


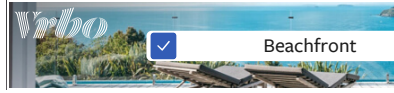
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In B.C.'s forests, a debate over watershed science with lives and billions at stake

Logging on the slopes of Mount Elphinstone represents a case study on the effects of the practice on forest hydrology and flooding, and how such risks are assessed in B.C.



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Brenna Owen

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 22 Comments



Cars move through floodwater along the Sunshine Coast Highway near Sechelt, B.C., during the atmospheric river event in a November 2021 handout photo. PHOTO BY ROSS MUIRHEAD /The Canadian Press

Ross Muirhead stood at the edge of a forestry cut blockfilled with stumps, rain pelting down as he watched water rushing over the barren ground.

The environmental advocate was storm watching during the atmospheric river disaster that swamped southwestern B.C. in November 2021.

Muirhead says that without a healthy forest to help absorb the excess water, it was gushing toward a creek near the Sunshine Coast community of Halfmoon Bay.

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“It was just complete surface run-off,” he says.

Muirhead went to see what was happening near the outlet of the creek and found highway crews already working — water and debris had caused a “complete engineering failure” of a culvert and the road on top of it, he says.

It was one of at least six washouts along a 40-kilometre stretch between Halfmoon Bay and Gibsons, says Muirhead, who lives in neighbouring Roberts Creek. He’s the founder of the group Elphinstone Logging Focus, named after the local mountain.

“These culverts are undersized for climate-change conditions, with atmospheric river events,” he says. “All across the Sunshine Coast, the majority of them were designed and put in place in the 1950s, when the highway was engineered.”

Now, Muirhead says he’s worried about plans for additional logging on the slopes of Mount Elphinstone, about half an hour’s drive north of his home.

He’s not alone. The harvesting plan has caught the attention of local officials, concerned about a situation that represents a case study on the effects of logging on forest hydrology and flooding, and how such risks are assessed in B.C.

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Scientists say the stakes in getting it right are huge, with lives and billions of dollars in the balance during climate-related extremes in a province where clear-cutting has been a dominant practice for decades, affecting large swaths of the landscape.

The province's logging agency, B.C. Timber Sales, was set to decide by the end of this month whether the Mount Elphinstone harvesting rights will be put up for auction in April.

The agency reduced the potential area available for logging to a total of 13 hectares over two cut blocks following a watershed assessment last year, and says it has committed to harvesting only half of what the Mount Elphinstone area can "sustainably support." A public information bulletin says the method would be "partial cutting," with 500 trees left standing in addition to substantial patches set aside for wildlife and reserves.

But Muirhead is still concerned about the effects of additional harvesting and the extension of logging roads on a landscape that he describes as "dying from a thousand cuts" sustained over more than a century of development.

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The board of the Sunshine Coast Regional District wrote a letter to provincial officials last month asking for the cut blocks to be removed from the B.C. Timber Sales operating plan. It also requested further hydrological studies to

evaluate the potential effects of logging on properties downstream.

The agenda for the board's meeting in March includes a reply from Pierre Aubin, a professional forester with B.C. Timber Sales on the Sunshine Coast. His letter says the agency is implementing all of the recommendations from the existing watershed assessment completed by the consulting company Polar Geoscience.

The study did reveal infrastructure that was "potentially undersized in light of climate change projections," including crossings on "urban" roads, Aubin says in the letter dated Feb. 22.

The information has been shared with that ministry, he adds.

Aging or undersized infrastructure is part of the problem. But Muirhead and others suspect another challenge may be looming over B.C.'s watersheds — scientific methods that underestimate the role of industrial logging in elevating flood risk.

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'The power of the forest'

A recent peer-reviewed study led by researchers at the University of B.C. says "deterministic methods," which are long-standing and widely used, result in projections that don't reflect the true risk of flooding after logging.

Deterministic modelling makes projections based on a set of factual inputs and is not designed to consider randomness or chance, the study says.

