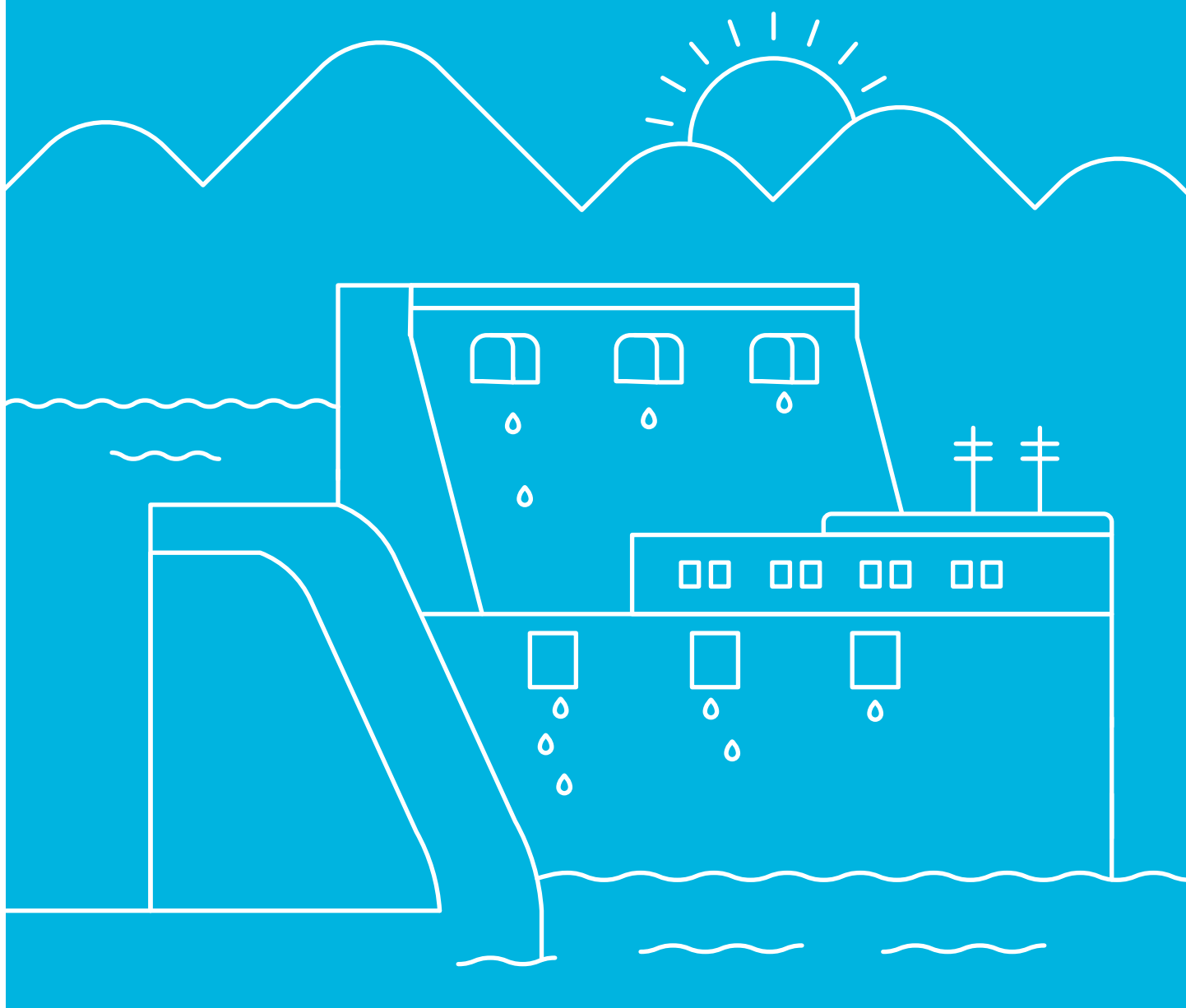


Casting drought:

How climate change is contributing to uncertain weather and how BC Hydro's generation system is adapting



Casting drought: How climate change is contributing to uncertain weather and how BC Hydro's generation system is adapting

British Columbia is experiencing one of its warmest and driest late summer and early fall seasons on record so far. Daily high temperatures in September and early October were well into the mid-20s, and dozens of daily temperature records have been broken across the province every week. The unusually dry weather is posing challenges for B.C. rivers and watersheds, where water levels are near record lows in some areas, posing a threat to fish habitats. With little precipitation in the near-term forecast, BC Hydro is helping by managing its system and maintaining downstream water flows to protect the environment while continuing to supply safe and reliable power to its customers.

