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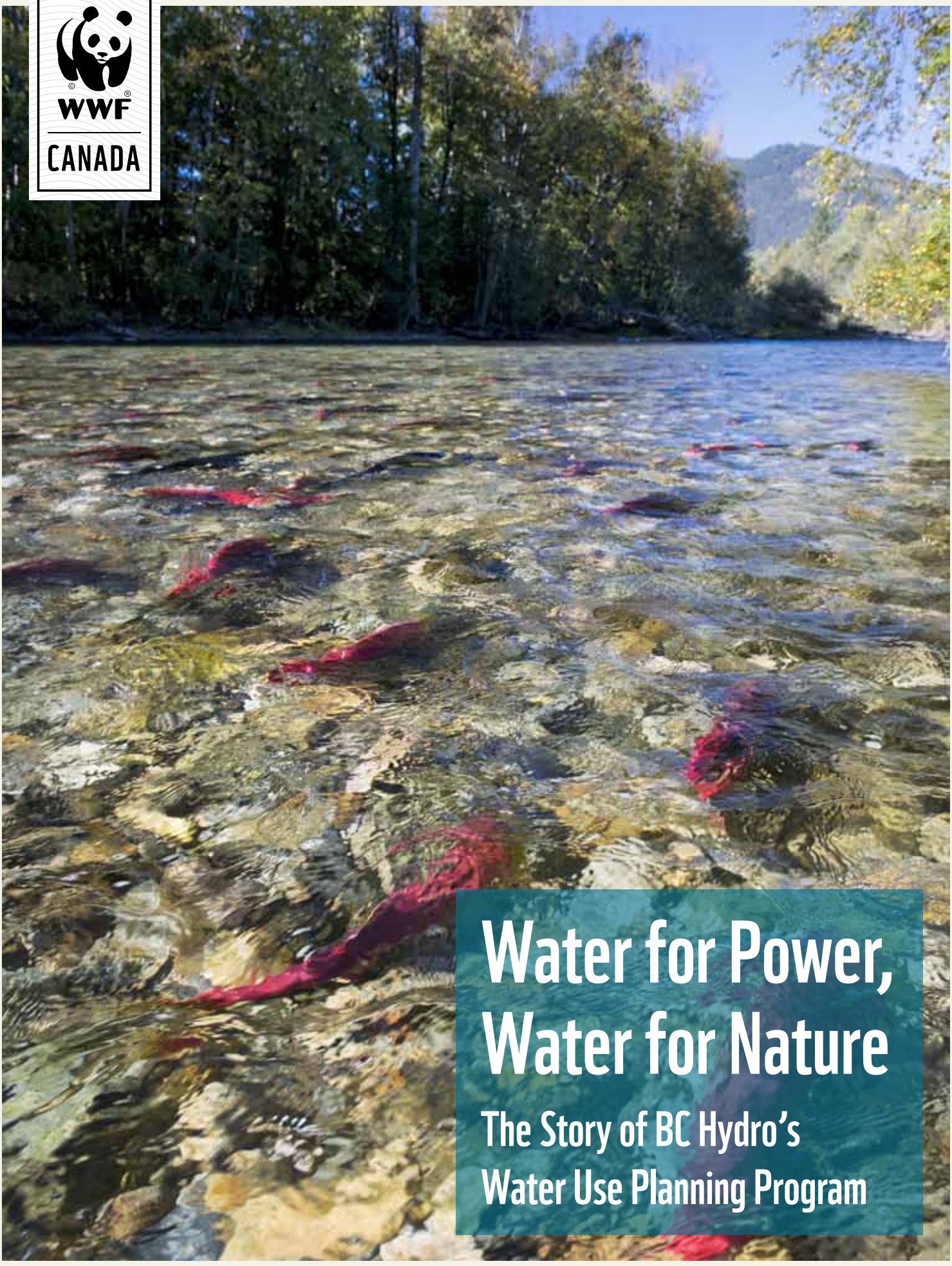

Water for Power, Water for Nature

The Story of BC Hydro's Water Use Planning Program

Front cover: sockeye salmon in the lower Adams River.

Published in October 2014

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Recommended citation: Mattison, J., et al. (2014). *Water for Power, Water for Nature: The Story of BC Hydro's Water Use Planning Program*. Vancouver: WWF Canada.

Acknowledgements: The authors wish to thank all the current and former staff of BC Hydro, and government agencies, particularly the BC Ministry of the Environment and Fisheries and Oceans Canada, for their willingness to supply information and answer questions, and review the report. For many of them, there was not only a willingness to supply information but an obvious pride in their accomplishments and a desire for us to get this right. This report could not have been written without that information and assistance.

The authors also wish to thank the people who gave their time to review and comment on this report: Mike Bradford, Fisheries and Oceans Canada; Adam Lewis, Ecofish Research Ltd.; Denise Dalmer, formerly Director Energy Policy and Project Assessment, Ministry of Energy and Mines, British Columbia; and Tony Maas and James Casey, WWF-Canada. Any errors or omissions are attributable to the authors.

This publication is funded by the Gordon and Betty Moore Foundation. WWF thanks the Foundation for their financial support that made this work possible.

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EXECUTIVE SUMMARY

Dams can provide important benefits to society, but they have significantly impacted freshwater ecosystems.

WWF-Canada produced this report to document the BC Hydro water use planning process and share the lessons from this successful, collaborative, multistakeholder water governance process. This process sought to find a better balance between competing uses of water, such as domestic water supply, fish and wildlife, recreation, heritage, and electrical power needs. By applying key concepts of collaboration and through the use of structured decision-making, alternative flow releases have been implemented, leading to improvements in fish productivity and habitat.

The lead author of this report, James Mattison, is the former comptroller of water rights for the Province of British Columbia, and held that position throughout the time when WUPs were being developed. Co-author Craig Orr was a participant the Coquitlam-Buntzen water use planning consultative committee, the Coquitlam fish technical committee, the First Nations water use planning committee, the fisheries advisory team on water use planning, the green hydro working group, and numerous other academic, technical, and informal meetings. Both bring detailed knowledge and insights based on their work on the water use plans (WUPs). The WWF-Canada co-authors undertook the study because environmental flow protection is a major policy goal of the Freshwater Programme. Since WUPs have improved environmental flows for 23 major BC Hydro facilities, WWF was interested in bringing this story to a wider audience.

The BC Hydro and Power Authority ("BC Hydro") is a Crown corporation, wholly owned by the Province of British Columbia (BC), and is one of the largest electricity utilities in Canada. British Columbia is a hydroelectricity powerhouse, and the water use planning initiative is the province's largest water restoration project to date. Dams had been built in British Columbia for more than 100 years before legislative initiatives such as environmental assessments or public hearings for utilities came into being. Most of British Columbia's dams had few, if any, environmental operating conditions as part of their water licences. A recognition of the need for water law and management to better account for ecosystem needs has emerged in the last few decades, and this recognition was one of the factors that prompted the creation of the water use planning process. Legal challenges such as a petition to the Commission for Environmental Cooperation alleging failure to enforce the federal *Fisheries Act* against BC Hydro were also a key factor.

The story of BC Hydro's water use planning deserves a wider audience because of the collaboration features, involvement of First Nations, public participation benefits, commitment to monitoring and adaptive management, use of structured decision-making, and on-the-ground implementation.

The water use planning process employed unique collaboration features, scoring highly on "factors of success" identified by academic literature on collaborative water governance. Using the five factors identified by the UBC Program on Water Governance, the planning involved (1) a partially delegated structure, (2) the scale of a river basin affected by a hydro facility for decision-making, (3) extensive participation beyond the proponent and the regulator, (4) a collaborative process, and (5) science-based decision-making (Nowlan & Bakker, 2010). One of our conclusions is that incorporating these features improved the likelihood of success.

Another reason to showcase the study is the involvement of First Nations. In British Columbia, historic dam construction and operation negatively impacted First Nations in a variety of ways; consequently, any question involving dams and fisheries is extremely contentious. The water use planning process resulted in some advances welcomed by First Nations, although historical grievances related to flooding, resettlement, and loss of traditional fisheries were outside the scope of the process. Changing the operating conditions of dams has particular significance in Canada due to the constitutionally protected rights of aboriginal peoples. Aboriginal peoples in many other parts of the world could benefit from learning how British Columbia's water use planning process has addressed impacts from dam operations.

The public participation benefits from this process are particularly notable: the process clearly demonstrated that participation of a wide spectrum of groups who care about water management adds value in formal decision-making. Bringing stakeholders together to educate all parties and build the plans is a strength of the water use planning process that merits continued attention from regulators and project proponents.

Another key feature is the structured decision-making process, which clarified objectives, fostered the development of management alternatives, revealed their economic, social, and environmental consequences, and made the trade-offs between the management alternatives transparent. SDM has been adopted in many other complex water management and resource use situations in British Columbia, and it could be replicated elsewhere. The planning processes included a commitment to monitoring and, in some cases, adaptive management. Each WUP included a provision for review within a specified time period. Those reviews are now underway. While the need for adaptive management is often invoked, it is less frequently put in practice and backed up by interim monitoring requirements. This is a case where the process "walks the talk."

