PINE-BEETLE BLIGHT MAY BRING FRASER FLOODING

By Will Koop.

Copy of the final story in the Georgia Straight newspaper, March 1-8, 2007.

(***Note:*** there was an error in the final version, and that error has been corrected. Original submission follows below.)

Many British Columbia residents have already made the connection between global warming and the onslaught of mountain pine beetles across the province. It has often been reported that these pesky bugs keep surviving warm winters, enabling them to munch their way across a huge swath of B.C. forests. But few of us are aware of the potential links between the mountain pine beetle and large floods in the Fraser River watershed.

Fraser floods like the one in 1948 may become the norm. Photo from Vancouver Public Library, Special Collections, VPL 44496.

At last November's annual meeting of the Fraser Basin Council, Allan Chapman provided some insights into what could happen. Chapman, head of the B.C. Ministry of Environment's River Forecast Centre, cannot be accused of being an ill-informed fearmonger. With training in forest hydrology—the study of stream flows from the forests—he is well-equipped to discuss the impact of dead pine trees on the spring runoff of melting snow.

Chapman said that B.C. is experiencing the most extensive beetle outbreak ever recorded in North America's 500-year colonial history.

In his 20-minute presentation, entitled "Mountain Pine Beetle in the Fraser Basin—Implications for Floods", he noted that the beetles spread from five separate epicentres, aided by global warming in the 1990s.

Provincial and federal government scientists, he said, are predicting that if abnormal weather trends continue, more than 80 percent of all of B.C.'s pine forests will be dead by the end of 2013.

Pine trees make up about a third of all B.C. forests species. Already, more than 10 million hectares of Interior forest lands—just over 10 percent of B.C.'s land base—have already been infected to varying degrees of mortality, he said.

The beetles previously only attacked older pine trees. But field reports from staff working for the Forests and Environment ministries now say that the bug is zeroing in on seedlings in young plantations.

So what does all this have to do with flooding in the Fraser River watershed, which extends from the City of Richmond all the way to the Rocky Mountains? Chapman said that most of the forests in this region—60 percent, or 13 million hectares—extend from valley bottoms up the sides of mountains. Of those, just over 50 percent are pine forests.

This means that there are about 7 million hectares of pine forests in the Fraser River watershed—pine forests that are currently being destroyed, have been destroyed, or possibly will be destroyed by the mountain pine beetle.

As any forest hydrologist will tell you, forests slow down the rate of melting snow. The trees partially or completely block the sun, providing shade that delays the melt. In addition, living trees' roots absorb water, which also regulates the runoff.

Chapman pointed out to his audience that the death of so many pine trees will change the forest hydrology in large parts of the Fraser River watershed. Dead forests will not be able to slow down the rate of melting snow as intact forests have traditionally done. This could result in a rapid rise in water levels in the Fraser River from its many affected tributaries. And that, he predicted, will eventually cause widespread flooding.

Chapman wasn't the only speaker at the conference. Monica Mannerstrom, senior project engineer with Northwest Hydraulics Consultants Ltd., gave an overview of the Lower Fraser River's inter-municipal dyking structures from Agassiz to Richmond. She showed old photographs of the last great Fraser River flood in 1948, which inundated homes, businesses, and farms.

Mannerstrom also linked the mountain pine beetles to possible flooding.

"Certainly we need to inform all levels of government that there is a problem, so that nobody can say that they didn't know," she said.

B.C.'s CLIMATE and rainfall patterns are changing from global warming. What was once predictable, such as a dry Interior winter or spring, may no longer be so reliable for predicting spring runoffs. In many western portions of B.C.'s pine-belt Interior, snowfall accumulations are at record highs, elevating flood risks for this spring.

Of course, global warming isn't the only reason for increasing numbers of beetles. Forest-management practices over the past 80 years have been contributing factors. Silviculture methods emphasizing single species and the suppression of natural fires have changed the genetic makeup of the land base. Many forests have also been made vulnerable by the careless dispersal of beetles falling off logs being transported by truck or rail.

But why haven't the federal and provincial governments publicly drawn connections between rapid logging of beetle-infested forests and the likelihood of future floods on the Fraser River? Certainly this information has been available to those interested enough to look for it.

