# Maximizing the Productivity and Benefits of the Comox Lake Water Supply

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## Summary

The existing Puntledge River power generation system below Comox Lake near Courtenay is suboptimal on at least two aspects:

- It uses only 88 meters vertical of the 133 meter drop from Comox Lake to sea level.
- It is restricted in storage capacity by the existing dam and penstock structures, so that storm and seasonal outflow from the lake is wasted or used destructively.

This paper proposes that a new penstock system be built from Comox Lake to a new generating station located on tidewater. This new generating station would operate primarily on excess water, with the existing power station being operated so as to provide a uniform flow to the lower Puntledge River.

Potential benefits would include:

- Increase in baseline power generation of 50% using the same annual volume of lake outflow.
- Possible doubling or more of electrical generation during times of high outflow.
- Improved fish spawning habitat in the Puntledge River by better river flow management.
- Reduction of flood hazard in the Countenay city core and in nearby housing locations.
- Potential for major improvement in water quality for the Comox Regional District water system.

### Overview of hydroelectric capacity on Vancouver Island.

The present state of hydroelectric generation capacity on Vancouver Island represents a paradox. On the one hand, nowhere in Canada are the two essential elements of hydroelectric capacity (rainfall and vertical topography) more abundant. Much of the island receives a lot of precipitation – and although rainfall and snowfall are strongly modulated by the seasons, the release of snowpack during the drier summer months partially moderates this variation. There are a dozen peaks on the island over 2 kilometres high, and no point on the island is more than 50 kilometres from tidewater. But the extreme slopes, small watersheds and short watercourses make engineered hydroelectric reservoirs economically unfeasible in most cases. The result is that rather minimal hydro-electrical generation capacity has been realized on the island. Put another way, only a tiniest fraction of the gravitational energy that is released as each raindrop travels from alpine meadow or forest floor to sea level is harvestable with the current paradigm. With run-of river generation, some of this may be prove to be harvestable. Importantly, though, this should be achieved without compromising environmental and ecological values.

Most of the electricity used on Vancouver Island (75%?) is imported from the mainland. This is the paradox: in a region of extreme topography and rainfall, we are short of hydro-electrical power.

This paradox is not limited to Vancouver Island: indeed much of British Columbia enjoys abundant rainfall and extreme topography. Yet British Columbia produces fewer megajoules of hydroelectricity per square kilometre than does Germany, a country with average rainfall

and moderate topography.

Vancouver Island has one intrinsic advantage: it contains a number of large lakes which are natural reservoirs, all within close distance of tidewater. If the waters of these lakes were directed to sea level while maintaining sufficient flows in their natural riverbeds to sustain fish habitat, could the electrical production of the island be substantially increased? This paper confines this question to the particular case of the Comox Lake watershed.

## The Puntledge Power Generation System

The Puntledge River power generation system is well described in BC Hydro's online resources, and will not be detailed here. Of importance, though, is how this facility came into being. Like the other power generating stations on Vancouver Island, it was conceived and built a long time ago, to the needs of a different age. As much as possible, it was made from pre-existing elements built by the Wellington Collieries Ltd. installation dating from 1912. Although the dams and generators have been rebuilt over time, the system that exists is not one that would be chosen if we were starting from scratch today. For one thing, the penstocks follow only half of the river's length, utilizing only an 88-metre descent of the 133-m drop from Comox Lake to the sea. One third of the hydroelectric energy is simply not harvestable with this limitation.

Another factor that limits the use of the water supply is the outlet dam at Comox Lake itself. The outlet control on the lake can allow a 4.5 metre fluctuation in the lake level, but no more. Comox Lake is deep, but its reservoir function is limited by the limited dynamic range required for outflow, not by lake volume.

The mean annual discharge at the Comox Lake dam is about 34 to 43 cubic metres/sec. In the winter months when the reservoir is close to its highest level, storm events can cause inflows into the lake up to a recorded high of 730 m3/s. The reservoir can absorb some of this inflow, but occasionally it is necessary to spill up to 350 m3/s downstream. Since the present penstock/generator system can handle only 27 m3/s of this, almost the entire storm spill must pass through the Puntledge river bed, causing all fish in the river to be washed out through he estuary, and risking flash floods in the heart of Courtenay.

## Maximizing Power Generation

An optimal  system would utilize the entire descent from lake level to sea level for whatever power is diverted for hydro generation. It would also allow greater flexibility in managing the lake itself as a reservoir.

It is proposed that BC Hydro create a new generating system for Comox Lake water, to be operated in conjunction with the existing facility, and similar in water volume capacity to the existing facility. The new system would consist of:

- new penstocks running from an intake point within the lake itself, to sea level near the southern limit of the estuary, and
- a generating station that would discharge this water directly into the sea.

It would be timely to construct these facilities as soon as possible, since the land required is not yet developed and could be easily acquired. A possible route would be along the riverside from the lake to the Comox Logging Road, and along the Comox Logging Road to tidewater near Royston (at a point near to the Royston wrecks, for example). Some of this land is

pending development, so the time to secure it is now. An alternate route could follow the existing BC Transmission Corp. powerline right-of-way. A shorter though more costly route would be the 10 km line directly from Comox Lake to Royston, but a tunnel would be needed at the upper end.