Highlights

- BC Hydro's hydroelectric system is directly impacted by variations in weather and the record setting, unseasonably dry and warm weather this fall highlights the impacts of climate change, hinting at challenges to come.
- Symptoms of climate change include increased frequency of extreme events like drought and intense storms, rapid glacial melt, increasing temperatures and amount of precipitation will directly affect electric utilities like BC Hydro that rely on water to generate power.
- Since mid-July, B.C. has experienced one of its driest and hottest extended periods on record.
- Currently, extremely persistent high-pressure ridging has extended B.C.'s more typically dry summer conditions well into the fall.
- This sustained summer weather has led to level 4 & 5 (the highest possible levels) drought conditions on Vancouver and Lower Mainland respectively, contributing to near-record low water levels in river systems and some of BC Hydro's smaller watersheds. The most impacted operations are Puntledge, Campbell River/Quinsam, Coquitlam and Stave/Ruskin.
- While there is no concern with BC Hydro being able to continue to deliver power through the drought because there is enough water at its larger facilities, with no meaningful precipitation in the forecast, its smaller facilities, in the Lower Mainland and on Vancouver Island will continue to see record low or near record low inflows for this time of the year.
- BC Hydro's reservoirs play an important role in managing these difficult conditions by using storage and planning releases to provide protection to downstream river flows.
- While the dry conditions have had an impact on BC Hydro's watersheds, the natural river systems have fared worse than expected as they cannot adjust inflows, with rivers drying up and thousands of fish killed.
- With the extremely dry conditions over the past few months, BC Hydro has taken proactive steps at many of its South Coast facilities to conserve water to protect the downstream fish habitat.
- BC Hydro also manages water levels by reducing its total electricity exports to Powerex Corp. as needed
- Unpredictable weather patterns related to climate change are expected to continue in the years ahead and BC Hydro is constantly adapting to these evolving conditions.

Solutions

Despite the unpredictability of weather and outside events that can impact BC Hydro's electricity system, BC Hydro continues to be prepared. Its system is designed and operated to perform safely across a wide range of conditions and extreme events, and BC Hydro staff are highly trained and experienced to adapt quickly to changing conditions.

BC Hydro began holding back water at some of its facilities in July and August anticipating the dry conditions to help ensure it would have some water storage for the later summer and early fall salmon spawning, and it will continue to work with government fish agencies and others to manage this drought event.

BC HYDRO IS ALSO:

- Continuously working to improve its weather and inflow forecasting. For example, all coastal watersheds can now be forecasted down to the hour, which improves the forecast accuracy for extreme events.
- Expanding its hydroclimate monitoring technology. This includes custom-made solutions that have been designed inhouse, as well as upgrading snow survey stations to automated, real-time snow and climate stations.
- Investing in capital projects—like spillway gate replacements—that will increase resiliency of the system to climate change.

Climate change and extreme weather patterns

Extreme weather patterns are becoming more common in B.C., in large part due to climate change. Climate change describes a change in the average conditions—such as temperature and rainfall—in a region over a long period of time. While the earth has always undergone temperature changes, the global warming happening now is directly related to human activities.

The warming is caused mostly by carbon dioxide being released into the atmosphere through activities such as burning fossil fuels. Symptoms of climate change including floods, droughts, rapid glacial melt, increasing temperatures and amount of precipitation will directly affect utilities like BC Hydro that rely on water to generate power.

B.C.'s climate is already changing. Historical data from 1900 to 2013 indicates that the average annual temperature has risen by 1.4 °C.¹ Global climate models project increasing temperatures and precipitation in all seasons in all regions of British Columbia during the 21st century. This means that British Columbia will face increasingly unstable weather patterns that could affect all rivers and watersheds, including BC Hydro's electrical system.

This report will examine the current drought in many parts of B.C. that is posing challenges to rivers and watersheds, and the role BC Hydro's reservoirs play in managing these difficult conditions. It will also examine how BC Hydro is constantly adapting to unpredictable weather patterns and evolving conditions related to climate change.