This paper begins with an examination of the driving forces that brought the process about and the history of getting down to action. It describes the process in detail, including principles and guidelines. The BC Minister of Employment and Investment and the BC Minister of Environment, Land and Parks announced the process to produce WUPs in November 1996. Water use planning became a major initiative for BC Hydro, provincial agencies, and what was then the Department of Fisheries and Oceans, now Fisheries and Oceans Canada (DFO). The federal fisheries agencies could see the benefits of this cooperative approach as opposed to a regulatory one and the costs, delays, and uncertainties of the litigation that would follow. It would take 14 years to complete the initial plans for the facilities.

We present detailed case studies of three of the WUPs, for the Bridge River, Cheakamus Project, and Coquitlam-Buntzen Project, examining the complexity, challenges, constraints, and opportunities that were encountered and the outcomes that were achieved. Two of these processes reached consensus, but one was the lone process out of the 23 completed plans that did not produce a consensus decision.

We then discuss WUP implementation, including interim operational changes and the public consultation process. We go on to explain the legal and financial processes that water use planning required.

Finally, the report examines the outcomes and critical success factors, and makes recommendations for adopting the process to apply to future water management.

The BC Hydro WUP story is a good-news story about implementation of environmental flows. WUPs are an exception to the oft-noted lack of action on re-allocation of water for environmental purposes and on changed operation of dam infrastructure (Le Quesne, Kendy, & Weston, 2010). The evidence to date shows that fish habitat has improved due to BC Hydro's new operating parameters, and fish populations appear to be improving, although it is too early to tell if the numbers are increasing as models forecast.

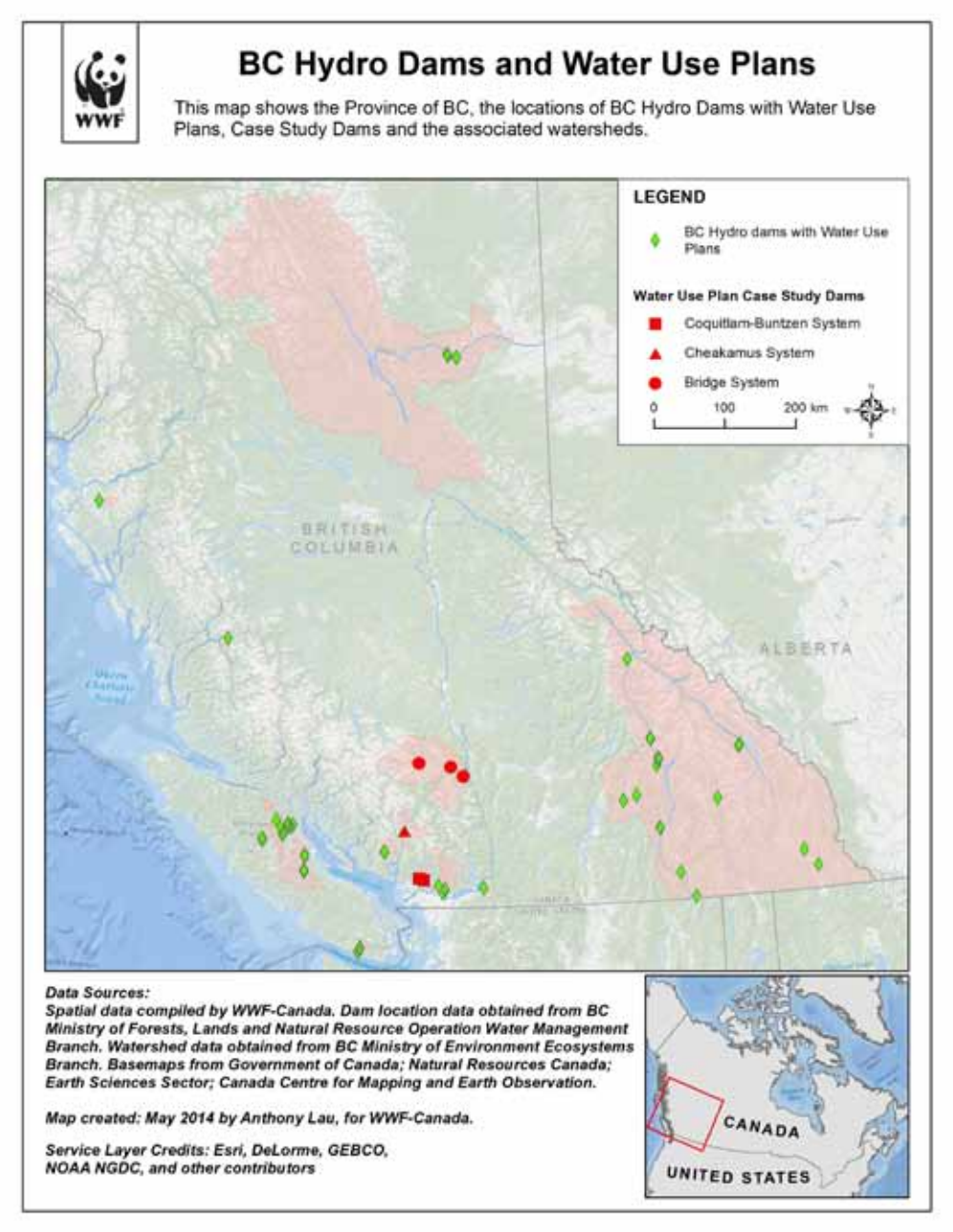


Figure 1. Location of BC Hydro dams that have water use plans and their watersheds.

INTRODUCTION

Conflicts over water use and dam operations escalated in the late 1990s in British Columbia.

Society's values were changing, and a series of events demonstrated that fish were not being protected from harm from hydroelectric operations. BC Hydro's Electric System Operations Review showed that fish issues had not been adequately addressed. A DFO–BC Ministry of Environment audit of BC Hydro water licences known as the Ward Report revealed frequent and numerous violations of licence terms, and high-profile incidents such as the loss of spawning gravel habitat in Campbell River, forced spills, and the draining (or drafting, the term preferred by BC Hydro) of Downton Lake reservoir on the Bridge River system in 1996, which resulted in significant fish mortality, were in the news. The mounting public distrust of BC Hydro culminated in a 1997 citizen petition to an international institution, the secretariat of the trilateral Commission for Environmental Cooperation (CEC),[1] alleging the failure of Canada's federal government to protect fish and fish habitat in British Columbia's rivers from ongoing and repeated environmental damage caused by hydroelectric dams.[2] These events, along with BC Hydro's redevelopment of the Stave Falls plant, which focused on fisheries issues, were the genesis of BC Hydro's water use planning process.

The need was clear. A better balance had to be found between competing uses of water in British Columbia, and the BC Hydro process was designed to better inform and make trade-offs between different water uses.

"Water use planning" is a term that came to be used by the provincial and federal government agencies and BC Hydro, the Crown-owned hydroelectric utility, to describe a structured, collaborative, consensus-based process to modify the province's operations of dams and hydroelectric generating stations to include managing for social and environmental outcomes, rather than having the systems solely optimized for power generation and, to some extent, flood control.

The purpose of this report is to document this process, as it has enabled improved water management decisions and outcomes in British Columbia. A primary focus of the water use planning process has been on improvements for fish and fish habitat. Although the process was expanded to include other social and environmental objectives, it was concern for fish that started the process, and fish—and the social, economic, and ecological values associated with fish—that benefited most from the process. This report also highlights the design elements of water use planning for collaborative water governance that proved successful in practice.

We begin with an examination of the driving forces that brought the process about, and the history of getting down to action. We describe the process in detail, including principles and guidelines. Detailed case studies of three of the water use plans (WUPs)—for the Bridge River, Cheakamus Project, and Coquitlam-Buntzen Project—examine the complexity, challenges, constraints, and opportunities that were encountered and the outcomes that were achieved. Two of these processes reached consensus and one was the lone process out of the 23 completed plans that did not produce a consensus decision.

[1] The Submissions on Enforcement Matters process under Articles 14 and 15 of the North American Agreement on Environmental Cooperation, the "environmental side agreement" to the North American Free Trade Agreement, provides that any resident of Canada, Mexico, or the United States can file a submission with the CEC Secretariat claiming that a party is failing to effectively enforce one or more of its environmental laws.

[2] In this case the petition, BC Aboriginal Fisheries Commission et al. (1997), passed the three hurdles to reach an outcome: the secretariat decided the submission was admissible, merited a response by the government of Canada, and warranted the preparation of a factual record. The final factual record was released by the CEC in 2000. The CEC petition is not addressed in detail in this report. For more on the process and how it was applied in the BC Hydro case, and how it focused the spotlight on the environmental effects of dams in British Columbia, see Christensen (2004).

This report then discusses WUP implementation, including interim operational changes and the public consultation process. It goes on to explain the legal and financial processes that water use planning required.

Finally, we examine the outcomes and critical success factors, and we make recommendations for adopting the process to apply to future water management. Though the report's primary lens is on changed hydroelectric operations for healthier fish and fish habitat, the report also discusses how well the water use planning process incorporated the five key features of successful shared water governance processes.