**Fishery Considerations**

At present, the excess runoff from Comox Lake runs down the Puntledge River as weather dictates during the winter months. In spring, runoffs of around 85 m3/s are scheduled as a kayaking event. In the summer, smaller pulses of water are sent down the river, supposedly to help the fishery. The imagined benefits to the fishery of these pulsed outflows has yet to be proven, and may even be destructive. In any case, the loss in generated electricity due to these pulsed events was estimated at $173,000 in a recent report.

We do know that the Puntledge River is home to all five species of Pacific salmon, plus steelhead salmon, but in numbers well below their historic levels. In pre-contact times (going back at least 1400 years as evidenced from the recently rediscovered fish traps in the estuary), and from historic records, the Puntledge was one one the most productive fisheries on Vancouver Island. Although the Puntledge River has two fish hatcheries, their returns have not lived up to expectations.

The most productive salmon river in the world is the Adams River. In 2010, some ten million sockeye made the arduous journey up the Fraser river to spawn in the 11 km long Adams River channel between Adams Lake and Shuswap Lake. For comparison, that number of fish in a small section of river is believed to be about the same as the total number of Atlantic salmon that spawned annually in **all the rivers that flow into the North Atlantic Ocean** at the **peak** of that (now declined) fishery. Those 11 km of Adams riverbed offer something very special indeed! What makes the Adams River the ideal spawning ground? It is the lakes themselves: Adams Lake buffers the river flow to a moderate consistent flow, free from flooding and attendant erosion of the spawning beds. The relatively constant water flow maintains clean gravel deposits on the Adams river bottom that are ideal for the development of salmon roe and alevins. In Shuswap Lake, the young salmon can feed for an extended period before making the long journey down the Fraser and out to sea. The Comox estuary serves a similar purpose, except it is saline.

Compare the Adams River with the situation we have created on the Puntledge. River flow varies by a factor of almost one hundred! The young salmon are flushed out to sea, with no time to imprint whatever information it is that they use to return at the end of their life cycle. If they were allowed to rest in the estuary, they could feed and imprint, improving their chances of survival and return. Worse, we have imposed the schedule when the young fish are flushed out to salt water. We know all young salmon undergo a biological change called smolting which prepares and adapts them for the change from fresh to salt water. Young fry who have not smolted have almost no chance of survival if flushed out to salt water prematurely.

Recent fish counts in the river suggest that our flushing of the river is not beneficial to salmon and steelhead. Seals have been blamed for low rates of salmon survival, but the seals have always been here, and historically the returns of salmon were much higher.

It is time to rethink our approach to the Puntledge River fishery. Another current problem in the Puntledge (besides variability of flow) is the high water temperatures (deadly to salmon) which occur during the peak of summer. With better capacity to control Comox Lake outflow, flow volume could be better maintained during the drier months. If a new intake was from

deeper, cooler water in the lake, safer water temperatures for salmon could be maintained.

### Flood Risk Considerations

Whether it is due to climate change or faster runoff from over-logged mountain slopes, the risk of flooding on the Puntledge and Courtenay rivers seems to have risen in recent years. Many reports in the local newspapers document this risk during the last few winters. As a result, the City of Courtenay is currently trying to relocate some 30 mobile homes and their residents, some of whom face homelessness. In other words, the current (mis)management of Puntledge river overflows has severe implications for Courtenay businesses and for individual citizens

### Domestic Water Supply considerations

The Comox Valley Regional District (CVRD) uses water from Comox Lake for the domestic water supply for about 38,000 people in the region. In recent years, this supply has been subject to episodes of contamination, largely accountable by the fact that the water is drawn from the surface of the lake rather than a deep intake. Construction of a new penstock/aqueduct from the lake would be of great benefit to the CVRD, and is under study. **A certain benefit would be a reduction in the amount of chlorine needed to treat the water supply.** Chlorine and its organic compounds are generally considered carcinogenic: reduction in chlorine use would be an immediate and direct health improvement.

### Other Stakeholders

The waters of Comox Lake and its watershed involve many stakeholders. In terms of volume of water, BC Hydro is overwhelmingly the largest user, but with its dominant position comes great responsibility. In terms of dollar values and human well-being, the other stakeholders are certainly no less important. Here is a partial list of stakeholders in this resource:

- BC Hydro: power generation
- Fisheries resource workers and recreational fishers
- Comox Valley Regional District, for domestic water supply
- Aboriginal peoples
- Courtenay businesses, subject to flooding damage
- Residents in the Courtenay River lowlands, subject to flooding and displacement

**Conclusion**

The existing facilities for handling and using the Comox Watershed water resource are simply incapable of delivering optimal use of this resource. BC Hydro could improve its electrical generation output by at least 50%, and at times up to 150% by using the full 133-metre descent from Lake to sea level. By allowing for greater uniformity of lake outflow into the Puntledge, the once-resilient fish-bearing capacity of the river can be restored. Other benefits for stakeholders include improved water supply and improved flood control.

Although many reviews of the existing water resource have been undertaken by BC Hydro, by consultants for the regional district, and by citizens groups in recent years, they have all approached the problem as a matter of redividing the existing “pie” as limited by current infrastructure. What is needed is not a reassessment of what is, but of what can be. I urge BC Hydro to proceed to engage all stakeholders with a plan for new investment in the Comox Watershed water resource.

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