It says this traditional method leads to results that are "diametrically opposite" to the alternative approach that the study's authors advocate.

Commonly used in other scientific disciplines, their preferred approach is known as "probabilistic" modelling, and the paper says it forecasts "larger effects" on flooding.

The study published in the journal *Science of the Total Environment* aims to guide the introduction of probability to forest hydrology in B.C., the authors say.

It's the latest volley in the debate about the use of probabilistic versus deterministic methodologies in forest hydrology that's been playing out for years.

But study co-author Younes Alila, a professor in the forestry department at the University of B.C., says the significance of the debate is more than just academic.

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The scientific methods behind watershed assessments inform the design of dikes, bridges, and highways, with safety and cost implications for infrastructure built in a way that doesn't reflect the risks, says Alila, who is also a professional engineer.

Alila has been calling for a shift away from deterministic methods in forest hydrology for two decades, saying they represent "the science of convenience."

"It's the only way they could justify the way they're logging in the form of clear cuts."

By contrast, Alila says probabilistic modelling takes into account the random nature of the forces influencing flooding, a complex interplay he calls "the power of the forest," and produces projections about the likely severity and frequency.

Alila says deterministic methods aren't designed to draw conclusions about the frequency of extremes and tend to underestimate the effects of industrial logging.

It's crucial to consider frequency because dikes and bridges can fail when battered by peak flows that are happening more often, he says, even if the rushing water doesn't exceed the maximum capacity of the infrastructure.

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He says frequency is the “lost dimension” in B.C. forest hydrology.

“What drives me is not conservation. It’s not my care for the environment, although I would care,” he adds. “What drives me is the science, period.”

On the Sunshine Coast, Muirhead’s group hired Alila to review the assessment commissioned by B.C. Timber Sales to inform how much more harvesting should be allowed on Mount Elphinstone.

The logging agency has described the existing study by Polar Geoscience as “one of the most comprehensive produced for the industry.”

Polar Geoscience, says the study was “conducted at a higher level of detail than is normally practised” in B.C. given the proximity to residential areas.

It provided its recommendations “with the specific objective of minimizing risk” and incorporated “a degree of conservatism” beyond that of previous studies in the area, the company says in a response posted to a B.C. government web page.

However, Alila says the study took a deterministic approach that underestimates the risk posed by additional logging.

In particular, he says the study employed “equivalent clearcut area,” or ECA, a common measure that depicts the hydrological impact of forest disturbances such as logging or wildfire. For instance, logging with an ECA of 10 hectares would have the same impact as clear-cutting that amount of forest. ECA — which can also be expressed as a percentage of the originally logged area — can fall over time, as forests regrow and recover hydrological function.

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A provincial information bulletin says forest losses may cause detectable increases in peak water flows if ECA is higher than 20 per cent.

Polar suggested that threshold for the Mount Elphinstone area, and B.C. Timber Sales says it has incorporated the company's recommendations.

Still, Polar's report shows ECA already exceeds 20 per cent for several specific points of interest identified through the assessment.

Alila, meanwhile, says ECA's deterministic methodology ignores the broader power of the forest, instead taking data from smaller stands of trees and using it to draw conclusions about larger areas.

A forest's influence on flooding stems from the many random or "chancy" features in a watershed, he says. That includes the overarching climate and physical characteristics such as mountains, rivers, lakes, soils, cut blocks and roads, as well as the slope, elevation, and exposure to the sun, Alila says.

Only a "probabilistic" approach can unravel those relationships to reveal how "super-sensitive" B.C.'s watersheds are to the cumulative effects of forest loss, he says.

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"Of course, if there is global warming, that law of chance is going to be intensified because we're going to see more frequent floods," he adds.

The response from Polar Geoscience last November says many of the professor's criticisms are "unfounded and flawed or focus on the hypothetical."

The company says its findings and recommendations were based on many considerations in addition to ECA and Alila's claim that the assessment was "microscale" in scope is a mischaracterization.

