# THE NORTH SASKATCHEWAN RIVER BASIN

The North Saskatchewan River Basin (NSRB) is a large watershed in Western Canada, encompassing parts of Alberta and Saskatchewan. The NSRB is defined by the North Saskatchewan River (NSR), which has its headwaters in the Columbia Icefields of the Rocky Mountains and flows eastward. In Saskatchewan, east of Prince Albert, the NSR merges with the South Saskatchewan River before continuing to Lake Winnipeg and eventually draining into Hudson Bay.

Several smaller waterways, called tributaries, flow into the NSR along its length. Several major tributaries located near the headwaters contribute significantly to the river's annual flow, including the Cline, Clearwater, Ram, Baptiste, and Brazeau rivers. Other major tributaries downstream of Edmonton include the Sturgeon and Vermilion rivers in Alberta.


***Did you know...***
***By the time that the NSR reaches the town of Drayton Valley, approximately 130km southwest of Edmonton, 87% of the NSR's flow is accounted for on an annual basis***

*Figure 1. Saskatchewan River drainage basin. Source: Canadian Encyclopedia, https://www.thecanadianencyclopedia.ca/en/ article/saskatchewan-river*

## WATER QUANTITY

The NSR generates approximately 5% of Alberta's total water supply. Typically, water quantity is reported as river flow (volume per time) to allow for continuous readings. River flows in the NSRB fluctuate seasonally. Generally, flows are lowest during the winter. During the spring freshet, when the snowpack and ice melts in the headwaters, flows rapidly increase. Precipitation during the spring and summer also contributes to river flows.

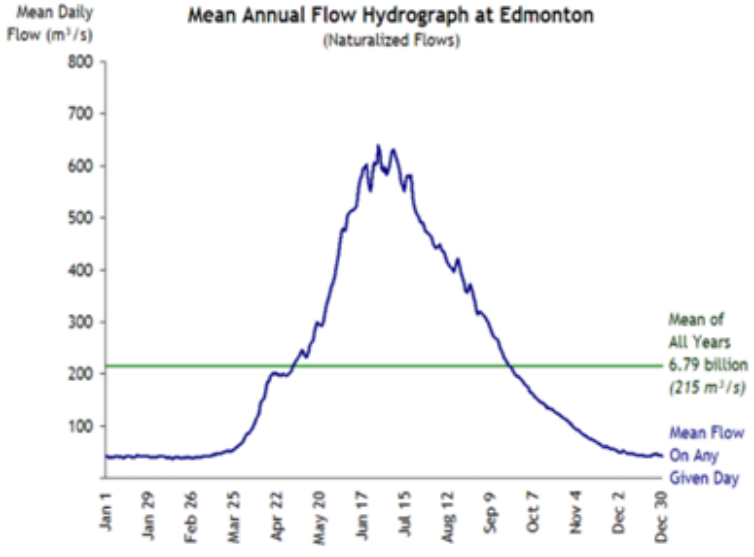


*Figure 2. Mean Annual Hydrograph at Edmonton. EPCOR. (2020). Source Water Protection Plan.*

Two hydroelectric dams are located in the headwaters of the NSR: The Brazeau dam (built 1965), located on the Brazeau River, and Bighorn Dam (built 1972) on the NSR mainstem. These two dams regulate the NSR's downstream flows to allow for higher flows during the winter and decreased flows in the summer than preexisted the dam. The dams typically reach full capacity in late summer and early fall and are nearly emptied by the start of spring runoff each year.

As a result, the dams do not substantially alter the annual discharge of the North Saskatchewan River, but only the timing of the flows. However, the dams do not protect the NSR from flooding.

Over the 96-year period from 1912 to 2007, there has been a statistically significant long-term decline in annual natural flow in the NSR, with a confidence level of 90%. This decline averages about 0.14% per year, or roughly 1.4% per decade. As part of the NSRB Roadmap Project, climate change impacts on future water supplies will be modelled.

