallow depressions.[1]



Trembling aspen with secondary quantities of balsam poplar, along with a thick understory, is the predominant vegetation. White spruce and balsam fir also occur. Poorly drained sites are usually covered with sedges, willow, some black spruce, and tamarack.

The lower sub-basin is a relatively flat, low-lying region occupied for the most part by the Saskatchewan River Delta. This area is covered almost entirely by level to ridged glacial till, lacustrine silts and clays, and extensive peat deposits. There are local areas of limestone bedrock outcroppings. The cold and poorly drained fens and bogs are covered with tamarack and black spruce. The mixed deciduous and coniferous forest is composed of stands of trembling aspen and balsam poplar. White and black spruce and balsam fir also occur.

The Pasquia Hills in the southern portion of the sub-basin are up to 400 m higher than the surrounding land. Stands of trembling aspen and balsam poplar with white and black spruce, and balsam fir are most

Gateway to the West

Samuel Hearne established Cumberland House on behalf of the Hudson's Bay Company (HBC) in 1774 close to its current location. This is the basin's oldest permanent community. It was noted at the time that the Northwest Company (NWC), based in Montreal, had already established a fort near what is now known as Cumberland Lake. The competitive atmosphere existing between the HBC and NWC apparently led Samuel Hearne to name his post Cumberland House, fully knowing how the predominantly Scottish NWC would react to naming a post after the English duke who had slaughtered so many of Scots, following the Battle of Culloden in 1746.

Charles John Brydges, Land Commissioner for the Hudson's Bay Company, travelled in the area in 1879 and noted:

> *I left Prince Albert in a York Boat on the 3rd September, and came down the Saskatchewan. Between the forks of that river and Lake Winnipeg, the country on the north side is useless for agricultural purposes. It is rocky land full of lakes and muskeg. In fact I may say that there is no good land between Prince Albert and Grand Rapids on the north side, altho' it is rather better between the former place and Fort a la Corne than below the latter. From La Corne downwards the country to the north is very largely under water, and from what Indians and our own people have told me, this bad land extends very far indeed to the north.*

In 1880, Mr Brydges described 'the improvements necessary to make a satisfactory navigation of the Saskatchewan River.' He requested:

- An additional steamer of large capacity, which the HBC would build if other improvements would be made by the Government of Canada, specifically
  - Piers at the head of two rapids south of Cedar Lake called *Roche Rouge* and *Demi-Charge.*
  - The building of wing dams and removal of boulders at Cole's [La Colle] Falls and Tobin's Rapids. 'At both these places great risk is run and in low water it is quite impossible to ascend them.'
  - He further notes 'I think you are aware that we already have a tramway at Grand Rapids (built in 1877), enabling us to carry passengers and freight round the rapid, upwards of four miles in length and which is quite impassable for any steamer.'

Steamboat activity on the Saskatchewan River was significant by the early 1880s. The *Northcote* and *Lily* were already steaming the Saskatchewan when, in 1882, they were joined by the *Marquis,* the *Manitoba* and the *North West*. Each of these last three vessels had to be warped up the Grand Rapids cataract (a 26 m drop in 7 km), a task that took close to two weeks for all three boats to ascend successfully.

abundant. Poorly drained fens and bogs are covered with tamarack and black spruce. The hills contain deep valleys and a large number of small lakes, ponds, and sloughs occupying shallow depressions. The hills are covered by glacial and lacustrine deposits. Well-drained gray soils are dominant.

The Precambrian Shield in the northern part of the sub-basin consists of ridged to hummocky bedrock, forming sloping uplands and lowlands. Local relief is rarely more than 25 m. Exposed bedrock is common. Soils composed of glacial and lacustrine deposits tend to be thin, although there are some deep peatlands. Lakes of various sizes drain into the river systems. Predominant vegetation consists of closed stands of black spruce and jack pine, shrubs and a ground cover of mosses and lichens. Discontinuous permafrost is common.

