

## CLIMATE CHANGE

The specific effects of climate change on Alberta's water supply are not crystal clear, but there is growing agreement on the broader pattern, and certainly, the range of possibilities. Seen individually, none of them are particularly pleasant. When combined, the entire nest presents a serious challenge for water resources management and policy in the future.

*This backgrounder is part of "From H<sub>2</sub>O: Turning Alberta's Water Headache to Opportunity," a forthcoming research paper by Casey Vander Ploeg identifying Alberta's water challenges and opening discussion on possible solutions.*

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**Warmer Temperatures:** Although the term "global warming" has given way to "climate change", the expectation is that most places around the globe will experience a warming trend, although the effect will vary from one place to the next. Warmer temperatures are expected to increase rates of evaporation and transpiration, and are expected to hit hardest in locations that are already dry.

**Precipitation:** The effect of climate change on precipitation is hard to gauge, but a number of scenarios continue to dominate. Lower amounts of precipitation are likely to widen the moisture deficit in already dry areas and create new moisture deficits in other areas. At the same time, higher amounts of precipitation could be experienced in already wet areas. The conventional thinking is that precipitation will see more seasonal and annual variability, and become less certain and less predictable. In some areas, precipitation type, timing, seasonal pattern, and geographic distribution could all undergo change, amplifying uncertainty well beyond current seasonal and annual variability. On top of changing precipitation patterns could come the prospect of long-term changes in the timing and amount of spring melt that feeds water into Alberta's river basins.

**Extreme Weather Events:** For some, the concern with precipitation is less about the amount and more about how it arrives. Some scenarios show that precipitation may come in the form of more extreme weather events. There may well be less rain, but the rain that does come will do so through more intense weather, producing too much water at one time and in one place. Climate change, then, brings the prospect of increased instability in the climate and this should be as much a concern as any overall change in the climate itself. Extreme events will run the gamut—more drought in some areas, more floods in other areas, more tornados here, and stronger hurricanes there. There is also the potential for impact on Alberta's water and wastewater infrastructure, including storm

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drainage. Much of this infrastructure was built for a stationary climate, and was not designed to accommodate a downpour of 5 inches of rain within a 20 or 30 block radius. Some estimates of retro-fitting infrastructure to accommodate increased weather volatility could reach up to \$40,000 per household.

*Drought:* Of all extreme weather possibilities, drought is the biggest risk for Alberta. While drought can occur in any climate, semi-arid regions like southern Alberta are the most vulnerable as they already have a moisture deficit and variable precipitation patterns. Fueled by warmer temperatures and lower precipitation, droughts in the future are expected to be more frequent, more intense, more persistent, and of longer duration. Western Canada has seen at least 40 severe droughts in the past 200 years. Multi-year droughts were seen in the 1890s, the 1930s, and the 1980s. The 1930s is generally considered a severe drought, where precipitation was 40% less than normal. But in 1988, the precipitation received was only 50% of normal. The most recent drought of 2001–2003 was quite unusual, both in its vast spatial extent and its intensity. The drought stretched from southern BC through the prairies and into the Great Lakes. This may be a sign of things to come—the western Canadian prairies have been identified as one of the locations where climate changes will bring a much higher risk of drought.

*Retreating Glaciers:* Glaciers in the Rocky Mountains supply about 10% of the base flow for rivers in central and southern Alberta, and in particularly dry years, that proportion can rise considerably. Glaciers are particularly important to some rivers, such as the Bow. Climate change is almost certain to accelerate the retreat of glaciers. From 1975–1998, the size of glaciers decreased by 50% in the South Saskatchewan River Basin and by 23% in the North Saskatchewan. Some are predicting that most glaciers may disappear completely within the next 50 to 60 years. Any permanent reduction in glacial ice amounts to the loss of a critically important backstop, making Alberta's rivers completely dependent on precipitation, which itself is predicted to be lower and more variable.

*Long-term reduction in river flows:* Glacial retreat and less precipitation is almost certain to reduce water flows across Alberta in the future. At the same time, the drier climate will increase the need for water, especially for irrigation. Climate change is expected to widen the water gap—just as the water supply slows, demand will rise. The pressure of less water will also be amplified by more seasonally concentrated increases in demand.

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*Water Quality:* Water quantity is intimately connected with water quality. If Alberta has less water, there is less opportunity for nature itself to filter urban storm water run-off, absorb industrial effluent, assimilate commercial contaminants, and filter and purify agricultural run-off. Existing problems with eutrophication of prairie waterways will worsen, being fuelled by warmer temperatures as well. Even bigger problems are likely to emerge with depleting oxygen levels. Lower surface flows are expected to slow groundwater recharge, stress aquifers, and reduce surface supplies even further. All of this carries serious implications for the quality of water Albertans can expect, in addition to the growing concerns over water quantity.

If there is any good news at all with respect to climate change, it is the potential prospect of a longer frost-free season, warmer northern temperatures, and a longer growing season. Some argue that this is expected to increase the potential of agriculture in the northern Canadian prairies, where there is currently a water surplus available for irrigation.

This should not be discounted. In the future, some predict that agriculture will become more important than oil and gas, with Canada serving as one of only a few critical “lifeboats” to secure the global food supply. Viewed from this perspective, there may indeed be a silver lining here. But it is still a slim sliver of silver. Whether that sliver can be turned to opportunity depends heavily on Alberta’s ability to prepare and adapt to a water future that could be considerably different in the future. If not, then it is quite unlikely for any single advantage to even begin offsetting the threats expected elsewhere. ■

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