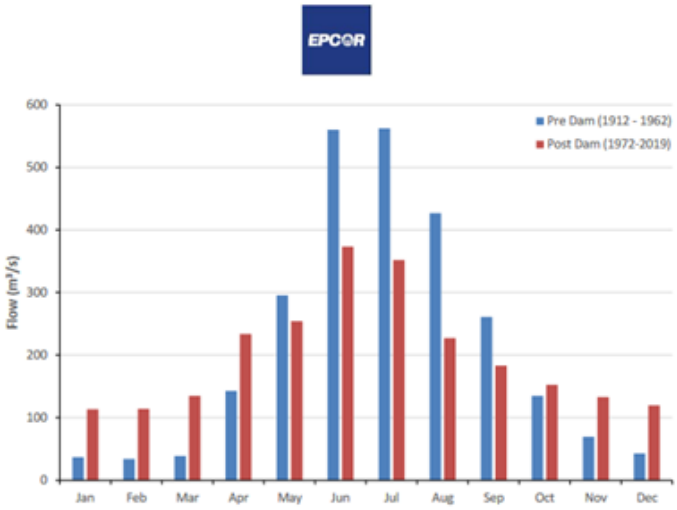


*Figure 3. Mean Monthly Flows at Edmonton Before and After Dam Operation. EPCOR. (2020). Source Water Protection Plan.*

***Did you know...***

**The construction of the Bighorn dam led to the creation of a reservoir, better known Lake Abraham, Alberta's largest artificial lake.**

*Figure 4: TransAlta's Bighorn Dam Retrieved from https://transalta.com/about-us/our-operations/facilities/bighorn/*

# WATER USE

In Alberta, the diversion of water is regulated by the Water Act. To divert water for non-household use from surface water and groundwater sources, an individual must be granted a water license that specifies how much water they may legally use and with what priority. The total amount of water licensed, or "allocated", for use does not indicate the actual water use in a basin, as many users will not use their total allocations, and some users, like municipalities, return water to the source after use. When water is returned to the environment, it is considered available for other uses, including baseline environmental flows or withdrawal licenses. Water that is not returned to the environment after use is called water consumption.

Water licenses operate according to a water license priority system. During periods of water scarcity, licenses issued earlier are entitled to their entire allocation before newer, lower priority licenses may take any of their allocation. The purpose of a license, such as drinking water, does not affect its priority. During water shortages, senior license-holders may choose to share their allocations with junior license-holders to ensure that essential needs, such as municipal water supply, remain accessible. However, the NSRB Roadmap project will not be constrained by water license priority limitations and will seek opportunities for collaboration instead.

In total, approximately 18% of the mean annual volume of the North Saskatchewan River, or around 1.2 billion cubic meters, was allocated for use (Alberta Environment, 2024). In practice, water license users often use less than their allocation. There has been a significant decrease in allocation in the NSRB since 2016, when there was a decline in water used for cooling in thermal power plants.

Water licenses are grouped into large categories, such as agriculture, commercial, industrial, and municipal use. Additionally, water licenses are issued for environmental projects and storm water management.

The human population in the NSRB is increasing and is expected to cause an increase in urban and industrial growth, particularly in the Edmonton Metropolitan Area. Edmonton's population increased 8.3% between 2016-2021, and this growth trend is expected to continue.[1] If this medium-growth trend indeed continues, it is estimated that municipal water use in the NSRB will increase by 16% in the next 15 years.

*Figure 5: Aerial View of the Edmonton River Valley. Images Alberta.*

[1] Statistics Canada. 2023. (table). Census Profile. 2021 Census of Population. Statistics Canada Catalogue no. 98-316-X2021001. Ottawa. Released November 15, 2023. https://www12.statcan.gc.ca/census-recensement/2021/dp-pd/prof/index.cfm?Lang=E

As part of the NSRB Roadmap project, we will examine the impact of population and industrial growth on water demands over time.

Alberta is obligated to share a portion of the NSR's flows with Saskatchewan. Under the 1969 Prairie Provinces Water Board (PPWB) Master Agreement on Apportionment, Alberta must pass 50% of the natural flow of rivers into Saskatchewan. As a condition of this agreement, certain water quality standards must also be met.