Agricultural land-use in the basin includes production of grains, oilseeds and forage in the lower basin and near The Pas. Pulpwood, local saw-log forestry, and a dimension lumber industry operate in the eastern part of the sub-basin. Other land-use activities include trapping, hunting, fishing and tourism. The lower Saskatchewan River Delta also supports commercial fishing. Principal communities in the sub-basin are Flin Flon and The Pas. There are many First Nations reserves and several Métis communities in the sub-basin.

Few protected lands are found within this sub-basin. Clearwater Provincial Park and wildlife areas in the lower Saskatchewan River Delta are examples. The sub-basin also has some privately held conservation lands.

SASKATCHEWAN RIVER DELTA

The Saskatchewan River Delta, shown in Figure 10.2, is the largest inland freshwater delta in North America. The delta was formed during the retreat of glacial Lake Agassiz some 10 000 years ago. A portion of the 6800 km^2 upper delta is commonly called the Cumberland Delta or Cumberland Marsh. This part of the delta is now dominated by a single channel and has forested natural levees. Separated by The Pas moraine, the 3150 km^2 lower delta is much younger and still behaves like a delta. That is, its sediment front is actively advancing into Cedar Lake.

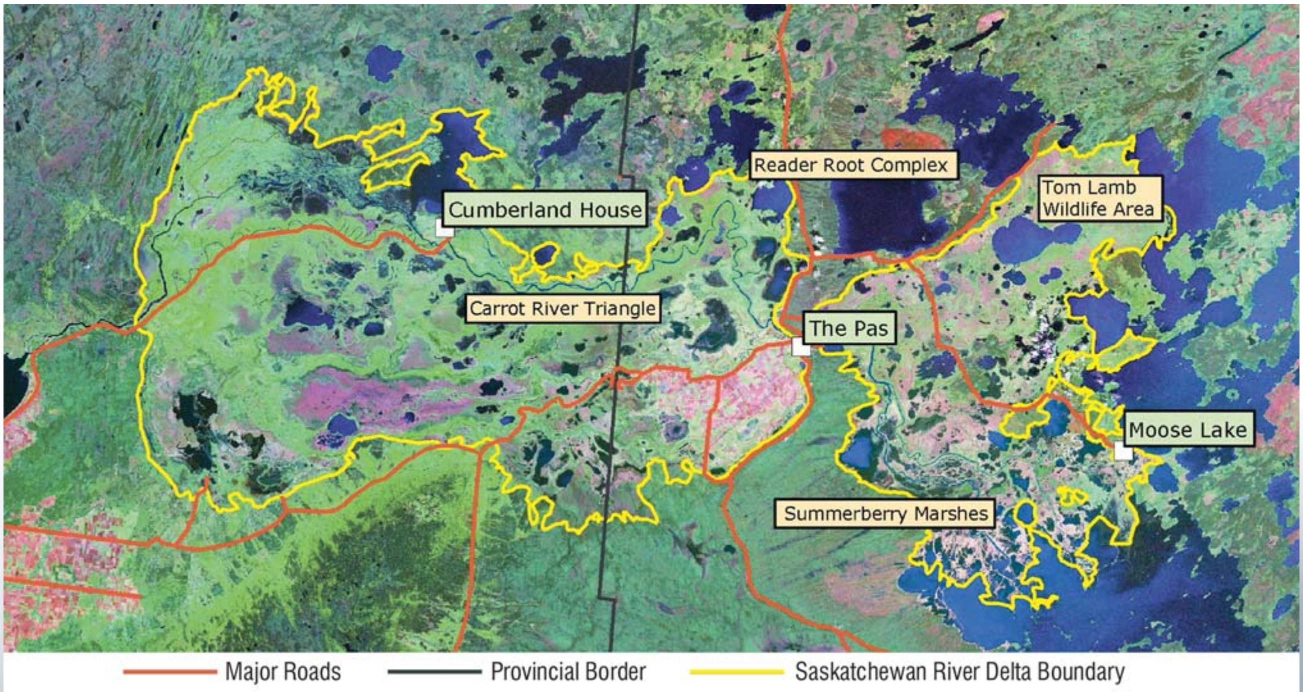


Figure 10.2. The Saskatchewan River Delta *(courtesy of Ducks Unlimited Canada).*

Since the earliest days of human settlement, people have been drawn to the Saskatchewan River Delta. The fertile plain of the delta supports numerous species of water birds, in addition to many mammals and fish species. The Saskatchewan River was the principal transportation corridor for aboriginal people and served as the means by which European explorers entered the interior plains. The delta featured a number of Cree in-gathering sites, where people came together in the spring or fall. Some of these sites had been used for thousands of years, and early fur traders established their posts near these sites. The Pas is one of many such settlements. Cumberland House is not.