THE WATER MANAGEMENT REGIME IN BRITISH COLUMBIA

The Province of British Columbia controls water use within its borders. The property in and the right to use water in British Columbia are vested in the provincial Crown. Under the BC *Water Act*, it is unlawful to divert and use water without authority, except for simple uses such as firefighting, mineral prospecting, and household domestic consumption. Officials under the *Water Act*, such as the comptroller of water rights and the regional water managers, are empowered to authorize the diversion and use of water by issuing a water licence. Water licences may contain many conditions that specify where, when, and how the water may be taken and the works that may be constructed and operated.

Water licensees pay fees for the right to use and divert water. In addition to an application fee, there is an annual rent payable to the Crown. In the case of hydroelectric facilities, fees are paid for storage (if applicable) based on the flooded area and the volume of water stored, and for the use of water based on the installed capacity of the power plant and the annual generation output of the plant. Most other licensees pay a fee for a fixed maximum quantity of water they are authorized to take, whether they use it or not. Hydroelectric plants pay a capacity fee, analogous to the maximum quantity fee, and a generation fee, which is a resource rent analogous to the quantity of water used. Several hundred millions of dollars are paid to the Province annually for water license fees from hydroelectric plants (Water Regulation, B.C. Reg. 204/88).

Under today's legal regime, an environmental assessment certificate is required before a water licence can be issued for a new proposal for a major dam and hydroelectric power plant more than 15 m high, or one that will impound a reservoir containing more than 10 million m^3 of water above the natural boundary of the streams that supply the water to the reservoir (Reviewable Projects Regulation B.C. Reg. 370/2002).[3] An environmental impact assessment examines the potential effects of the dam and related facilities on fish and fish habitat, and conditions are included in the environmental assessment certificate, and consequently in the water licence, to prevent or mitigate most impacts. The environmental assessment certificate is a relatively new requirement, however. The BC Ministry of Environment did not exist until 1975, and the *Environmental Assessment Act* was not passed until 1994. After 1980, the *Utilities Commission Act* regulations required applications for an energy project certificate to identify and assess any impacts by the projects on the physical, biological, and social environments and to propose means of reducing negative impacts.

Dams were built in British Columbia for more than 100 years before legislative initiatives such as environmental assessments or public hearings for utilities came into being. Most of British Columbia's dams had few, if any, environmental operating conditions as part of their water licences.

[3] Environmental assessments are also required for modification, dismantling, or abandonment of dams.

BC HYDRO AND POWER AUTHORITY

BC Hydro is a Crown corporation, wholly owned by the Province of British Columbia, and is one of the largest electricity utilities in Canada. With 31 integrated hydroelectric generating stations, two gas-fired thermal power plants, and one combustion turbine station, BC Hydro has a total installed generating capacity of 12,000 megawatts and provides power to 95% of the people of British Columbia. The GM Shrum and Peace Canyon generating stations on the Peace River produce 28% of BC Hydro's electricity requirements. The Mica and Revelstoke plants on the Columbia River produce another 30%. The Kootenay Canal plant on the Kootenay River and the Seven Mile plant on the Pend d'Oreille River together produce 10%. The remaining 25 generating stations supply 12% of electricity requirements, for a total of 80% of electricity requirements met by hydro power from BC Hydro's own plants. The remaining electricity requirements are met by 1% that comes from the Burrard Thermal Generating Station, and 19% from purchases from other power producers, some of which may be hydropower. The majority of BC Hydro's facilities were completed in the 1960s, with the last "heritage"generating station, the Revelstoke plant, completed in 1984.

CHANGING ENVIRONMENTAL REQUIREMENTS FOR HYDROPOWER FACILITIES[4]

International pressure for change in the way dams are operated has escalated in the last few decades. In 1998, the World Bank and the International Union for the Conservation of Nature formed the World Commission on Dams in response to controversies over the impacts of large dams on local communities and the environment. In 2000, the commission issued its influential final report. While debate continues on whether the

[4] Much information in this section is drawn from WUP Management Committee (1999), as well as from the source documents referenced here.

Decision makers have learned to seriously consider hydropower dam impacts on fish species in BC rivers.

report found the right balance between the benefits and impacts of large dams, it made significant contributions concerning the processes that major dam developments should use, recommending recognition of the rights of all stakeholders. The report noted that "locally driven processes to establish the objectives of environmental flows will lead to improved and sustainable outcomes for rivers, ecosystems and the riverine communities that depend on them," and that legal measures are often required to enable implementation of environmental flows (World Commission on Dams, 2000, p. 239). Both these findings were echoed in the water use planning process.

At the same time, water law has evolved and has become "greener" in recent years to reflect the key role water plays in ecosystems (Burchi, 2007; Eckstein, 2010). Environmental flow protection in particular is driving water law reform in many parts of the world.[5] This is a growing topic of interest across all of Canada (Nowlan, 2012) and in British Columbia in particular, as the history of BC Hydro's water use planning process illustrates.

A recognition of the need for water law and management to better account for ecosystem needs has emerged in Canada in the last few decades. Society's changing view of water is illustrated by several legal developments in British Columbia. The *Fish Protection Act* was passed around the same time as the water use planning process was launched, and it prohibited the construction of new bank-to-bank dams on many of British Columbia's largest rivers, including the two largest salmon-bearing rivers, the Fraser and the Skeena.[6] British Columbia's hundred-year-old water law was also ripe for an overhaul. The title and content of the new BC *Water Sustainability Act*, passed by the Legislature in April 2014 to replace the BC Water Act, shows this evolution in thinking about water.

The change in thinking about water and the environment has been a gradual evolution over the past half-century. The 1970s saw the rise of the environmental movement in Canada, and governments began to respond with legislative change. Canada's Department of the Environment was first created in 1971. Although federal fisheries legislation dates back to the *British North America Act* and the founding of Canada, it was not until 1977 that Section 35 of the *Fisheries Act* was passed. Section 35(1) (as written then)[7] regulated any work or undertaking that results in the harmful alteration, disruption, or destruction of fish habitat. The Minister could authorize such work, which would have to be carried out in accordance with the Minister's conditions or under Regulations. By 1986, DFO created its "Policy for the Management of Fish Habitat," which included the management goal of "no net loss" of the productive capacity of fish habitat.

[5] In 2005, the Millennium Ecosystem Assessment reported that the calculation, adoption, and implementation of environmental flow laws and policies were increasing in a number of places in the world (Hassan, Scholes, & Ash, 2005, p. 178). See also Nowlan (2012).

[6] The BC *Fish Protection Act*, SBC 1997, c 21,was meant to balance the needs of fish with the needs of people, to the benefit of both. Many of its provisions, including those on prohibited bank-to-bank dams on listed rivers, sensitive streams, stream protection, and fish population protection orders have now been moved to the new BC *Water Sustainability Act*, passed April 2014 and not yet in force at the time of publication. The list of rivers on which bank-to-bank dams are prohibited includes the Adams River, Alsek River, Babine River, Bell-Irving River, the West Road River (commonly known as the Blackwater River), Clearwater River, Fraser River, Nass River, Skagit River, Skeena River, Stikine River, Stuart River, Taku River, Tatshenshini River, North Thompson River, South Thompson River, and Thompson River.

[7] This section was amended in 2012. R.S., 1985, c. F-14, s. 35; 2012, c. 19, s. 142.

The Electric Systems Operations Review

Historical complaints about reservoir impacts, especially from the Columbia Basin, and provincial and federal agency concerns were the impetus for the provincial government to direct BC Hydro to review its system operations to determine if alterations should be made to increase net environmental and social benefits for the province. BC Hydro's hydroelectric systems had been optimized for electricity production, with some systems also required to provide flood control. The Electric Systems Operations Review (ESOR) started in 1993, when the Province asked BC Hydro to look at non-power resource values, including aesthetic values and fish and wildlife habitat. The ESOR report, completed in 1995, concluded that BC Hydro's system operations balanced water needs for power and non-power uses. The report was based on available data, which constrained both the analysis and the ability of the agencies to review the report.

The Province concluded that the report was lacking, particularly relating to fisheries and aquatic resources. BC Hydro was directed to make eight operational changes that were designed to make improvements for fish. BC Hydro was also requested to improve its data collection to help resolve some of the uncertainties over fisheries impacts. All eight operational changes were implemented by BC Hydro, and BC Hydro began addressing its data gaps.

The liaison committee that prepared the government response to the ESOR report formed a subcommittee to further explore approaches to managing conflicts with BC Hydro operations. At the same time, other activities were bringing further pressures on the Province and BC Hydro. DFO had negotiated with BC Hydro some flow increases for certain times of the year, though these flow releases were not a requirement of the facility's water licence. In addition, BC Hydro and DFO cooperated on a technical committee and collected flow data in the 1980s and 1990s to assist in making decisions about fish flows at BC Hydro facilities. This committee also designed cooperatively managed habitat restoration projects such as riparian planting, side-channel construction, and replenishing spawning gravels with appropriate substrate. Nevertheless, DFO still had concerns for fisheries at several of BC Hydro's facilities that they were unable to resolve cooperatively. In 1991 DFO charged BC Hydro for destruction of fish habitat on the Lower Bridge River due to spills of water from Terzaghi Dam during spawning season. In 1997, DFO ordered flow releases for the Cheakamus and Columbia rivers, but recognized that going through the courts would be a long and expensive process and unlikely to be effective given the lack of quantifiable data. At the staff level, DFO was pressuring the Province to undertake a review of BC Hydro's operations.