# WATER MANAGEMENT

There is no Water Management Plan for the NSRB, therefore the Government of Alberta's Surface Water Management Directive governs the NSRB's water goals, including water allocation limits, environmental considerations, and best practices.

Additionally, the Government of Alberta released a Surface Water Quality Management Framework for the NSR Basin. Water quality and water quantity are strongly tied together. Minimum flows are required to maintain water quality, both for human use and the overall health of the aquatic ecosystem.

The designated Watershed Planning and Advisory Council (WPAC) for the North Saskatchewan River under the Government of Alberta's Water for Life Strategy is the North Saskatchewan Watershed Alliance (NSWA).


*Figure 6: Map of WPACs in Alberta. Source: Government of Alberta Environment and Parks.*

# WATER QUALITY + TREATMENT

Like water quantity, water quality fluctuates in the NSRB. These fluctuations may be related to seasonal changes, including the spring melt or high-precipitation events, but land uses have the potential to modify the overall quality of waterbodies and waterways in a basin. If run off increases, increased nutrients and pollutants may enter waterways, decreasing downstream water quality.

Wastewater has a significant impact on downstream water quality. After water is withdrawn from a waterbody or waterway by a municipality and used, this wastewater is treated, and the resulting effluent is returned to the natural system. Wastewater effluent is treated according to the Federal Government's Wastewater Systems Effluent Regulations, which outlines wastewater management standards, including effluent quality treatment and release standards.

Because of its high population density and level of industrial activity, the Edmonton Metropolitan Area has long had the most concentrated impact on downstream water quality of the NSR. Stormwater run-off and wastewater effluent are responsible for this decrease in water quality. Historically, domestic sewage and industrial wastewater was directly released into the river or only minimally treated. Since the 1960s, downstream quality has steadily improved as improved wastewater treatment and improved water quality monitoring has been adopted. Municipal wastewater in Edmonton is treated at the Goldbar Wastewater Treatment Plant, downstream of the E.L. Smith and Rossdale Water Treatment Plants.

Due to the impacts of the City of Edmonton on water quality, EPCOR maintains a regional water service area that makes treated water available to surrounding communities.Water is treated at the both water treatment plants in Edmonton, before being distributed to over 90 communities and counties, both within and beyond the Metropolitan area.


*Figure 7. EPCOR Edmonton Region Water Service Area. Retrieved from https://www.epcor.com/content/dam/epcor/documents/supporting-documents/edmonton_regional-water-service-area.pdf*

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# BASIN CHARACTERISTICS

Given the scale and diversity of the NSRB in Alberta, the watershed is organized into subwatersheds for more effective water management. The NSR's subwatersheds are delineated based on the major tributaries, as well as the natural topography and hydrology of the regions, which directs water from various parts of the landscape into the tributaries and ultimately into the NSR.