The Saskatchewan River Delta has been modified by both natural and human-induced change. A massive change took place in the 1870s, when the course of Saskatchewan River switched from its dominant channel and established a new one, a process known as avulsion. Prior to this time, the Saskatchewan River flowed in a well-developed meandering channel that passed just slightly south of Cumberland Lake. The avulsion, which local knowledge attributes to an ice jam, directed the river and its sediment load north, towards the Torch River. The Torch River channel was unable to contain the new flow. The river now passes through a complex network of new channels and flows into Cumberland Lake. It then leaves the lake, through three channels, to rejoin the Saskatchewan River. Over time, the river will undoubtedly re-establish a single dominant meandering channel.[2] The channel changes brought about by the avulsion eventually put an end to the sternwheeler riverboat traffic on the Saskatchewan River, as the boats were unable to pass through the new channels.[3] The new trans-continental railways doubtless played a part as well.[4]

The avulsion significantly changed the character of Cumberland Lake. The surface area has been reduced from 219 km^2 to 171 km^2, largely on account of delta development at the entrance of the new channels. Although the lakebed has not changed, the lake has decreased in depth from six metres, according to Hudson's Bay Company records, to two metres in the 1950s, to one or two metres today. The physical and ecological changes in the delta are of great concern to local residents. In addition to the effects of the avulsion, the delta has also been affected by completion of the E.B. Campbell Dam in 1963, approximately 30 km upstream of the delta, and Grand Rapids Dam in 1968, downstream of the delta.

The E.B. Campbell Dam, which created Tobin Lake, has modified the flow, sediment and thermal regimes downstream on the Saskatchewan River. The delta is also affected by the lingering effects of the 1870s avulsion and by changing climate. One possible effect of river regulation on the delta is that reduced ice jam frequency may have decreased frequency of overtopping of the natural levees of the channels and flooding of perched basins. This could lead to drying out of the delta.[5] As the delta becomes drier, foliage becomes denser and less suitable for some species. Increased fire suppression also plays a role in vegetative change. Changes in climate variables could lead to drying, although an analysis of evaporation at The Pas shows no trend over several decades.[6] Effects of the dam on the lake sturgeon population of the Saskatchewan River are important, as the sturgeon spawn in the tailrace of the dam.

The Grand Rapids Dam raised water levels on Cedar Lake in the lower delta by 3.5 to 4 m. The reservoir affects up to 2500 km^2 of the lower delta. While the reservoir can affect habitat for water birds and mammals, the key concern is with fish habitat. The commercial fishery on Cedar Lake is the only such fishery in the entire Saskatchewan basin. After a decline in the 1980s, the fishery has now rebounded.

Many control structures and other works have been constructed in the Saskatchewan River Delta. The original structures were built to enhance muskrat populations and to aid forestry transportation. (Water levels in the delta were very low in the 1930s.) By far the most significant works have been those carried out by Ducks Unlimited Canada (DUC) since the 1940s to improve habitat for waterfowl populations. The delta represents DUC's largest single project in North America. The delta is recognized as a Canadian

Important Bird Area of global significance. More than half of the delta consists of wetlands. It is a significant waterfowl-producing area and is critically important to migrating waterfowl and other water birds. Within the Cumberland Marsh – the upper delta – there are now 42 control structures, 60 km of dikes and 90 km of channels regulating water levels in a 1300 km^2 area. There are a further 57 structures in the lower delta aimed at enhancing habitat in three wildlife management areas.[7] Since these works were constructed for waterfowl and muskrat enhancement, fish passage facilities are a relatively recent addition. The muskrat harvest has plummeted since the 1950s, but beaver numbers have increased. There were almost no beaver in the lower delta in the 1940s.