The Stave Falls Disposition Order

Stave Falls Dam is located near Mission, British Columbia. It was constructed in 1912, and its powerhouse was once British Columbia's largest hydroelectric power source and is now a national historic site of Canada. In June 1995, BC Hydro received an Energy Project Certificate Disposition Order, which gave approval to construct and operate a replacement power plant at Stave Falls, subject to the conditions of the order. One key condition required BC Hydro to develop and implement an operating plan for the Alouette system, incorporating the results of the Alouette River Instream Flow Study as well as stakeholder interests.

The plan was meant to address long-standing community and agency concerns with fish impacts from the diversion of water from the Alouette River system into the Stave River system.

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Spatial data compiled by WWF-Canada. Dam location data obtained from BC Ministry of Forests, Lands and Natural Resource Operation Water Management Branch. Powerhouse and Tunnel Diversions digitized from Water Use Plans by WWF-Canada.

Figure 2. Alouette River hydropower system.

BC Hydro formed the Alouette Stakeholder Committee to explore alternative operating conditions, evaluate implications and tradeoffs and, if possible, provide consensus suggestions to BC Hydro about operations of the Alouette facilities. Membership was broad and, in addition to community and interest groups, the Committee included representatives from government, BC Hydro, and the Katzie First Nation. BC Hydro explicitly stated that it recognized that the involvement of the Katzie First Nation was without prejudice regarding any land claim or treaty discussions between the Katzie Nation and senior governments. This operating plan for the Alouette River became known as the first WUP and provided much of the framework for the work that was to come.

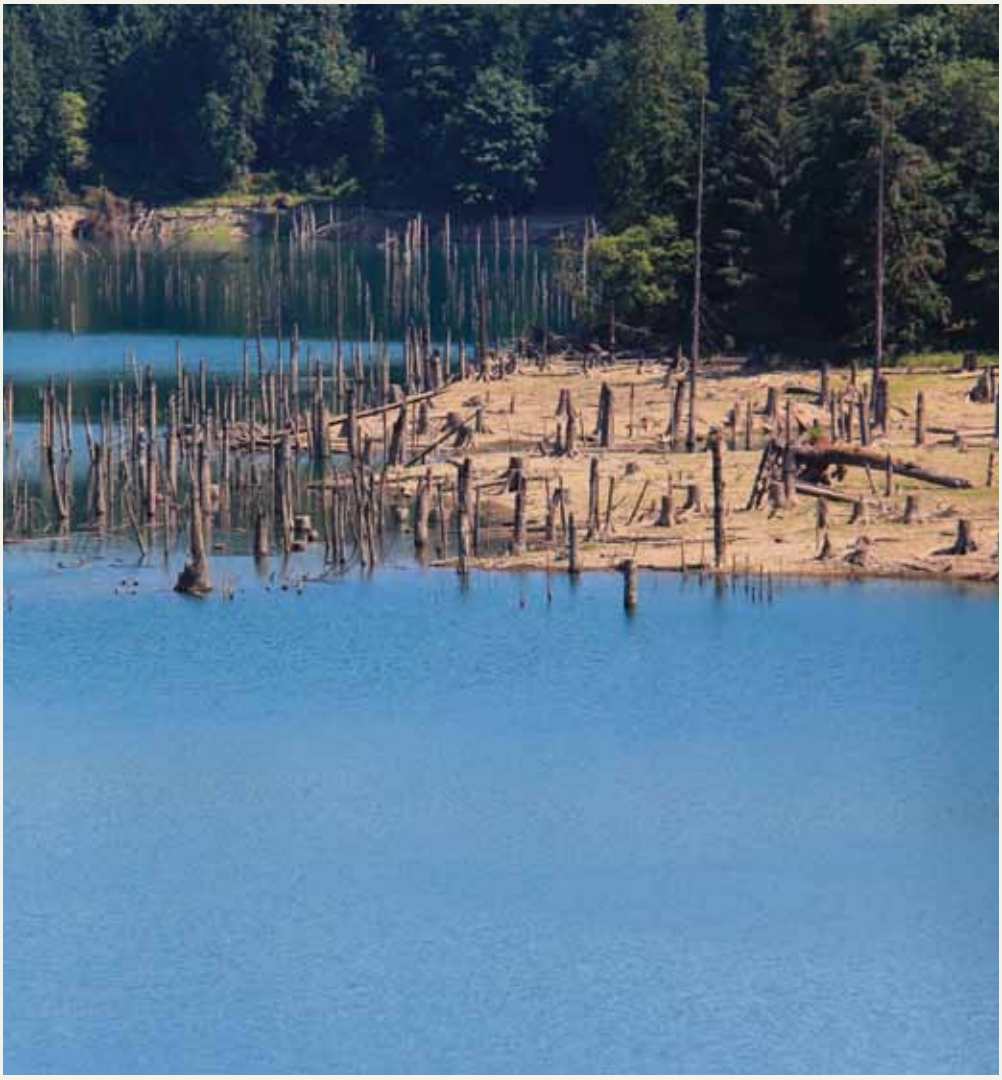
The Downton Lake Special Environmental Auditor and BC Hydro Reports

In May 1996, BC Hydro substantially drained or drafted the Downton Lake reservoir behind the Lajoie Dam on the Bridge River system.

The Province appointed a special environmental auditor, Greg McDade of the Sierra Legal Defense Fund, to review actions taken by BC Hydro. The Interim Report of the Special Environmental Auditor (McDade, 1996) concluded that the drawdown was deliberate and caused substantial fish mortality. (A subsequent independent review by R.P. Griffith &

Associates and BC Hydro [1996] concluded "no substantial fish mortality was caused by the planned deep draft.") Although acknowledging that BC Hydro was making efforts to address fisheries issues, the special environmental auditor's report pointed out a problem that BC Hydro had with respect to the federal *Fisheries Act*. It stated that the *Fisheries Act* was prohibitive with respect to fisheries and had limited use as a regulatory tool. DFO could only take action after habitat damage was done or fish were killed. If BC Hydro followed the legislation, they could not carry on their business, as it was clear that their dams altered, disrupted, and in some cases, destroyed fish habitat. All of these dams (except Revelstoke) had been constructed before Sec. 35(1) of the federal *Fisheries Act* became law in 1977, and there was no authorization from the Minister of Fisheries and Oceans for these structures. BC Hydro's only course of action was to operate despite the legislation and rely on the cooperation of the government regulators.

The special environmental auditor's report recommended that "BC Hydro and the Ministry of Environment establish an independent, multi-stakeholder process to complete a proper [ESOR] report which would gather the environmental and other information necessary to fully assess options for management strategies which would balance power, flood control, social, recreational and environmental impacts"



The needs of residents along a reservoir must be balanced with its multiple other uses.

The Ward Report

In 1996, a report commissioned by DFO and the BC Ministry of Environment, Land and Parks was released by Ward and Associates concerning BC Hydro's water diversion practices (Ward & Associates, 1966). The Ward Report claimed that for the majority of time since 1960, BC Hydro's water diversions significantly exceeded their licensed flow, and that six of the 10 facilities were operating out of compliance. Ward claimed that in approximately 33 out of the 38 years on record, BC Hydro had diverted water averaging 19% to 27% in excess of its licensed amount, with the greatest excess recorded in 1995, when water diversion was 51% in excess of the licensed amount.

A subsequent internal review by the Province and BC Hydro (R.P. Griffith & Associates & BC Hydro, 1996), which considered additional licences for these and ancillary facilities, indicated that only one plant of the 10 was out of compliance, and BC Hydro immediately adjusted its operations. Both the Ward report and the follow-up review showed the complexity of hydroelectric operations and the difficulty of interpreting old water licences in light of present operational realities. Licence conditions were too general to guide or regulate these complex operations; e.g., maximum reservoir elevation, maximum annual diversion, and maximum quantity to be stored do not provide any guidance for daily operations. Again, the conclusion reached was that a detailed, comprehensive yet adaptable plan of operations was needed for these facilities to manage the additional environmental demands of reservoir and hydroelectric facility operation.

MAKING THE CHANGE

The events of 1995 and 1996 had started people thinking about a more comprehensive program of operational planning for hydroelectric facilities within both government agencies and BC Hydro.

The operating plan for the Alouette system created under the Stave Falls disposition order was supported by consensus from the Alouette Stakeholder Committee. Federal and provincial agencies and BC Hydro cooperated with the stakeholder groups in defining management objectives and creating and evaluating a wide range of operating scenarios before achieving this consensus. The eventual success of this effort, which produced a recommendation for a new operating plan for water flows for the Stave hydroelectric power facilities, led to an expansion of the use of structured decision-making (SDM) processes for all other major BC Hydro hydroelectric facilities (McDaniels & Gregory, 2004).

As a result of high flow events on the Campbell River in 1995, a similar process was undertaken for the John Hart facility, to produce the Campbell River Interim Flow Management Strategy.

External reports had called for new operational plans for BC Hydro facilities. Both also talked about the information gaps and the complexity of hydroelectric operations requiring a comprehensive and in-depth review of operations. Nongovernmental organizations were pressing for change, and there was much media attention at this time. Internally, BC Hydro and BC government staff were concerned about managing hydroelectric operations to achieve a wider range of environmental and social values.

