

Climate Models Show a “Surprisingly Resilient” Elbow River

By Ann Sullivan

Despite climate change and its anticipated effects – increased temperatures, decreased snowpack, wildfires, extreme weather events – the Elbow River will likely flow on regardless, albeit in a more “flashy” way. Not flashy as in colourful or flamboyant, of course, but as in unpredictable or slightly out of control.

That’s according to data from recent modelling studies in the Elbow River basin by John Pomeroy and his colleagues at the USask Centre for Hydrology. Pomeroy, Canada Research Chair in Water

Resources and Climate Change at the University of Saskatchewan, and his team have run detailed simulations under a variety of disturbances (climate change, pine beetle infestation, forest harvesting, wildfire, etc.) and are currently compiling their data for publication.

One heartening piece of data that Pomeroy has pulled from the modelling studies is this: “The Elbow is surprisingly resilient under climate change.”

The river will certainly change due to climate change-related stresses. In future, even small storms may lead to a rapid rise in stream flow, which will bring with it increased sedimentation,



A healthy riparian area that includes a mix of vegetation helps the Elbow River retain its resiliency. Photo: Cows and Flsh

bank erosion and water turbidity, none of which is good for the fish, wildlife and humans who depend on the Elbow for clean water.



The Elbow River runs fast and high after several days of rain in June 2022.

Photo: A. Sullivan

Pomeroy said that stream flow volume in the Elbow, averaged over the whole year, won't change too much in future. "That's the resiliency part." A warmer climate in the Elbow basin will also be a wetter climate, in which increased precipitation compensates for warming temperatures and a smaller snowpack (possibly 46 fewer days of snow coverage, according to the models). This is because the Canadian Rockies are tall enough and far enough north to generate precipitation in the coming decades, even under climate change. "We

won't get the snows that we used to, but we'll have the rains, and that keeps these rivers going," Pomeroy said. That's the good news.

The bad news is that the Elbow River will be different – "flashier," more variable, likely warmer and with longer periods of drought. The timing of water availability throughout the year will also change. "Water usability will change because it will come in these flashy bursts and it will come in the wintertime," Pomeroy said. "The problem is if that rain all comes in a five-day torrential burst." Bursts of heavy rainfall could result in high flows and flooding, both earlier in the spring – in April and May rather than the usual May and June – and in the fall.

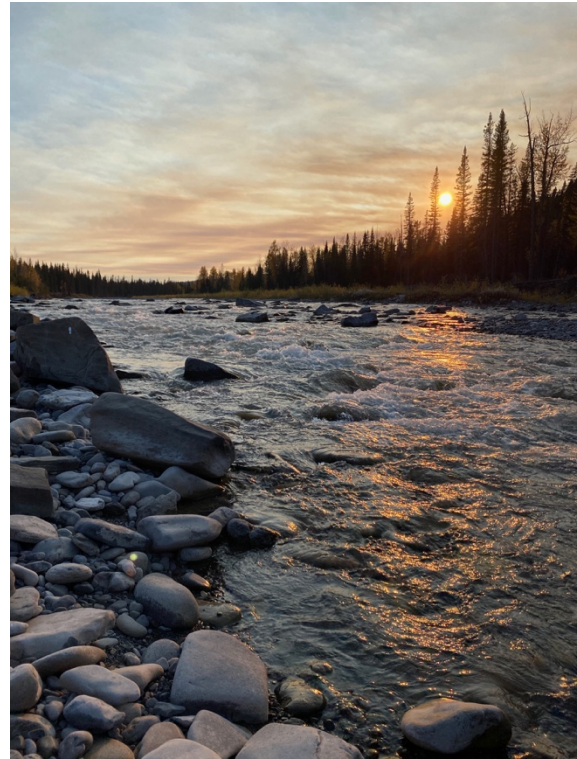
Pomeroy and his team used the "Cold Regions Hydrological Model" to simulate hydrological processes in the Elbow River basin: rainfall and snow cycles, percolation of moisture into groundwater, etc. Researchers first ran the model using weather conditions since the turn of the century – including floods and droughts from the past few decades – and then using a "pseudo global warming" technique to create future weather over the Elbow River basin for the period from 2085 to 2100. Their modelling predicts a temperature increase of 4.5 degrees Celsius on average by 2100 and an increase in precipitation of 15 percent.

At 4-km model resolution (compared to a 60-km resolution scale for typical models), the pseudo global warming model allows researchers to calculate temperature and, more

importantly, precipitation, with greater accuracy. “Future weather is really important for figuring out the future hydrology of these basins,” Pomeroy said.

Of all the possible future risks to the Elbow River basin, the one that worries Pomeroy the most is wildfire, an indirect impact of climate change. So far, the Eastern slopes have avoided extreme fires like the ones that struck British Columbia in 2021, but similar fire scenarios here are likely a question of when, not if. Over the next century, Pomeroy said, “we probably will have a massive wildfire in the Elbow River basin that will take out a large portion of the forest.”

Ironically, wildfires often lead to more water in the river as fire-scorched mineral soils become hydrophobic, or unable to absorb runoff. Pomeroy suggested that an extreme wildfire could lead to “doubling of flows on the Elbow, including more than a doubling of the peak from the 2013 flood.” Soil damage from forest harvesting can also lead to less effective runoff capture, which is why good forest practices and solid management are crucial to protecting the Elbow River and its ecosystems.



Smoke from wildfires lends a golden glow to the Elbow River as it flows through Redwood Meadows.
Photo: A. Sullivan

Pomeroy suggests that riparian buffers – “the larger the better” – help protect the river by shading the water and allowing porous forest soils to absorb runoff, which may be higher in cases of clearcutting. Forest thinning, rather than clearcutting, would have less impact on rivers such as the Elbow. “Allowable cuts need to take into account climate change,” he said, adding, “It’s not just [about] the area that’s cut, it’s [about] minimizing the soil disturbance. It’s absolutely crucial.”

Pomeroy noted that the Elbow River basin was not historically a green carpet of forest but rather a mix of young and mature trees disturbed by wildfires and by Indigenous wildfire management techniques. This heterogeneous mix likely made the river more resistant to wildfire and is perhaps a direction land-use planners and stewardship groups could work toward. The important thing is to have a long-term vision for the Elbow.

“There’ll have to be some adaptation in the basins for those who live there and those who use the resources,” Pomeroy said. “We’ll have to manage our way through it.”

Pomeroy says he doesn’t want to understate the problems related to climate change, which he describes as “absolutely, outstandingly massive,” but he does hold out some hope for the

future. As an example, he points to wetlands research in the Sibbald Flats area and the recovery of beavers in that area. (<https://www.erwp.org/pages/fa-wetlands--bigger-is-not-necessarily-better>) "There's tremendous recovery in these systems as well," he said.

Future impacts will no doubt put more pressure on the Elbow River, but the situation here is perhaps not as dire as in other parts of the world. Pomeroy, who has spent countless hours outdoors in the Elbow basin, had this to say about its ecosystems: "You pick up on their strength and how the different components support each other and the resilience that comes from that, and that does give me hope because there's a lot of it [resilience] in these systems."