Outside of The Pas, First Nations represent about 20 percent of the population of the delta and a further 78 percent are Métis. Many depend on the hunting, fishing and trapping opportunities provided by the delta. Their long occupancy of the delta and the traditional values imbued in specific species such as lake sturgeon are culturally important.

The first grain grown in the Saskatchewan River basin was in 1751 near The Pas in the lower delta. Within the lower delta is a 550 km^2 area lying between the Carrot and Pasquia rivers, reclaimed for agriculture in the mid-1950s. The project was developed by PFRA with construction of four polders, perimeter dikes, and pumping stations. The land is seeded to grains and oilseeds and yields exceed the provincial average, except in wet years. About 300 km^2 is currently in production.

The delta also has significant forestry resources, discussed in the following section.

FORESTRY

Forestry has a long history in this sub-basin. There has been a forestry industry in the region surrounding The Pas for generations. Similarly, in the eastern part of Saskatchewan, we find a considerable history. Current conditions in the forestry industry, however, have led to a halting of all industrial forestry activities within the Saskatchewan portion of the sub-basin.

Saskatchewan manages its forestry activity through:

- A Forest Management Agreement (FMA) that confers harvesting rights for a specific timber volume for a defined area. This is a 20-year agreement.
- Forest Management Plans (FMPs), which are 20-year plans renewable every ten years. These plans include the licensee's strategies for inventory, harvesting, renewal and access.
- Annual Operating Plans (AOPs), which are five-year plans updated annually detailing how the FMP will be implemented.
- In addition, Saskatchewan also may issue Term Supply Licences (TSLs) that allow harvest of specific products for up to ten years, or a Forest Product Permit that has effect for less than a year but would allow for the harvest of a specific non-timber forest product.[8]

Saskatchewan crown lands, including provincial forests, are subject to an ecosystem-based, comprehensive-planning process. Plans emerging from that process provide a framework for integrated resources management and use. Two land-use planning areas split the Saskatchewan River Delta – the Pasquia/Porcupine to the south and the Amisk-Atik to the north.

Manitoba has divided its forested areas into forest management units (FMU). Each FMU consists of common forest conditions that can be managed as one unit. The forest inventory within each FMU is analyzed to determine annual allowable cuts of softwood and hardwood species. Although there are several FMUs in the sub-basin in Manitoba, harvesting is administered under a single forest management licence, issued to Tolko Industries. Manitoba manages its forestry activity through:

- A Forestry Management Licence (FML) that is granted for a period of not more than 20 years but may be renewed. The FML describes the land upon which trees may be cut, the volume

that may be harvested, and other terms and conditions. There are three FMLs in Manitoba, one of which (that held by Tolko) includes land in the Saskatchewan River basin.
- The holders of an FML are obliged to prepare long-term (20-year) Forest Management Plans (FMPs).
- Annual Operating Plans (AOPs) describing in detail how the licence holder will implement their FMP for the current year and providing a broader understanding of their activities for the following two years.[9]

While lumber markets have plummeted and the Tolko sawmill at The Pas is operating only one shift, five days a week (about 40% of the level of production in the mill as recently as two years ago), production of sack kraft paper continues at a high level. Tolko's annual allowable cut (AAC) in the part of the Saskatchewan River basin they are licensed to utilize is approximately 350 000 m^3. Of that, Tolko regularly harvests only about two-thirds of the AAC. Given that conditions are such that timber volume is about 130 m^3/ha, Tolko is harvesting approximately 2700 ha annually.

The boreal forests of the sub-basin are subject to natural disturbances such as fire, disease, and insects that are part of a healthy forest ecosystem. Indeed, fire is the principal factor controlling species composition and age structure of the forest. Insects are part of the food chain for many bird species, while disease outbreaks are part of the natural evolution of the forest. As forests become more intensively used and harvested, there is a desire to suppress outbreaks of fire, insects or disease. This, in turn, may affect the long-term health of forest ecosystems. Increasing efforts are made to harvest timber so that patterns of natural disturbance are mimicked. Increasingly, fires that do not threaten human settlements may be allowed to burn.