The Alouette and Campbell examples showed that consensus could be achieved with a wide range of stakeholders if they were meaningfully involved. This experience underlined a key finding that all parties that have an interest must be involved, including First Nations, environmental groups, community representatives, and a wide range of government agencies.

The interagency government liaison committee formed after the government response to ESOR took the lessons learned from these events and proposed a consensus-based, multi-stakeholder public planning process, led by BC Hydro, to review all BC Hydro facilities in order to adjust operations for a wider range of environmental and social outcomes. This process was called water use planning.

The process to produce WUPs was announced by the BC Minister of Employment and Investment and the BC Minister of Environment, Land and Parks in November 1996. Water use planning became a major initiative for BC Hydro, provincial agencies and DFO. The federal fisheries agencies could see the benefits of this cooperative approach as compared with a regulatory approach and the accompanying costs, delays, and uncertainties of litigation. Compared with a litigious or regulatory approach, a cooperative approach had better communication and a common information base, and it was more conducive to creative solutions.

Subsequently, the ministers announced that a review of BC Hydro water licences would be coupled with water use planning. Although the framework was not completed until 1998, work was begun immediately, and interim orders were issued for some facilities where benefits could be realized for fish while the planning process was underway. It would take 14 years to complete the initial plans for the facilities.

THE CITIZEN PETITION TO THE COMMISSION FOR ENVIRONMENTAL COOPERATION

Another important event that raised the profile of the water use planning process was a complaint launched by NGOs in 1997 protesting the way BC Hydro's dams had affected fish and water.

The North American Agreement on Environmental Cooperation—the "environmental side agreement" to the North American Free Trade Agreement—includes a public complaint procedure for persistent non-enforcement of domestic environmental laws, which provides that any resident of Canada, Mexico, or the United States can file a submission with the Commission on Environmental Cooperation (CEC) Secretariat claiming that a party is failing to effectively enforce its environmental laws.[8]

In 1997 the BC Aboriginal Fisheries Commission, BC Wildlife Federation, Trail Wildlife Association, Steelhead Society, Trout Unlimited (Spokane Chapter), Sierra Club (U.S.), Pacific Coast Federation of Fishermen's Association, and Institute for Fisheries Resources made a submission using this process, alleging the failure of Canada's federal government to protect fish and fish habitat in British Columbia's rivers from ongoing and repeated environmental damage caused by hydroelectric dams.

The submission passed the three hurdles to reach an outcome: the secretariat decided the submission was admissible, merited a response by the government of Canada, and warranted the preparation of a factual record. The Government of Canada asserted that its enforcement efforts were effective, and it documented a wide range of measures, including WUPs, to show that it was enforcing its law. The CEC Secretariat retained an expert, Stephen Owen, former ombudsman of British Columbia and commissioner of resources and the environment to assist it with the development of the factual record, and it established an expert group of three people with expertise in hydro operations, law, and fish habitat, who prepared a report that was attached as an appendix to the factual record. All the stakeholders (the submitters, Canada, British Columbia, and BC Hydro) had the opportunity to provide information concerning the effectiveness of the Canadian approach to enforcement as part of the development of the factual record.

[8] For more on the process, see the CEC website at cec.org, particularly the Guidelines for Submissions on Enforcement Matters, and for more on how the process worked in the BC Hydro case, see Christensen (2004).

The final factual record was released by the CEC in 2000 (BC Hydro, 2000). It did not conclude whether the allegations of persistent non-enforcement of environmental law were proved, as it is not an adjudicative body. The final record did repeat the conclusions of the expert group on possible shortcomings of the water use planning process as a response to non-enforcement.

The CEC submission focused the spotlight on the environmental effects of dams in British Columbia and led to other improvements in environmental enforcement related to dams (Quadra Planning Consultants & Nowlan, 2004). The groups that made the submission found it to be extremely valuable because of the substantive commitments made by the Canadian and BC governments, recorded in the factual record. The executive director of the BC Inter-Tribal Fisheries Commission was quoted as saying that while the water use planning process would probably have gone ahead anyway, without the factual record it would have been a "much weaker" program, and the counsel for the submitting groups said that "the filing of the submission crystallized for the government the building of public awareness; it put it in concrete terms for them" (Bowman, 2001).

WATER USE PLANNING

A WUP results in a set of specific and measurable operational limits or boundaries for a facility that defines the operating conditions for that facility.

This is interpreted into a *Water Act* order by the comptroller of water rights and then used by the facility managers and operators to make day-to-day decisions for managing the facility's water use.

WATER USE PLANNING PRINCIPLES

A number of principles were developed to guide the water use planning process, first published in an undated document (1998 or later) with the logos of British Columbia, BC Hydro, and DFO, and later revised by the WUP Management Committee (Province of BC, n.d.).

This first set of principles were akin to process guidelines. Most of the process details were stripped out in a second set of principles that were presented in a different manner in *Provision of Information to the Independent Experts* (WUP Management Committee, 1999), where their number had been reduced to six, as follows:

1. **Recognition of multiple objectives.** Because water control facilities and, in particular, the BC Hydro system provide benefits to British Columbians across a variety of cultural, economic, environmental, safety, and social objectives, the water use planning process must consider all of these interests and values.
2. **No change to existing legal and constitutional rights and responsibilities.** The purpose of the program is to clarify and articulate legal and constitutional requirements in detailed operating plans while safeguarding the regulatory powers of, for example, the *Fisheries Act* and the *Water Act*.
3. **Collaborative, cooperative, and inclusive process.** The program recognizes the variety of perspectives, values, and interests that are required as part of long-lasting decision-making.
4. **Recognition that tradeoffs (choices) have and will occur.** Because certain conflicts in the management of water arise (between for example, fish and power or fish and flood control), water use planning seeks to find incremental improvements to balance various water uses.
5. **Embodies science and continuous learning through information gathering and analysis.** Information gathering is a key element, with an emphasis on developing decision-focused knowledge that is shared by all and can facilitate discussion and understanding.
6. **Focus on issue resolution and long-term benefits.** The program seeks to ensure the results of each WUP are focused on real and achievable outcomes that can be measured.

Principles 1 and 4 are similar in that optimization of cost requires trade-offs in other values. It was this trade-off process that provided the rationale for *Fisheries Act* authorizations. Principle 2 was particularly important, as it meant that if DFO approved the WUP, BC Hydro would be in compliance with the federal *Fisheries Act* while they were operating in accordance with that WUP. DFO had also stated that where required, they would issue *Fisheries Act* authorizations for a facility after they approved the WUP for that facility. This

would overcome the regulatory conundrum pointed out in the McDade report discussed on page 12. The fact that BC Hydro facilities had no authorization from the federal government under the Fisheries Act (not required when they were built) and needed a Water Act licence or licence amendment from the provincial comptroller of water rights meant that both the federal and provincial governments had to be involved in the water use planning process. It was clear at the outset that the process was not intended to fetter the discretion of either the federal minister of fisheries and oceans or the BC comptroller of water rights.

Principle 2 was also expanded to encompass compensation for "rights" that were diminished or "expropriated" through the implementation of a WUP. In the *Provision of Information to the Independent Experts* (WUP Management Committee, 1999), the following statement is made on page 11:"In addition, if rights are voluntarily diminished and there are financial impacts on the licensee, compensation for losses will be an important consideration in making such changes." This concept is discussed further on pages 32 to 34, and was extremely important in bounding decisions in the SDM process.

Principle 4 on trade-offs was also important, particularly in the Columbia and Peace WUPs, where the provincial government, recognizing the key role that these generating facilities play in providing low-cost, reliable electricity to the province, made a policy decision to limit the scope of operational changes it was willing to accept on these systems. This principle originally was worded as follows: "The recognition of trade-offs among different water uses and interests is part of the water use planning process and may be characterized in monetary and non-monetary terms. Trade-offs occur within the bounds set by legislation, regulations, policy, constitutional rights and provincial funding constraints. Trade-offs also recognize facilities as they exist and seek incremental improvement to balance various water uses."

The principles helped guide the participants in the collaborative process. Many water and resource management processes now start by defining principles. This set is a helpful starting point and model to follow.

WATER USE PLANNING GUIDELINES

As the process got underway and the multi-stakeholder CCs were being set up, there was clearly a need for guidance for participants in the process. The Province responded in December 1998 by issuing its Water Use Plan Guidelines (Province of British Columbia, 1998), cooperatively developed by the BC Ministry of the Environment with contributions from DFO, BC Hydro, the provincial Ministry of Employment and Investment (responsible for BC Hydro) and Ministry of Fisheries, and the Crown Corporation Secretariat, and incorporating comments from First Nations, environmental groups, community organizations, and individual citizens. The guidelines could be used by any licensee or project proponent and were not directed at BC Hydro, although BC Hydro was the first, and for many years the only, proponent to use them.

The purpose of the guidelines was twofold:

1. To instruct holders of water licences and applicants for licences on the preparation and approval procedures for WUPs.
2. To inform local governments, First Nations, key interested parties, and the general public on how to participate in plan development.

The guidelines set out a 13-step, four-stage process.The following description outlines how the guidelines were applied to BC Hydro facilities.

Initiation and Announcement (Step 1)

1. **Initiation and announcement.** The comptroller initiates a water use planning process for the particular facility.

Because BC Hydro had been directed by government to do a WUP for all their facilities,[9] BC Hydro drew up a schedule of plan development and discussed it with government to allow for resource planning.