According to a 2004 Alaska state research bibliography report, entomologist Ed Holsten stated that similar beetle epidemics in the United States caused "large increases in stream flow" that endured "25 years after this outbreak". Holsten's summary was not mentioned in a similar November 2005 federal research report on historical beetle surveys and resultant increases in water flows.

Forest hydrologists study ways in which forests control stream, river, and groundwater sources. But prior to 2005, federal and provincial administrators largely ignored the issue of hydrology in developing strategic logging plans to address the beetle epidemic in B.C.'s watersheds.

In August 2004, Ministry of Forests science researcher Marvin Eng cautioned B.C.'s then–chief forester, Larry Pedersen, about hydrology.

This came in a small paragraph in a ministry document called Technical Report Number 019. Eng wrote that Pedersen's consideration of increasing the rate of Interior logging to "salvage" beetle-

infested timber would “adversely” affect water runoff because many areas had already been previously logged.

Pedersen appeared to have ignored Eng’s advice, authorizing large increases to annual logging rates in three mid-northern forest regions by October 2004.

Pedersen’s replacement as chief forester, Jim Snetsinger, wrote an eight-page “guidance” report in December 2005. It defended Pedersen’s controversial decision, although Snetsinger acknowledged that the “80 percent” increase in logging would pose “a significant risk of hydrological problems”. Snetsinger noted that he was “mindful” of the issue.

Instead of a precautionary approach, logging politics had won.

Concerns over hydrology only began to take prominence a year and a half ago. In a July 2005 Forest Ministry report called Beetle Stewardship Research Strategy, this issue was given the “highest priority” rating alongside silviculture research. However, the report noted that numerous hydrological impacts from beetles and logging—such as rising water tables, landslides, road failures, stream channel erosion, increased sediment in water courses, fish-habitat destruction, warming waters, and floods—were all identified as having considerable “knowledge gaps”.

IN LATE AUGUST 2006, I took a trip north into B.C.’s Interior, where I observed horizon after horizon of endless red and grey stands of dead pine forests. Afterwards, I spent six weeks contacting university professors and government staff and gathered numerous reports. To my surprise, I discovered that the majority of B.C.’s pine forests are concentrated in the Fraser River watershed.

That raised a big question: were there legitimate concerns about potential flooding in the Lower Fraser River, which is home to a large human population and plays a central role in the provincial economy?

To find the answer, it was necessary to analyze statistics on the amount of previous logging, as well as on areas burned by fires. But I was told that the provincial government had never conducted such a study. One alternative was to use Google Earth to look at visual satellite imagery of the logging. This was a formidable task, given the area was the size of Great Britain.

The second necessary piece of information was estimating the area of pine forests in the watershed killed by beetles. The government’s statistics are inconsistent, and not all figures are available.

Chapman’s estimate of close to 7 million hectares of pine forests in the Fraser River watershed seemed reasonable.

Overlapping information about logging and beetle infestations helps determine the percentage of the land base that has been disturbed. This is a method commonly used by forest hydrologists.

Some fascinating new information emerged at last October’s annual conference of the B.C. chapter of the Canadian Water Resources Association. Steve Chatwin, a senior forest hydrologist with the B.C. Forest Practices Board, highlighted unpublished findings from the first forest-hydrology study conducted on beetle-infested timber, at Baker Creek. That’s a heavily logged watershed just west of Quesnel.

Chatwin relied on computer modelling. He demonstrated that if dead pine trees were left alone and not logged, this would lessen the severity of the spring runoff by half. This is called “peak runoff”. The shade from the standing trees would slow the rate of melting snow.

Chatwin’s conclusions conform with first-year tested field results from four recent studies on snow-melt characteristics in beetle-killed forests. They were conducted by Prince George hydrology consultant Pierre Beaudry, Williams Lake–based Ministry of Forests’ hydrologist Paul Teti, Kamloops-based Ministry of Forests’ hydrologist Rita Winkler, and University of Northern B.C. assistant professor of geography Sarah Boon.

Here’s what the public might conclude from all of this. If all the pine forests in B.C.’s Interior had never been logged—and given their conversion from living to dead forests—good forest-hydrology science would recommend against conventional logging operations for decades within a majority of those stands. That would delay the spring runoff, alleviating the risk of flooding in the Fraser River and its tributaries, as well as other rivers.