Record dry conditions

BC Hydro's hydroelectric system is directly impacted by variations in weather, and the sustained dry and warm temperatures through the summer and early fall demonstrate how climate change is contributing to unprecedented weather patterns and events.

For example, since mid-July B.C. has experienced one of the driest and hottest extended periods on record, and extremely persistent high-pressure ridging has extended B.C.'s more typically dry summer conditions well into the fall. Average daily high temperatures in September and early October were well into the mid-20s, and dozens of daily temperature records have been broken across the province every week.

Impact on watersheds, rivers, and reservoirs

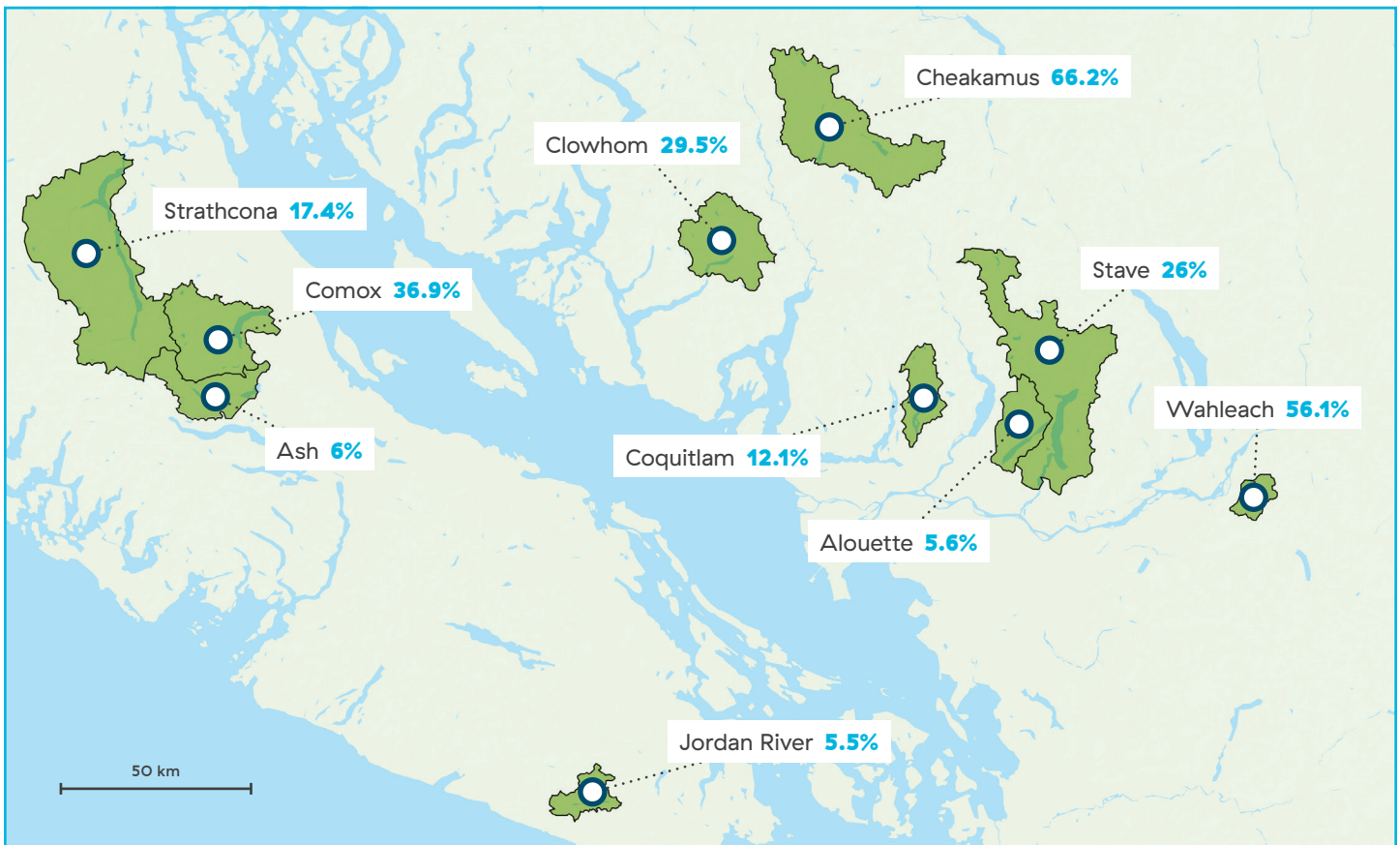
While wet conditions and good snowpack existed across British Columbia in the late spring and early summer, continuous warm and dry weather since mid-summer has created problems for rivers and watersheds across the province.