Plan Development (Steps 2 through 9)

2. **Defining issues and interests.** BC Hydro scopes the water use issues and interests with regulatory agencies and key interested parties.
3. **Process goals and roles.** BC Hydro determines the consultative process to be followed and initiates it.
4. **Defining water use objectives.** BC Hydro, together with the other participants, confirms the issues and interests in terms of specific water use objectives.
5. **Information gathering and exchange.** BC Hydro gathers additional information and calculates the impacts of water flows on each objective.
6. **Consider a range of alternatives.** BC Hydro, together with the other parties, creates operating alternatives for regulating water use to meet different interests.
7. **Assessing water use choices.** BC Hydro, together with other participants, assesses the trade-offs between operating alternatives in terms of the objectives.
8. **Consultation report.** The participants determine and document the areas of consensus and disagreement and prepare a consultation report.
9. **Draft WUP.** BC Hydro prepares a draft WUP and submits it for regulatory review.

Decision (Steps 10 and 11)

10. **Provincial review and decision.** The comptroller reviews the draft plan and issues a decision.
11. **Federal review.** DFO reviews the authorized WUP and issues advice and authorizations as appropriate.

Implementation (Steps 12 and 13)

12. **Monitoring compliance and review.** The comptroller and regulatory agencies monitor and assess compliance with the authorized WUP.
13. **Scheduled plan review**. BC Hydro and the comptroller review the plan on a periodic and ongoing basis.

[9] Except Kootney Canal. A Kootenay Canal WUP would require participation of other non–BC Hydro power licensees, which the BC government did not direct to undertake water use planning.

WUP CASE STUDIES

Three case studies on the Bridge River, Cheakamus, and Coquitlam-Buntzen WUPs illustrate the complexity, challenges, constraints, and opportunities that participants encountered during the BC Hydro water use planning process.[10] Also highlighted are the process and water management precedents that were set through these WUPs.

The Coquitlam WUP is an example of an urbanized BC Hydro facility whose reservoir also served as a major drinking water source for Metro Vancouver. The Cheakamus WUP is an example of a BC Hydro facility where power and fisheries interests conflicted with recreational water uses, such as rafting and kayaking. The Bridge River WUP is an example of managing and restoring fisheries interests across an interbasin diversion.

Although every water use planning process was unique, these three studies were chosen from the 23 completed WUPs because of their particular circumstances and the issues that had to be overcome. The resolution of the data, process, and relationship issues is instructive in understanding how complex multistakeholder processes can succeed.

Case Study 1: Coquitlam-Buntzen WUP

The watershed of the Coquitlam-Buntzen hydroelectric facility, near the City of Coquitlam, close to Vancouver, lies within the traditional territory of the Kwikwetlem First Nation.

The Coquitlam Dam impounds the Coquitlam River to provide additional storage for water to power the Buntzen Lake generating station, which, before the WUP was completed, had the capacity to produce approximately 200 gigawatt hours of electricity annually (just 0.4% of BC Hydro's total capacity).

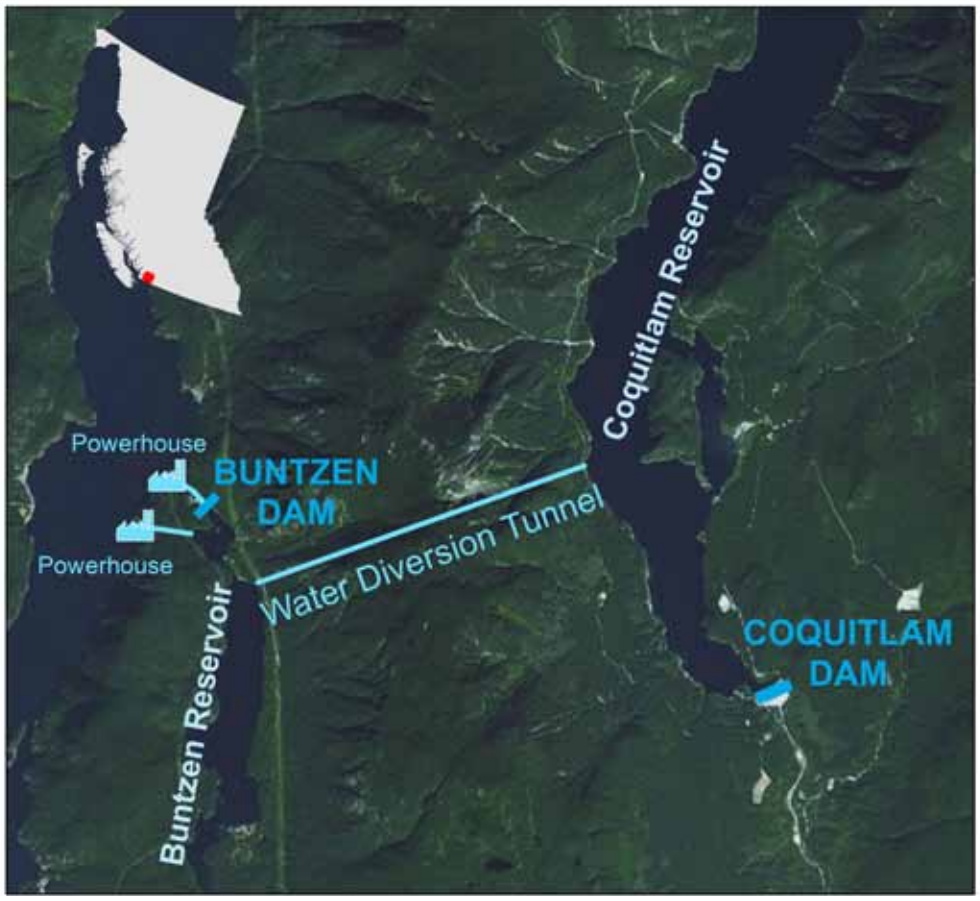
The reservoir is also used as the major source of domestic water in the Greater Vancouver area, and the watershed is managed by Metro Vancouver to protect the water supply. BC Hydro manages the reservoir.

Below the dam, the watershed is the most urbanized of all of BC Hydro's water use planning processes. The Coquitlam River is used by wildlife and for recreation, and is consistently ranked in the top five on the Outdoor Recreational Council's annual list of endangered BC rivers, mainly due to low flows, depleted fish populations, urban encroachment, and impacts from gravel mines along the banks of the river below the dam. The construction of the dam also cut off access by sockeye and other anadromous salmon to historical spawning sites.

Due to competing interests for water, the large urban population in the watershed, and the depleted status of the watershed's fish and wildlife, the Coquitlam water use planning process ultimately became one of the longest, most costly (in terms of volunteer and professional investments, time to complete, and direct cash investments to support the process), and debated water use planning processes. The process began in 1999 and concluded in 2003 after more than 70 consultative committee (CC) and technical meetings, and after reaching not one but two consensus agreements. To say it was a complex undertaking is an understatement.

BC Hydro staff led the Coquitlam water use planning, and 40 individuals, representing a broad range of interests, formed the Coquitlam-Buntzen CC.

[10] These are summaries of the full case studies, available at wwf.ca.



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Spatial data compiled by WWF-Canada. Dam location data obtained from BC Ministry of Forests, Lands and Natural Resource Operation Water Management Branch. Powerhouse and Tunnel Diversions digitized from Water Use Plans by WWF-Canada.

Figure 3. Coquitlam hydropower system.

The range and importance of interests was initially scoped using a questionnaire. Not surprisingly, given the large focus on the river's health, the lack of flows for fish emerged as a main issue. Committee members also identified concerns over fish passage (blocked by the dam), habitat restoration, flooding, recreation, power rates, culture, safety, and drinking water, among others.

The vast domestic water supply in the Coquitlam Reservoir was the main interest of the Greater Vancouver Regional District (GVRD, now known as Metro Vancouver). Much was at stake with the potential of releasing more water for fish, especially given projections of increased population growth and water demand. Water for humans remained a major issue in trade-off considerations and eventual flow agreements throughout the water use planning process.

Data and technical support issues were addressed early through the formation of a fish technical committee, which supported the CC.

The CC and various working groups set performance measures for eight objectives: fish and river flows, wildlife and environmental protection, flood control, domestic water, hydroelectricity, recreation, industry and economic development, and archeology, history, and culture. CC members also agreed on the issues that needed to be decided outside of WUPs, including the quality of flows into the river downstream of the dam and sockeye passage above the dam.

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Sockeye salmon, also known as red salmon *(Oncorhynchus nerka)*, line up behind one another as they swim through shallow water in the Adams River.

A defining feature of this water use planning process was the inordinate attention given to modelling, refining, and resolving various flow alternatives. Technically, much of the flow alternative discussion was the purview of keen and engaged agency experts and volunteers on the Coquitlam-Buntzen WUP's fish technical committee. In particular, a salmon conservation-flow estimation, prepared by provincial rivers expert Ron Ptolemy, set the stage on how conservation flows might be derived for various life history phases (rearing, spawning, and migration) of different salmon. Based on mean annual discharge, this preliminary tool guided decisions and focused analysis across many WUPs.

Yet the water use planning process was only informed by technical experts; the ultimate decisions on prioritizing objectives, resolving trade-offs, and recommending operating and monitoring plans remained in the court of the CC, a mix of technical and non-technical stakeholders.