HYDROLOGY

The Saskatchewan River reach extends 642 km from The Forks at elevation 400 m to Lake Winnipeg at elevation 217 m. Unlike the upstream parts of the Saskatchewan River basin, this reach exhibits the conventional pattern of tributaries joining larger streams, like a randomly branching pattern of tree roots. More than 90 percent of the sub-basin contributes to streamflow in a median year. Non-contributory surface drainage, for the most part, lies in boreal wetlands. Boreal fens have considerable sub-surface flow and may indeed contribute flow to the surface water system.

The annual precipitation throughout much of this sub-basin ranges from 425 mm in the west to 450 mm in the east. Precipitation is a little higher in the northern Precambrian Shield portion of the sub-basin. About three-quarters of the annual precipitation falls as rain, with much of that occurring in June through September.

Runoff in the sub-basin is driven by snowmelt and precipitation during the snowmelt period. Figure 10.3 shows the hydrograph of naturalized flows for the Saskatchewan River at The Pas. The peak flow occurs in July as a result of mountain runoff, but the effects of earlier runoff from the tributaries of the lower sub-basin are evident. The figure also shows the median recorded flows since 1965. The differences between recorded flow and naturalized flow demonstrates the cumulative effects of river regulation and surface water consumption in the entire Saskatchewan basin upstream of The Pas. Note, for example, that the recorded plains runoff peak in May is typically higher than the July mountain runoff peak.

One of the major tributaries, the Carrot River, originates in the Waterhen Marsh in east central Saskatchewan and flows northeast for about 400 km, to join the Saskatchewan River near The Pas. (The Waterhen Marsh project, initiated in 1938, was the first Ducks Unlimited Canada project in Saskatchewan). Its largest tributaries include the Leather River, and Goosehunting, Melfort and Burntout creeks. Figure 10.4 provides an example of the median monthly tributary inflow for the Carrot River. Tributary flows for this sub-basin typically peak in May.

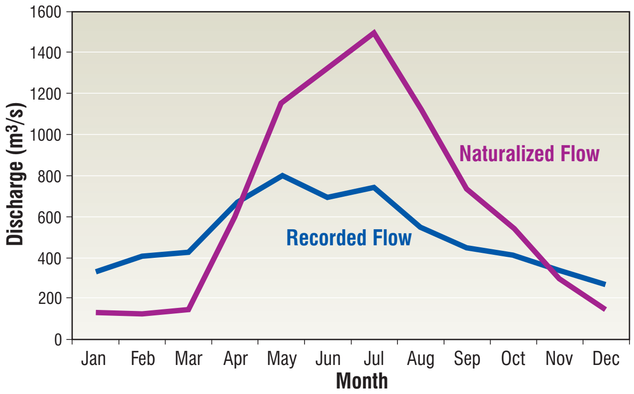


Figure 10.3. Median Monthly Naturalized Flow for Saskatchewan River at The Pas.

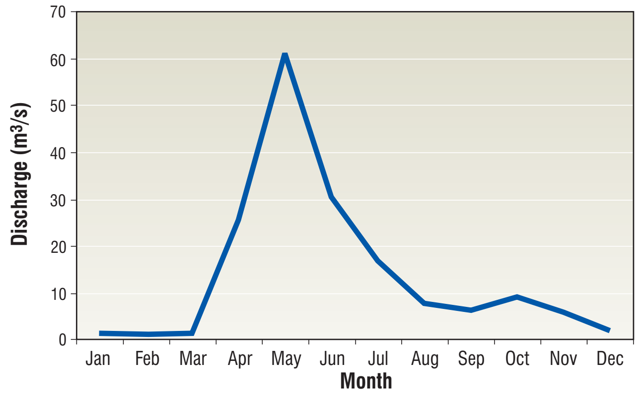


Figure 10.4. An Example of Tributary Flow for the Carrot River.

Although tributary flows in this sub-basin tend to be more reliable than flows of the plains tributaries further upstream, they are still not as reliable as the flows of the mainstem.