Currently, sustained summer weather has led to Level 4 & 5 drought—the highest possible levels—conditions on the South Coast (Lower Mainland and Vancouver Island), contributing to near-record low water levels in river systems and some of BC Hydro's smaller watersheds. BC Hydro is seeing the most significant impacts on operations at Comox/Puntledge and Campbell River on Vancouver Island as well as Coquitlam and Stave/ Ruskin in the Lower Mainland. Campbell River, for example, broke a 53-year-old record for the month of September with the lowest inflows. In the Lower Mainland, inflows since the beginning of September are ranked in the bottom three compared to historical records.

¹ Climate change adaptation

While the dry conditions have had an impact on BC Hydro's watersheds, the natural river systems have fared worse than expected, with rivers drying up and thousands of fish already killed this fall. Unlike natural systems, BC Hydro can store and plan the release of water to benefit fish and the environment.

ACCUMULATED SOUTH COAST RESERVOIR INFLOW SINCE SEPTEMBER 1 AS PER CENT OF NORMAL



How BC Hydro is managing

With no meaningful precipitation in the forecast, some of BC Hydro's smaller facilities will continue to see record low or near record low inflows for this time of the year. BC Hydro's reservoirs play an important role in managing these difficult conditions by using storage and planning releases to provide protection to downstream river flows.

With the extremely dry conditions over the past few months, BC Hydro has already taken proactive steps at many of its South Coast facilities to conserve water to protect the downstream fish habitat. For example, BC Hydro began holding back water in July and August at some of its facilities anticipating the dry conditions to help ensure it had water storage for the later summer and early fall salmon spawning.

Right now, at Coquitlam and Stave/Ruskin systems, water is being conserved by releasing less so that fish flows can be sustained through the dry period until inflows increase. On Vancouver Island, BC Hydro reduced Puntledge River flows by one-third last week and these levels may be sustained until near the end of the month. On the Campbell River, BC Hydro is currently keeping the riverbed covered with water, and on the Quinsam BC Hydro has closed the diversion and reduced releases to conserve water.



Low water levels at the Comox Dam on Vancouver Island in October.

While many of BC Hydro's smaller systems in the Lower Mainland and on Vancouver Island are under some pressure, there are no concerns about continued power delivery. British Columbians benefit from BC Hydro's integrated, provincial electricity system to send power across the province, including to Vancouver Island. Most of the electricity generated and used in B.C. is produced by larger facilities in the north and southeast of the province—and while water levels in those areas are below normal levels, there is enough water to meet the province's power needs.

Forecasts are currently showing no rain in the near-term; however, historically, precipitation shows up by the end of October. If that does not happen, BC Hydro will continue to closely track weather and inflow forecasts to adapt its operations to protect fish.

Climate change adaptation

Despite the unpredictability of weather and outside events that can impact BC Hydro's electricity system, BC Hydro continues to be prepared. Its system is designed and operated to perform safely across a wide range of conditions and extreme events, and BC Hydro staff are highly trained and experienced to adapt quickly to changing conditions. BC Hydro also has the tools and expertise to continue to manage the unpredictable weather and climate change. This includes in-house weather forecasting and ensemble runoff forecasting, operations planning optimization methods, and its own climate, water and snow monitoring network.

It is also a contributing partner in complementary networks in B.C. for water, climate, snow and glacier monitoring. It is continuously working to improve the weather and inflow forecasting. For example, all coastal watersheds can now be forecasted at an hourly time step, which improves the forecast accuracy for extreme events. Probabilistic forecasts are available for a two-week forecast horizon, which supports planning for a range of outcomes.

Seasonal ensemble forecasts are being extended to better predict extreme scenarios. BC Hydro continues to invest in expanding its hydroclimate monitoring technology to provide even more accurate and timely information about the current state and to monitor for changing trends in temperature, precipitation, snow and surface water availability. For example, off the shelf technology has proven insufficient to meet precipitation and snow water monitoring requirements. As a result, all season precipitation and snow water monitors are custom-made and designed in-house, and research and development is ongoing to improve accuracy and robustness.