Despite reaching an important agreement in which fish and domestic water were set as the top co-objectives (with power ranked third), substantial challenges remained. The proposed changes were limited by the ability of existing works to provide sufficient conservation flows, including the number of "fish valves" available to pass water through the dam, and storage levels behind the dam. The ultimate challenge, though, remained reaching agreement on flows that best resolved competing objectives and met performance measures.

Fish and river performance measures (e.g., spawning, rearing, and invertebrate habitat), depth, and velocity were included to model "weighted useable width" by flow for each month, by river reach, for different life history stages of salmon. The lack of empirical data, however, later became an issue that prolonged the water use planning process and led to new adaptive alternatives that would be explored over many following years.

Many tricky flow issues were considered. The main challenge facing the CC was that there was simply not enough water to satisfy fish objectives, domestic water objectives, and low-cost power needs, particularly in the low-flow summer months, when salmon conservation concerns and human water demand were both highest, even when BC Hydro was ranked as the third priority and only took what was "left over."

On Saturday, October 22, 2001, the 40-member fish technical committee met to select a flow alternative and monitoring plan to recommend to the water comptroller. More than two years had passed since the first meeting in September 1999. Many members had attended more than 60 CC and fish technical committee meetings just to get to this stage. Little wonder, given such investments and the strongly promoted fish and water objectives, that despite a 12-hour marathon session, every one of the flow alternatives was "blocked" by more than one member.

Despite these challenges, the CC agreed by consensus to an operating plan that included the completion of a two-year in-stream flow needs study and implementation of a program to test benefits of fish flows into the Coquitlam River. This was the first consensus agreement for this particular WUP.

Thus, an "adaptive management" program was established to test benefits to fisheries of higher water releases from the dam to the Coquitlam River in order to ensure that water in the system was well used. While some water would be on the table for allocation at the end of the 10- to 12-year adaptive management program, justification for future releases above the "4 Fish Valve New" (10-12% mean annual discharge) operating plan option had to be clearly demonstrated. A multisectoral monitoring committee was also struck.

The CC reconvened one final time on March 31, 2003—some three and a half years after the process had started—to consider new fish technical committee recommendations, using the in-stream flow needs results to amend monthly in-stream flow targets, and considering the results of a rigorous power analysis of the adaptive management program (including the monitoring plan).

To take into consideration CC concerns about how the lower target flow in the final adopted option—known as "Share the Pain" or STP6—might not adequately satisfy fish objectives and performance measures, a suggestion was made to give fish first priority throughout the year, rather than from October to June. This suggestion further reduced the probability of dam releases to the river falling below upper target levels during the flow trial period, especially important during the summer months, including the August "bottleneck" period. At the same time, this approach addressed the GVRD's concern for more certainty in alternatives like the "sharing the pain" concept because it identified an operating condition in the very unlikely event of extreme conditions. Progress on the GVRD's filtration upgrades at its Capilano and Seymour facilities also added needed certainty and flexibility over increased regional water supplies.

CC members ultimately agreed to discontinue the original CC adaptive management program and accepted instead, with some reservations but still unanimously, the second consensus agreement in this water use planning process: the fish technical committee's recommendation of having one flow trial plus continued baseline flows (2 fish valves), rather than two flows plus a baseline flow. The annual costs to BC Hydro would be $1 million to $2 million per year in foregone revenues, depending on the flow trial. The comptroller finalized the Coquitlam-Buntzen WUP on April 7, 2005 (BC Hydro, 2005b).

TREATMENT SCHEDULE 3 3 Years Base (2FVC) | 9 Years STP6																		
Activity	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Treatment #1 - 2FVC baseline smolt monitoring	1	2	3	4	5	6												
Dam Modifications				1	2	3												
Treatment #2 - STP6							1	2	3	4	5	6	7	8	9			

Figure 4. Final flow treatment schedule for the Coquitlam-Buntzen WUP.

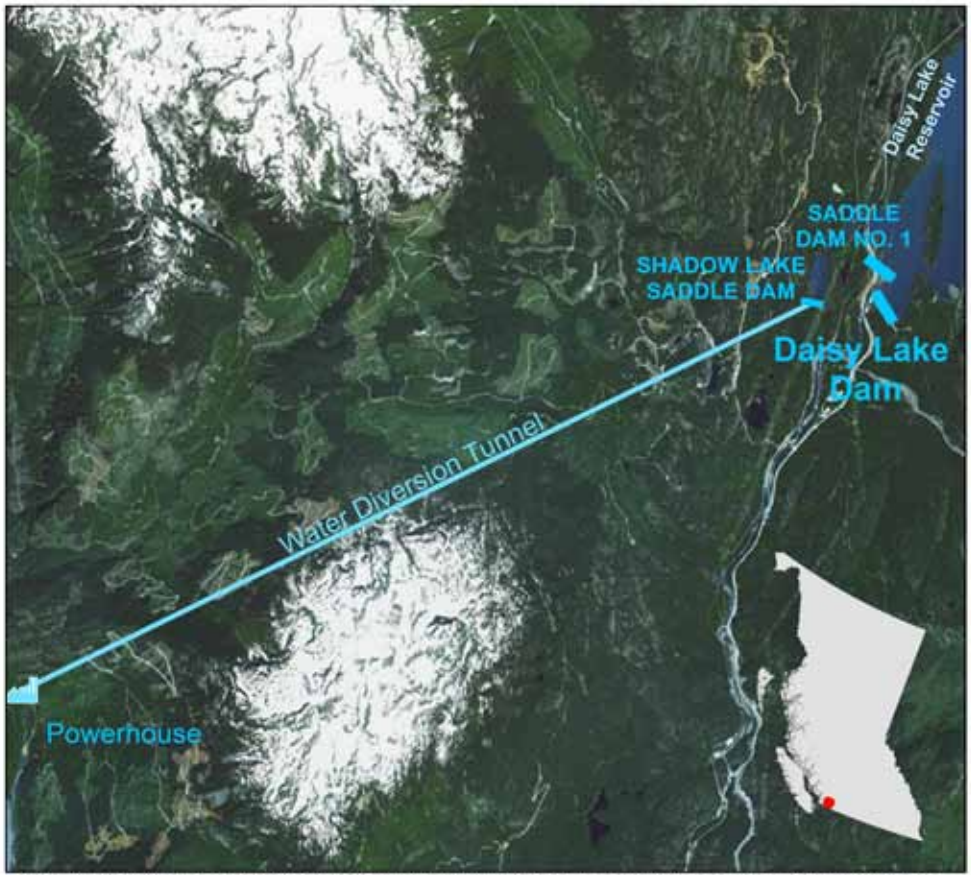
The agreed-to flow trials to this date remain an experiment in progress. A final assessment awaits the results from a soon-to-be-completed monitoring program of eight ongoing studies of fish productivity, substrate quality, pink salmon passage, habitat use assessment, invertebrate monitoring, temperature, tributary access, and rampdown (fish stranding) monitoring. Flushing flows were also to be evaluated. Early indications, largely the result of more than doubling the baseline flows through release of an additional one to five cm of water, show an improving river, as well as an enhanced level of learning and river stewardship.

Today's Coquitlam River has moved down a few notches on the "endangered rivers" list annually released by the Outdoor Recreation Council. Substantial habitat restoration efforts, integrated into WUP monitoring plans so as not to confound the flow trial results, have improved salmon productivity. Recent escapement counts of several species of salmon have improved considerably.

More than an additional $2 million has also been invested in assessing the feasibility of restoring sockeye salmon, and the Kwikwetlem Salmon Restoration Committee—which includes many of the original CC members—is currently completing a stock establishment study for submission to BC Hydro. Hopes are high of one day adding a fish ladder to the dam. However, Metro Vancouver has concerns about salmon in the drinking water supply. Some eight adult sockeye also returned to the dam in 2008 (from an earlier smolt release) and were transported via an ongoing trap-and-truck program into the reservoir, the first "red fish up the river"—the literal Coast Salish language meaning of *coquitlam*—to complete their lifecycle in more than 100 years, to great fanfare in the community.

Stewardship efforts have also been significantly bolstered by a City of Coquitlam water quality monitoring program, and in particular, through the formation of the multiparty Coquitlam River Watershed Roundtable, now completing a unique-to-Canada watershed plan that assesses the health of key ecosystem services and related measures of human well-being.

All in all, hopes for an improved river have never been higher, and the Coquitlam WUP stands as an important catalyst in that achievement.



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Spatial data compiled by WWF-Canada. Dam location data obtained from BC Ministry of Forests, Lands and Natural Resource Operation Water Management Branch. Powerhouse and Tunnel Diversions digitized from Water Use Plans by WWF-Canada.

Figure 5. Cheakamus hydropower system.

Case Study 2: The Cheakamus WUP

The Cheakamus WUP is typical of the early WUPs, with one exception: of the 23 completed, it is the only non-consensus WUP.

The Cheakamus watershed is in the Squamish-Lillooet Regional District, between the communities of Whistler to the north and Brackendale to the south. It is entirely within the traditional territory of the Squamish Nation. The Cheakamus River provides spawning and rearing habitat for several salmon species and also is a large fall and winter congregation area for bald eagles that feed on salmon carcasses. The river also provides rafting, kayaking, and sport fishing opportunities.