Using a probabilistic framework "could be a useful approach for a portion of our assessment," and Polar is testing such methods, the response says, calling the models "promising." But it isn't yet practical, reliable or cost effective, due in part to a lack of streamflow data to support the modelling, it says.

Polar says its approach aligns with guidelines released by the Association of B.C. Forest Professionals and Engineers & Geoscientists British Columbia in 2020.

'They don't want complicated methods'

Martin Carver, a registered professional engineer and geoscientist who previously worked as a hydrologist for the B.C. government, says deterministic methods are “deeply rooted” in forest hydrology in the province and beyond.

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“There is a discussion happening in the peer-reviewed literature now, between the two camps,” he says, referring to deterministic and probabilistic approaches.

But outside forest hydrology, probabilistic work is “common or the norm,” he says, pointing to climatology, meteorology and other areas of hydrology.

“It's not just coming out of nowhere ... But for some reason, which is kind of a good question, it's not been present in forest hydrology practice in British Columbia.”

Speculating about why that's the case, Carver says deterministic methods are simple for those managing forests.

“They like simple methods to manage. They don't want complicated methods, even though the system they're managing is complex,” he says.

“And those simplified methods that are all over the place in British Columbia, and have been around for quite a while, are problematic.”

But worsening climate change is shining a spotlight on “gaps” in the science of forest hydrology, especially around extremes such as flooding, he says.

The past can no longer serve as a reliable estimate of the future, Carver says.

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Climate-related extremes are getting worse and they're happening more often, he says, raising the consequences of any limitations in the science used to predict and respond to the risks.

In B.C. and across Canada, the costs of climate-related disasters are adding up.

Ottawa's expected disaster assistance funding to help B.C. rebuild after flooding and landslides in 2021 that claimed five lives has surpassed \$3 billion, a fraction of the total price tag, while the B.C. government says its expenses this year will be \$996 million higher than expected after responding to the worst wildfire season in the province's history.

The results of watershed assessments aren't typically shared with the public in B.C., Carver notes. They belong to the companies that produce or commission them.

Carver did not specifically review the Mount Elphinstone watershed assessment or Alila's review of the study before speaking with The Canadian Press.

But he says a probabilistic approach is necessary to assess the risk of post-logging extremes once a watershed reaches a certain size or complexity.

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"When our systems get larger, both in terms of the size of the watershed, or the events get larger ... you cannot do that analysis deterministically anymore," he says.

“You no longer know how the complex of processes are interacting, overlaying, competing, compensating, right? All of those things are happening and yielding an outcome. But we do know from the frequency analysis that as remarkable as nature always is to us, a pattern emerges in the frequency distribution.”

Alila and Carver say the B.C. government has no set prescriptions for how exactly watershed risk assessments should be conducted before forest harvesting.

Instead, the province has been using a system known as professional reliance to manage forestry and other resources industries since the early 2000s. It’s up to engineers, geoscientists and other professionals to decide how to assess risks.

Carver is one of the primary authors of the joint professional guidelines that Polar Geoscience says it adhered to with its Mount Elphinstone study.

He says the guidelines are not prescriptive when it comes to scientific methods.

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“It’s like a community of practice out there, and we’re all meeting certain scientific expectations, and if you’re going to depart from that, then explain yourself.”

In its response last fall, Polar says Alila should approach the professional groups if he believes the guidelines require revision. It suggests that Alila offer “practical, defensible and cost-effective solutions to implementing the concepts he promotes.”

Carver says he believes there’s a growing recognition of the differences between deterministic and probabilistic approaches among professionals in B.C.

But he says the province is “lagging behind” when it comes to incorporating the science.

And as climate extremes become more frequent and severe, he says, assessing the risks incorrectly could lead to greater damages and losses of life.

“If we continue to mischaracterize (extremes), and if we continue to manage the forest and disturbance levels as if we were doing fine, we’re going to take the system further and further out of anything that is protective.”



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