Already, there is an elevated risk of runoff from industrial clearcut logging, not to mention from the maze of logging roads. For the past 60 years of B.C. history, increases in logging have been associated with fish-habitat destruction, landslides, erosion, flooding, drying of streambeds, and the ruination of drinking-water sources.

There is a close bond between trees and water flows. If the government gives the green light to logging all the beetle-infested forests in the B.C. Interior, it could bring in billions of dollars for forest companies. It could also generate tax revenue for the government. No wonder that the hydrology issue has been sidelined.

In the early 1970s, Idaho-based hydrologist Al Isaacson introduced a phrase called “equivalent clearcut area”, or ECA. It’s a hydrological threshold used to provide recommendations when cutting can resume in already logged areas. Here in B.C., forest hydrologists calculate the amount of logging or disturbance that can occur in a given watershed before it begins to seriously affect water runoff and increase erosion.

For instance, a large stand of dead pine trees dominating a watershed has an ECA of about 50 percent. This is well beyond the 35-percent maximum threshold that B.C. hydrologists now allow. But that didn’t stop Pedersen and Snetsinger when they approved increased logging rates in beetle-infested forests, ostensibly to make use of the timber.

An unprecedented 40-year study in forest hydrology in Oregon illustrates the seriousness of the “hydrologic” recovery rate. U.S. Forest Service hydrologist Gordon Grant’s 1995 report found that full hydrologic recovery only occurs 40 years after logging. The figure extends to 50 years or more in B.C. because its more northern forests grow at a slower rate than those in Oregon.

If Grant’s findings were applied to B.C., it would take until 2060 or longer before water flows began to assume their normal patterns in a reforested Fraser River watershed landscape.

The Fraser Basin Council’s 2006 State of the Fraser Basin Report conservatively estimates that “potential flood damages” here “range from $2-$6 billion, not including the indirect costs associated with the disruption of critical infrastructure and the economy”. That’s a big price to pay.

The council's report does not link flood risks with forest mismanagement. But whatever the costs of flooding turn out to be, don't be surprised if a tide of resentment rises against those who decided to gamble with the Fraser River watershed in the pursuit of short-term profits.

Will Koop is coordinator of the BC Tap Water Alliance, a citizens' group that advocates for the preservation of community watersheds.

PINE-BEETLE BLIGHT MAY BRING FRASER FLOODING

(Original Story submitted to the Georgia Straight newspaper, before final edit.)

By Will Koop,
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The Fraser River watershed, with its numerous tributary watersheds, encompasses an incredible 23 million hectares in area, about one quarter of BC's land mass. From its mouth at the City of Richmond eastward to the Town of Hope, then north to the City of Prince George, and eastward again to its headwaters in the Rocky Mountains near the Town of Jasper, the Fraser's river channel meanders a distance of almost 1,400 kilometers. Its watershed is equivalent to almost the size of Great Britain, or Romania, or the State of Oregon.

The Fraser Basin Council monitors and reports on sustainability issues related to the natural resources and economies in the Fraser River watershed. Established in 1997, an off-spring of the former Fraser Management Board, it has become an influential organization. At its annual conference held in Vancouver on November 17, 2006, a few speakers gave presentations about global warming, summaries about which were also included in the Council's *2006 State of the Fraser Basin Report*, circulated to attendees and the media.

Allan Chapman, the Head of BC Ministry of Environment's River Forecast Centre, gave a twenty minute presentation called *Mountain Pine Beetle in the Fraser Basin – Implications for Floods*. He said that since the late 1990s global warming was responsible for launching a destructive beetle invasion on BC's pine forests, spreading from five separate epicenters. It has become the most extensive beetle outbreak of its kind ever recorded in North America's 500 year-old colonial history. These beetles, which are native, or 'endemic', to BC's and many Interior American and Canadian forests, are normally kept from spreading due to former severe cold winter months.

Global warming is not the only factor for the beetle increase. Forest management practices over the last eighty years, primarily widespread Interior fire suppression and silviculture, have manufactured stress in the genetic stability of natural forests. Many forests were also made vulnerable by the careless dispersal of beetles falling out of logs while transported on logging trucks and train cars.