The mainstem of the Saskatchewan River is highly regulated. The North Saskatchewan River upstream of The Forks is regulated by two projects, while the South Saskatchewan River is regulated by many projects. SaskPower's Nipawin and E.B. Campbell Generating Stations on the Saskatchewan River provide additional regulation.

At Nipawin, the Francois-Findlay Dam, commissioned in 1985, creates Codette Lake but the project is essentially a run-of-the-river facility, benefiting from upstream regulation. The E.B. Campbell Dam, commissioned in 1963, stores a significant quantity of water in Tobin Lake. The E.B. Campbell Generating Station is used to provide automatic generation control for the entire SaskPower system, by maintaining frequency and matching generation to load demands. Because of this operational characteristic of the generating station, daily water level fluctuations downstream of the dam are highly variable. In the early days of operation, flows downstream of the dam would drop to near zero on weekends. Because of concerns from downstream communities, the operating plan was changed in September 2004 to maintain a minimum flow of 75 m^3/s. Figure 10.5 shows the flow variations below this generating station.

The reservoir traps sediments as well as nutrients and contaminants bound to those sediments. Cumberland Lake, formerly a place where river sediments have been deposited, has become a source of sediments. The relatively clear water released from the reservoir leads to degradation or down-cutting of the river channel downstream. This effect extends some 40 km downstream: that is, into the Saskatchewan River Delta.

The Saskatchewan River flows are smoothed by the passage of the river through Cumberland Lake. Further downstream, just before the river joins Lake Winnipeg is Manitoba Hydro's Grand Rapids Generating Station. The station provided automatic generation control for the entire Manitoba Hydro network. This means that downstream water level fluctuations are considerable.

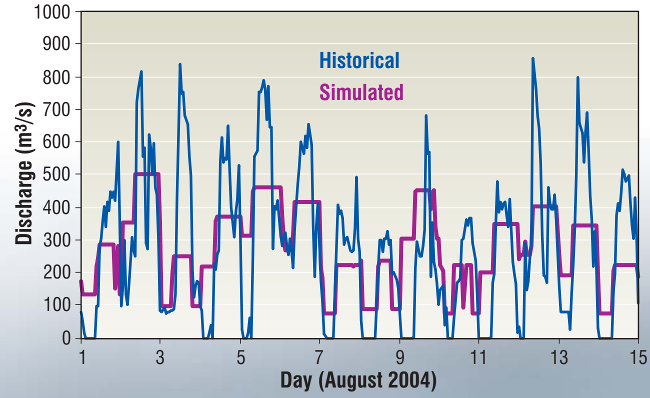


Figure 10.5. Effect of 75 m^3/s Downstream Flow Constraint at E.B. Campbell Dam.

Under most circumstances, the Grand Rapids Dam completely regulates the Saskatchewan River. The usable storage in Cedar Lake is about double that in Lake Diefenbaker although the reservoir rarely reaches it full supply level.

The Saskatchewan River has been affected significantly by river regulation and by upstream water consumption. While recorded flows have trended downward, there is no apparent trend in the naturalized flows of the river.[10] That is, the reduced flows in the river are attributable to increased water consumption, not decreased supply.

Water levels and streamflows are monitored at gauging stations in this sub-basin by the Saskatchewan Watershed Authority, Environment Canada, Manitoba Hydro and Manitoba Water Stewardship. There are 34 gauging stations, 16 of which are streamflow stations.

WATER USE

The licensed water allocation in the Saskatchewan sub-basin is 470 578 dam^3 from surface water and 9499 dam^3 from groundwater. Figure 10.6 shows the distribution of water licences from surface water. Water consumption is very low in comparison to overall supply.