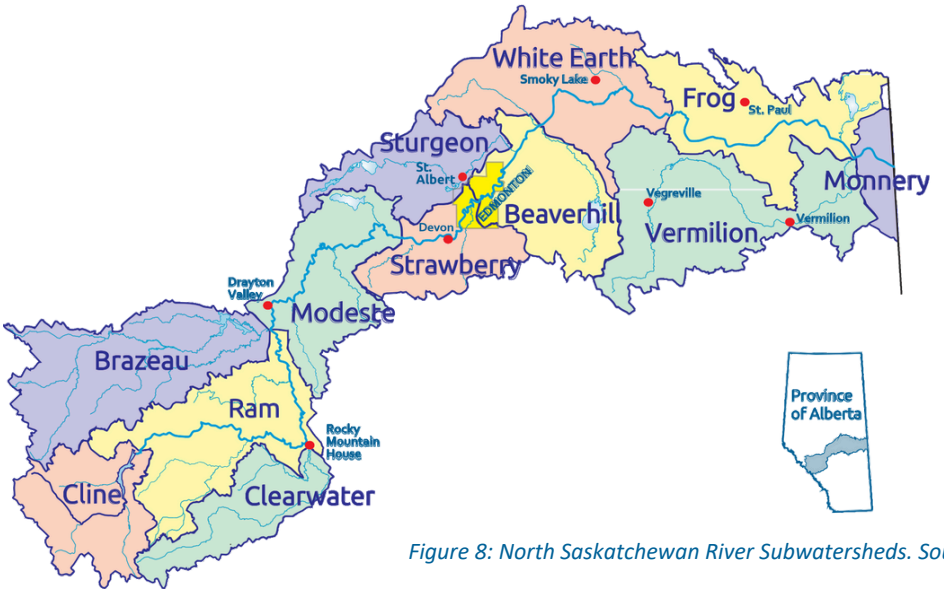


*Figure 8: North Saskatchewan River Subwatersheds. Source: NSWA*

The Cline, Brazeau, Ram, and Clearwater subwatersheds are located near the NSR headwaters, in the Rocky Mountain and foothills natural regions. These headwaters regions are home to many protected areas, particularly in the Cline subwatershed. Active industries include forestry, oil and gas, and tourism. The largest urban community in these upstream subwatersheds is the town of Rocky Mountain House.

[MS1] Further East, the Modeste subwatershed is located in the foothills and boreal natural regions. The Modeste subwatershed functions as a transition between the sparsely populated headwaters and the more urbanized downstream regions of the NSRB. The oil and gas industry is significant to the economic base of the area, particularly near the town of Drayton Valley.

The Strawberry, Sturgeon, and Beaverhill subwatersheds are located in the parkland and boreal forest natural regions. The City of Edmonton Metropolitan Area is located across these three subwatersheds. The White Earth sub-watershed is environmentally similar, though sparsely populated by comparison. Outside of the highly urbanized areas, key economic activities include agriculture and oil and gas production, processing, and aggregate extraction.

The eastern-most areas of the NSRB in Alberta are home to the Vermilion, Frog, and Monnery subwatersheds. All three subwatersheds are characterized by agricultural activities and are dominated by grassland and cropland.

# INDIGENOUS NATIONS

The NSRB is located in the territories of Treaty 6, Treaty 8, and the Métis homeland. Several First Nations have reserve lands across the NSRB in Alberta: Alexander First Nation, Alexis Nakoda Sioux Nation, Enoch Cree Nation, Frog Lake First Nation, O'Chiese First Nation, Onion Lake Cree Nation, Paul First Nation, Saddle Lake Cree Nation, Stoney Nakota First Nation, Sunchild First Nation.

Three Metis settlements are also located in the NSRB, including Elizabeth Lake, Fishing Lake, and Kikino.

Few of these indigenous nations are connected to regional water lines, relying instead on local sources of water.

# MUNICIPALITIES

The NSRB in Alberta is home to nearly 80 municipalities. Edmonton is the largest urban centre, with a population of 1,010,899 people in 2021. Edmonton's population increased 8.3% between 2016-2021, and this growth trend is expected to continue [1].

Six of the seven cities in the NSRB in Alberta are in the Edmonton Metropolitan Area: Beaumont, Edmonton, Fort Saskatchewan, Leduc, Spruce Grove, and St. Albert. Other adjacent areas, including Strathcona County and Parkland County, are also a part of the Edmonton Metropolitan area. Together, these municipalities are home to an estimated 1,561,810 people [2].

West of Edmonton, larger centres include the towns of Devon, Drayton Valley, Rocky Mountain House, and Stony Plain.

East of the Edmonton Metropolitan Area, larger centres include the City of Lloydminister, and towns of St. Paul, Vegreville, and Vermilion.

[1] Statistics Canada. 2023. (table). Census Profile. 2021 Census of Population. Statistics Canada Catalogue no. 98-316-X2021001. Ottawa. Released November 15, 2023. https://www12.statcan.gc.ca/census-recensement/2021/dp-pd/prof/index.cfm?Lang=E (accessed September 23, 2024).
[2] Government of Alberta Office of Statistics and Information. 2024. https://regionaldashboard.alberta.ca/region/customregion/19/population/#/

# HUMAN FOOTPRINT

The diversity of natural regions across the NSRB in Alberta supports a variety of land uses and variable levels of land intactness. Human footprint describes the impact of human land-use changes on an environment.