Chapman provided the audience with a lot of information. On a large screen were shown numerous maps, photos of the infected and dead forests, and relevant statistics. Provincial and federal government scientists, he said, are predicting that if the abnormal warming trends continue, more than eighty percent of all BC's pine forests will have died by the end of the year 2013.

Pine forests represent about a third of all BC's forest species. At present, over 10 million hectares of Interior forest lands, just over 10 percent of BC's land base, have already been infected to varying degrees of mortality.

Numerous disturbing field reports from Ministry of Environment and Forests staff are steadily pouring in on how seedling and young pine plantations, the successors, are also being attacked. Previously, beetles only attacked older pine trees.

From his background training in the science of forest hydrology - the study of stream flows from forests - Chapman said that the death of these forests will cause widespread flooding, particularly in the Fraser River watershed. He said that sixty percent, or thirteen million hectares, of the Fraser River watershed is made up of valley bottom to mountain side forests. Just over fifty percent of those forests, or seven million hectares, are pine. This is bad news, because these dead pine forests that represent just under a third of the entire Fraser watershed can no longer regulate or slow down the rate of snow melt during the warming Spring season as intact forests have traditionally done. This will result in the rapid rise of the Fraser River from its many affected tributaries.

According to a 2004 Alaska State research bibliography report, entomologist Ed Holsten stated that similar beetle epidemics in the United States caused "large increases in stream flow," enduring "25 years after this outbreak". Yet Holsten's summary was not mentioned in a similar November 2005 federal government research report of historic beetle surveys and resultant increases of water flows.

BC's climate and rainfall patterns are changing as a result of global warming. What was once normal or average is about to change. What was once predictable, such as a dry Interior Winter or Spring, may no longer be accurate for predicting Spring runoff. For instance, in many western portions of BC's pine-belt Interior snowfall accumulations are presently at record highs, which means Spring flooding for many unprepared communities.

Prior to Chapman's presentation, Monica Mannerstrom, Senior Project Engineer with the respected Northwest Hydraulics Consultants Ltd., provided an overview on the Lower Fraser's (Agassiz to Richmond) numerous inter-municipal dyking structures. She also showed old photographs from the great flood of 1948 that inundated homes, businesses and farms, and resulted in rigorous reinforcement of existing dykes. Concerning possible future flooding from the beetles and the raising of existing dykes, she said: "Certainly we need to inform all levels of government, that there is this problem, so that nobody can say that they didn't know".

Afterwards, Chapman stated, "It looks fairly ominous for Monica's concern, and the question may be, how many meters do we have to raise these dykes?"

On September 21, 2006, two months before the annual conference, Fraser Basin Council Flood Management Coordinator Steve Litke stated to me that, oddly, there were no coordinated efforts between his agency and the provincial government to assess the looming problems of pine beetles and flooding of the Fraser. His comment is significant, because it well indicates how the provincial government has been reluctant, until just recently, to investigate this critical issue with the Council, or with other public interest bodies.

The reason for this peculiar avoidance has everything to do with forest industry politics.

Prior to 2005, federal and provincial administrators had ignored the issue of hydrology during their preoccupation in developing strategic logging plans for the beetle epidemic in BC's watersheds. The science of Hydrology studies and measures the diverse relationships of the hydrologic cycle (rain, snow) on land forms. As a recent branch of this science, Forest Hydrology practitioners study the way

in which forests control stream, river and groundwater sources. This science is, supposedly, one of the main tools in preparing provincial logging plans. This tool was avoided.

Former BC Chief Forester Larry Pedersen was finally cautioned about the hydrology impact by his Ministry's science researcher Marvin Eng in August 2004, by way of a small paragraph in Technical Report number 019. Pedersen's consideration to increase the rate of Interior logging to "salvage" pine beetle timber would "adversely" affect water runoff, Eng wrote, because many areas had already been heavily logged. Eng's advice was ignored. By October 2004 Pedersen authorized large increases to annual logging rates in three mid-northern Forest Regions.