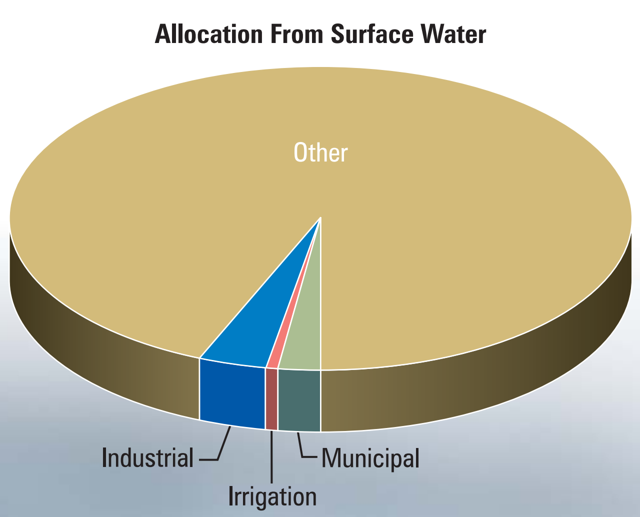


Figure 10.6. Licensed Withdrawal from Surface Water.

Roughly half of the groundwater-pumping is for drainage at the Nipawin Generating Station, and this water is returned to the Saskatchewan River. Most of the remaining groundwater allocation is for municipal purposes, and much of that also returns to surface waters.

The only significant surface water allocation – the 'other' sector in Figure 10.6 – in the Saskatchewan sub-basin is for lake stabilization and habitat enhancement. Many of the latter projects are DUC developments. The water allocated to this category is consumed by losses to groundwater or evaporation. The only significant industrial demand is for the Tolko Industries pulp and paper mill at The Pas; much of this water is consumed. Most of the water allocated to municipal purposes returns to surface water.

The flows in the Saskatchewan River are subject to the PPWB *Master Agreement on Apportionment*. The Master Agreement requires that Saskatchewan pass half of the natural flow received from Alberta to Manitoba, plus half the natural flow that originates in the basin within Saskatchewan. In practice, the quantity of water originating in Saskatchewan is small compared to that received from Alberta.
The Saskatchewan River tributaries that rise in Saskatchewan and flow across the interprovincial boundary, before joining the Saskatchewan River, are considered separately under the Master Agreement. If water uses in Saskatchewan on say, the Carrot River, became significant, the natural flow would be divided equally between Saskatchewan and Manitoba.

WATER QUALITY

Water quality is routinely monitored at several locations in this sub-basin. Table 10.1 lists these locations.

Long-term monitoring data have been used to produce an overall water quality index for the Saskatchewan River at the interprovincial boundary. This index is shown in Figure 10.7. Water quality at this location is strongly influenced by flow conditions, as there are few point sources of contamination. High flow conditions,

Table 10.1. Long Term Water Quality Monitoring Locations.

Stream	Location	Agency	Remarks
Saskatchewan River	at interprovincial boundary	Environment Canada	PPWB site near Manitoba boundary
Saskatchewan River	at The Pas	Manitoba Water Stewardship	upstream of Carrot River
Cedar Lake		Manitoba Water Stewardship	
Saskatchewan River	at Grand Rapids	Manitoba Water Stewardship	
Carrot River	near Turnberry	Environment Canada	near Manitoba boundary

for example, may result in contributions of water usually retained in the marshes of the Saskatchewan River Delta to the flow of the Saskatchewan River. These waters tend to have higher concentrations of mineral, nutrients, and total dissolved solids.

Water quality in the mainstem of the Saskatchewan River is generally fair to good. Phosphorus and nitrogen are nutrients of considerable concern, with respect to water quality in Lake Winnipeg. Although trends in nitrogen concentrations have not been analyzed, those for phosphorus concentrations along the Saskatchewan River system have been produced. There has been no significant trend in phosphorus concentrations along the mainstem of the Saskatchewan River during the period 1974 through 1999. However, there was a significant increase in phosphorus concentrations in the Carrot River, near Turnberry, during that same period. The phosphorus concentrations at Grand Rapids, just before the flow enters Lake Winnipeg, tend to be lower than further