Since land use changes can have significant impacts on downstream water quality and water quantity, measuring the human footprint of an area can provide general guidance about the overall watershed health. In areas with a more concentrated human footprint, like urban and industrial areas, natural environmental processes tend to be disrupted more than in naturalized areas like parks, gardens, and riparian zones along waterways.

As of 2021, it is estimated that the human footprint in the NSRB in Alberta is 51.8% of the total watershed area [1]. However, human footprint is not uniform across the NSRB. Upstream of Edmonton, the human footprint was estimated to be lower, totalling 30.7% .  Notably, most of this 30.7% is accounted for in the corridor between Drayton Valley and Edmonton.

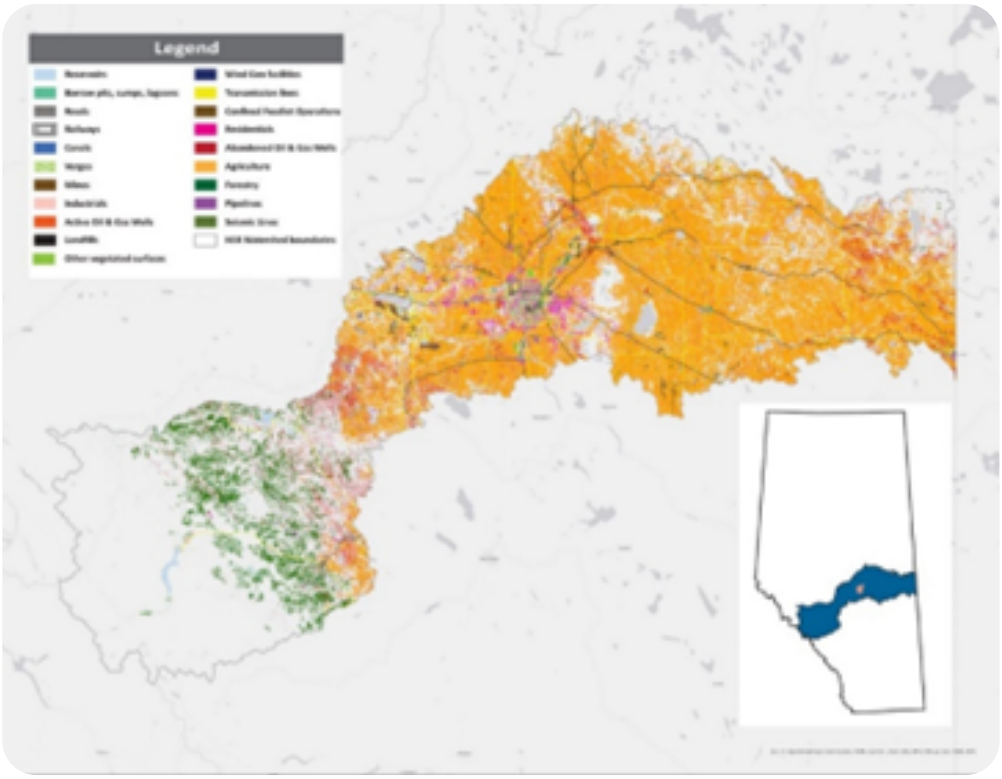


*Figure 9: NSR Watershed Human Footprint Map. Source: NSWA.*

[1] Alberta Biodiversity Monitoring Institute. 2024. Summary of Land Cover and Biodiversity: North Saskatchewan Watershed Alliance. ABMI Online Reporting for Biodiversity (ORB) Tool: Statistics Canada. 2023. (table). Census Profile. 2021 Census of Population. Statistics Canada Catalogue no. 98-316-X2021001. Ottawa. Released November 15, 2023.