After Chief Forester Jim Snetsinger replaced Pedersen, he wrote an eight page "guidance" report in December 2005 defending Pedersen's controversial decision. He acknowledged that the "80 percent" increase in logging would pose "a significant risk of hydrological problems", noting that he was "mindful" of those problems. Instead of taking the 'pre-cautionary approach', logging politics won out. Government and private industry officials began playing Russian roulette with provincial waterways. Hydrology concerns only began to take prominence a year and half ago, finally identified in a July 2005 Ministry of Forests (MoF) *Beetle Stewardship Research Strategy* report. It was given the "highest priority" rating alongside silviculture research. However, the report noted that numerous facets of resulting hydrological impacts from the beetles and logging – i.e., rising water tables, landslides, road failures, stream channel erosion, increased sediments in water courses, fish habitat destruction, warming waters, floods – were all identified as having considerable "knowledge gaps".

Because of the close bond, or marriage, between trees and water flows, it is not surprising that forest management politics by the forest industry in the United States and Canada are beset by controversy. Fish habitat and riparian destruction, landslides, erosion, flooding, drying of streambeds, and the ruination of drinking water sources have been the predominant themes over the last sixty years in BC alone, directly related to escalated increases in provincial harvest rates and logging methods. With the beetle epidemic, these politics are evidently continuing, but with serious future consequences.

I know something of these long-standing politics. Twelve years ago, during my nine year effort to help protect Greater Vancouver's drinking watersheds from logging I began to study forest hydrology. At that time the Greater Vancouver Water District, University of BC, government and industry foresters defended the logging on the ridiculous premise that it would "maintain or enhance" drinking water quality. Their claim, they said, was supported from science.

I began a lengthy investigation of North American literature on this subject and interviewed many hydrologists, even uncovering flawed research from a forest hydrology experiment in the Greater Vancouver watersheds used to defend the claims. I then understood the common theme with almost all logging operations: their relation to impacts on water flows and the interpretation (good or otherwise) by professionals on where and how much logging can occur, or continue to occur, or to not occur at all.

In late August, 2006, I took a trip up north into BC's Interior. I haven't been up there for years, and what I saw was very troubling. There was horizon after horizon of endless red and grey dead stands of pine forests. That experience was so compelling I decided to begin an investigation. Over a period of six weeks I made inquiries with government staff, university professors, and gathered numerous reports. I soon discovered that the majority of BC's pine forests are concentrated in the Fraser River watershed. I then became concerned about the big question: were there legitimate concerns about potential flooding to the Lower Fraser, home to the majority of BC's population and industry?
There are two pieces of information needed to tackle such an investigation for the Fraser River watershed. The first concerns collecting statistics on the total area of logging taken place, and projected

to take place, including areas burned by fire. I was told that the provincial government had never made such a study. “Watershed Assessments” began and were routinely assigned in the 1990s for much smaller areas, but never at such a complicated, enormous scale. I then began to examine and collect visual satellite imagery of the logging, via Google Earth, a formidable task. Though I was unable to calculate total percentages of logging for each of the many tributary watersheds, much has already occurred.

The second piece of information is estimating the area of all the dead pine forests killed by the beetles. Statistics from MoF Timber Supply Analysis Reports on the total hectares of Interior pine forests are inconsistent and not all the figures were available. Allan Chapman stated at the Council conference that it was close to seven million hectares, a figure which is probably accurate.

When those two layers of information about logging and the beetles are overlapped to form a final layer, it becomes a qualitative tool to help calculate the percentage of the total disturbed land base, a method of analysis commonly used by forest hydrologists. Interpretations about changes to the overall hydrology can be applied and estimated, including the more daunting, complex question about future impacts to the Fraser River.

In addition, I recently learned an important fact while attending the Canadian Water Resources Association’s BC Chapter annual conference in Vancouver (October 24-26, 2006) from two up-to-date presentations on hydrology and the beetles. The conferences regularly attract a wide range of professionals from government, academia and the private sector concerned with the governance and resource management of our fresh water systems.

Steve Chatwin, a senior forest hydrologist with the BC Forest Practices Board, highlighted new, unpublished findings from the first forest hydrology study conducted on the beetles at Baker Creek, a heavily logged watershed just west of the Town of Quesnel. Chatwin’s main finding through computer modeling showed that if the dead pine trees are left alone and not logged, compared to all the dead forest being logged, their impact would lessen the resulting severity of the Spring runoff, called “peak flow”, by half. Rough translation: the shade from the standing dead trees acts to protect and slow the rate of snow melt.