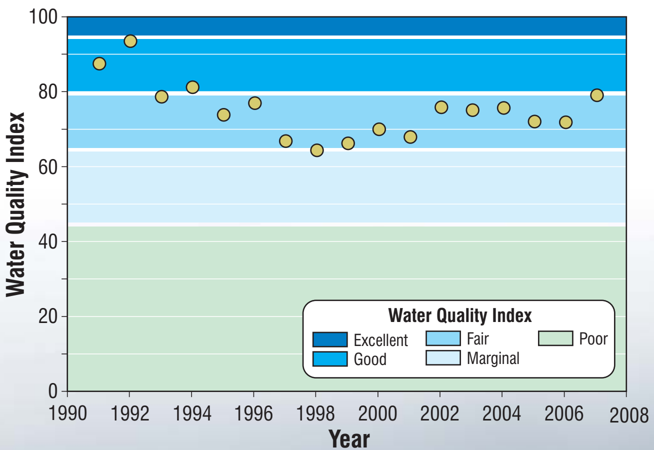


Figure 10.7. General Water Quality Index for the Saskatchewan River.

upstream, suggesting phosphorus assimilation by vegetation in Summerberry Marsh and other wetlands above Cedar Lake and, particularly, retention within Cedar Lake itself. Although the concentrations of nutrients in the Saskatchewan River are not particularly high, the volume of flow means that nutrient loadings to Lake Winnipeg are still significant.

BIODIVERSITY AND ECOSYSTEMS

Although the relatively high flows of the Saskatchewan River and the small numbers of people living in this sub-basin may suggest environmental stress in the sub-basin is low, ecosystems have been altered because of river regulation. Forest harvesting has also altered the terrestrial landscape. Large mammals such as black bear and moose occur throughout the sub-basin. White-tailed deer and coyote are common in the upper sub-basin while other mammals such as wolves, lynx, and snowshoe hare occur in the lower basin. The upper sub-basin provides critical habitat for large numbers of neotropical migrant bird species, as well as ruffed grouse and waterfowl. Bird species in the lower sub-basin include raven, common loon, spruce grouse, bald eagle, gray jay, hawk owl, and waterfowl. The Saskatchewan River Delta is an enormously productive ecosystem. More than 50 plant species have been identified and 48 fish species.[11] Aquatic mammals such as beaver, muskrat, mink and otter are found throughout the delta. Water birds include ducks, geese, swans, shorebirds, grebes, terns, and gulls. Yellow rails – a species of concern – are present during the breeding season. The delta has been recognized as a globally significant Canadian Important Bird Area. This is based on population numbers of several species of waterfowl. The delta, for example, has about 10 percent of the world's population of ring-necked ducks. The upper delta is also ranked as nationally important for migratory birds, one of only two such areas in the basin.[12]

With the exception of the Saskatchewan River Delta, very little information is available concerning the algae, plants and invertebrates of the sub-basin. There are no indications that populations are unhealthy, except for effects of river regulation.

The terrestrial and aquatic ecosystems of the lower basin may be affected by acid deposition, caused by sulphur and nitrogen compounds. Fortunately, agricultural soils are not sensitive to acid deposition. Only the forested upland of the boreal shield north of the Saskatchewan River is sensitive to acid deposition and currently receives atmospheric loads that exceed critical loads.[13] Sulphur dioxide and various nitrogen oxides originating in Alberta oilsands developments, and carried eastward by prevailing winds, are the primary source of the problem. Sulphur dioxide emissions from a smelter at Flin Flon also contribute.

The main stem of the Saskatchewan River is noted for fish species such as burbot, goldeye, lake sturgeon, northern pike, perch sauger, and walleye. Tobin Lake is considered a major destination for those who seek trophy-sized pike and walleye. The commercial fishery in Cedar Lake is dependent on species such as walleye and goldeye and to a lesser extent, whitefish, sauger, and pike.

Although lake sturgeon occur throughout the North and South Saskatchewan rivers and the Saskatchewan River, its numbers have been declining and the species is considered endangered. The species is long-lived but reproduces slowly. Since sturgeon migrate up to 100 km, they are threatened by habit fragmentation from construction of dams and control structures. Mortality tends to be higher in flood years. The sturgeon population downstream of E.B. Campbell Dam is of particular interest because of long association with the people of Cumberland House and The Pas. About 3 to12 percent of the population is harvested annually by aboriginal people. Sturgeon spawn at several locations in the Saskatchewan River Delta, as well as below the dam. Fish hatcheries at Grand Rapids and Fort Qu'Appelle are used to support stocking programs.

ENDNOTES

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