Of importance, Chatwin’s conclusion generally agrees with first year tested field results in 2006 from four recent studies on snow melt characteristics in beetle killed forest stands. There were done by Prince George hydrology consultant Pierre Beaudry, Williams Lake MoF hydrologist Pat Teti, Kamloops MoF hydrologist Rita Winkler, and University of Northern BC professor Dr. Sarah Boon. There is little surprise in these findings, generally corroborated by ongoing research since the late 1960s.

However, this knowledge, in itself, is very disturbing. Here’s what it means, in general. If all the pine forests in BC’s Interior had never been logged, and given their conversion from living to dead forests, good forest hydrology science would recommend against conventional logging operations within the majority of those stands for many decades. That’s because the standing dead forests, themselves, will considerably upset the natural hydrology. On top of Interior landscapes already patterned and dominated by large forest openings from industrial clearcut logging and a maze of logging roads, the natural hydrology will be upset even more. Small wonder this issue was being suppressed.

BC forest hydrologists calculate the amount of logging or disturbance that can occur in a given watershed before it begins to seriously affect water runoff and increase erosion. They then provide

recommendations when logging can resume in the future. This hydrologic threshold is called the "equivalent clearcut area" (ECA).

For instance, a large stand of dead pine trees completely dominating a watershed has an ECA of about fifty percent. This is well beyond the maximum threshold of thirty-five percent that BC hydrologists now allow. BC's Chief Foresters Pedersen and Snetsinger, along with government advisors, understood that they were going well beyond the ECA threshold when they gave their orders to increase logging rates in the Interior.

This ECA is an adopted phrase and concept first introduced in the early 1970s by Idaho-based hydrologist Al Isaacson. According to interviews with veteran Isaacson many years ago, he stated the ICA rationale adopted in BC in the 1980s was outdated and often misapplied. That's because he later helped refine and reduce the ICA threshold by taking into account more restrictive "sediment standards". Isaacson also stated that in the early 1970s many foresters hindered and fought against the ECA concept because they mistakenly and stubbornly argued that logging was not linked to increased water flows.

The issue of "hydrologic recovery" rate from the beetles and logging becomes quite serious when one considers the critical findings from an unprecedented forty year long study on forest hydrology in Oregon State. United States Forest Service hydrologist Gordon Grant's 1995 report from the H.J. Andrews Experimental Forest found that full "hydrological recovery" only begins to occur 40 years later. The definition of hydrologic recovery is when water flows assume normal rates as the coniferous forest gets older in an area that has been logged or disturbed. That figure extends to over 50 years or more for BC, because northern latitude forest growth rates are much shorter than those in Oregon.

When Grant's study was reported on in the Oregonian newspaper on March 8, 1996, timber giant Weyerhaeuser's hydrologist Kate Sullivan refuted Grant's peer-reviewed findings. Why? They challenged the uncorroborated, philosophical underpinnings of the forest industry, the long held assumptions for logging methods for shorter logging rotations on the Nation's forests.

Rather than relying on a specific time period as identified by Grant, in BC the hydrologic recovery of Interior and Coastal forests are assumed according to early plantation "tree height", an untested and highly controversial assumption. In other words, Grant's finding means that it is going to take until the year 2060, or longer, before water flows begin to assume their normal patterns in a reforested Fraser watershed landscape.

The Council's *2006 State of the Fraser Basin Report* states the Fraser watershed will also be battered by forest fires and extreme storm events, resulting in floods, drought, lower river flows, and continued warming of river temperatures. It also conservatively estimates, without clearly identifying flooding with forest mismanagement, that "potential flood damages" here "range from $2 - $6 billion, not including the indirect costs associated with disruption of critical infrastructure and the economy." Not described is how these costly flooding problems will be compounded in the future at the River's mouth with the Cities of Richmond and Delta by the predicted rise of ocean levels, combined with rising inner river tide levels.

Unfortunately, if the concerns from forest hydrology science are correct, British Columbians who live along the Fraser River may soon begin to experience flooding disasters. And these won't be one in one hundred year events. They will occur more frequently than they ever have since the last ice age.

Whatever the costs may be, there may be a tide of bitter resentment in the future against those who decided to gamble with the Fraser River, and many other BC rivers, for short-term profits.