From its very beginnings in the early 1950s, the development of the Cheakamus facilities was opposed by local residents and fisheries agencies.

Objections to the project were eventually withdrawn when the comptroller of water rights inserted a clause into the water licence allowing for the order of release of water for fish. Concerns about flows for fish persisted for decades.

The Cheakamus generating system consists of the Daisy Lake dam and reservoir on the Cheakamus River and the Cheakamus powerhouse in the Squamish Valley, 10 km northwest of Brackendale. Water is diverted out of the Cheakamus River at the Daisy Lake dam into a canal under the Sea-to-Sky highway, where it enters an 11-km tunnel through Cloudburst Mountain. Two penstocks carry it down to the twin turbines of the Cheakamus generating station, where it then discharges into the Squamish River. Maximum flow through the generating station is 65 m^3/second, with a total maximum head of 340 m. The powerhouse's installed capacity is 157 megawatts. Approximately 75% of the total flow of the Cheakamus River originates upstream of the Daisy Lake dam.

A planning process was initiated for BC Hydro's Cheakamus facilities in 1996, but the process was interrupted in 1997 when DFO issued a flow order that specified minimum flows to be released from Daisy Lake dam. BC Hydro appealed the order, but the court directed the parties to settle the matter out of court. An interim flow settlement agreement was reached and accepted by the comptroller of water rights, and in April 1999, the comptroller ordered BC Hydro to implement the agreement.

The Cheakamus WUP project was initiated in February 1999. A draft WUP and CC report were completed in October 2003. The WUP was revised for acceptance by the comptroller in October 2005, and implementation orders were issued in February 2006 (BC Hydro 2005a).

The original water licence for the Cheakamus WUP (CWL 22284) did not require a minimum release from the Daisy Lake dam; however, it did contain a clause requiring the comptroller of water rights to set forth the "quantity and time of water releases to be made through the impounding dam on the Cheakamus River in the vicinity of Daisy Lake, for the purposes of maintaining a flow of water in the Cheakamus River for fish propagation." Without such direction from the comptroller, the flows below the Daisy Lake dam would depend on local inflow for much of the year. The settlement agreement in 1998 required BC Hydro to provide water for the preservation of fish by way of an interim flow in the lower reach of the Cheakamus River until the WUP was completed. As part of the interim order, a monitoring program was also ordered "to assess the effectiveness of the above procedures with regard to the preservation of fish in the Cheakamus River below Daisy Lake."

The interim order required that flows be released from the Daisy Lake reservoir into the Cheakamus River that would average 45% of the inflows over a seven-day period, with flows allowed to vary from 37% to 52% on any given day. In any case, however, a minimum release flow of five m^3/second had to be provided at all times. In addition to the prescribed flows, the order also contained a requirement for monitoring.

Public consultation began on the WUP in February 1999 with a 20-member CC, including the Squamish Nation, following the provincial water use planning guidelines. The CC identified objectives for power, First Nations, recreation, flooding, fish, and aquatic ecosystems, and agreed on performance measures for each. The consultation was completed in April 2002 after 25 CC meetings, with a failure to reach consensus.

Consensus was not reached because half of the CC members at the end of the process felt that the performance measures were insufficient, due to the fact that engineered side channels had been built and were not being adequately recognized as fish habitat. This issue emerged late in the process, which led to some frustration in the committee. DFO had constructed the side channels to work in the pre-interim-flow period, and they had been designed to work in a low-flow time. However, eight of the 16 members preferred the higher flows in the main channel, which also resulted in higher flows in the side channels to provide the maximum amount of fish habitat. They wanted to continue to monitor the interim flows for another three to five years to provide additional information to thoroughly assess effects. The other half of the CC, including representatives of BC Hydro, DFO, and the Ministry of Energy and Mines, accepted the performance measures and based their support on the outcomes depicted by the computer modelling. They favoured lower flows as

providing the greatest amount of main-channel fish habitat, and they also argued that these flows provided adequate flow in the side channels, which had been designed to function in a lower-flow state. As BC Hydro was not able to obtain a consensus on this issue, they drafted a non-consensus WUP in accordance with the guidelines and submitted it to the comptroller of water rights. This means that BC Hydro chose the majority view and built the final plan based on that view, but the area of non-consensus was documented and presented in the consultation report in full.

The comptroller gave public notice of his decision to implement the WUP (as submitted by BC Hydro) and held three oral hearings during the winter of 2004-2005 to consider public opinion, especially from the recreational sector. He also considered written submissions on the relationship between flows for fish and flows for commercial rafting, which resulted in changes being recommended for the WUP. Changes included a recommendation to BC Hydro to increase the minimum flows at Brackendale to 38 cm in July and August, the highest-value rafting season for commercial rafters. In addition, due to concerns raised by the Squamish Nation, it was recommended that the WUP review period be shortened from 20 years, as recommended in the WUP, to five years. Based on this work, BC Hydro revised the WUP and submitted a revised plan dated October 1, 2005, for the comptroller's reconsideration.

By order on February 17, 2006, the comptroller of water rights required BC Hydro to operate its works in accordance with the procedures that would implement the revised WUP. Although BC Hydro would still have to increase base flow in the Cheakamus River over their historical practice, there would be less water required than under the Interim Flow Agreement. This allowed BC Hydro to generate more electricity at their generating station on the Squamish River, resulting in additional power with an estimated value of $7 million annually.

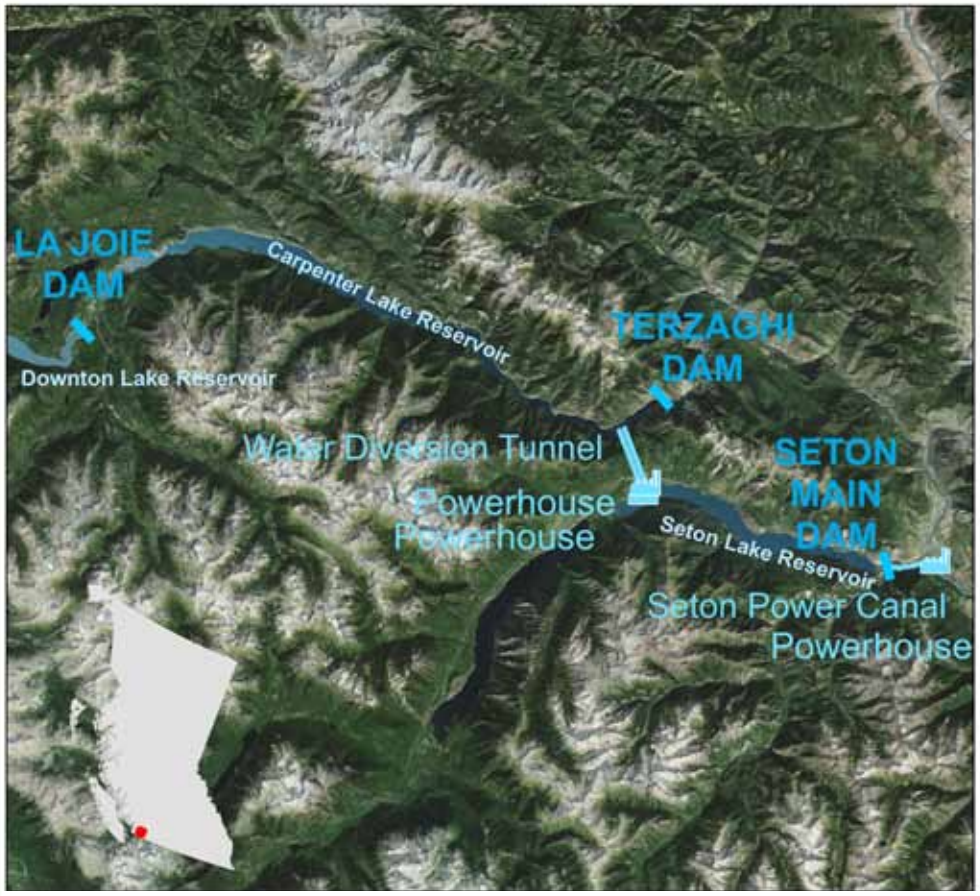
The order required specific minimum releases from Daisy Lake dam into the Cheakamus River for fish habitat, and also specified additional releases as necessary to maintain specified flows for fish and recreational use, as measured at the Brackendale Water Survey of Canada gauge. The comptroller also ordered that 10 monitoring programs be developed in consultation with federal and provincial agencies. Monitoring reports have been received annually since 2008.

To date, the monitoring program shows that changes introduced by the WUP do not appear to have resulted in an increase or stabilization of the rainbow trout population parameters of relative condition, size-at-age, or abundance. A longer-term study is needed, including the collection of further evidence. A complicating factor was the Canadian National Railway derailment in 2005, which dumped 40,000 litres of caustic soda, killing fish and confounding the WUP monitoring and work benefits.[11]

The Cheakamus WUP was originally scheduled for a five-year review, which should have happened in 2011. Instead, in 2011 BC Hydro met with the Cheakamus WUP Monitoring Advisory Committee, and they agreed that the monitoring studies should be continued for another five years.

Even with a non-consensus WUP, the process benefits may be seen. All stakeholders have a better understanding of the operation of the hydroelectric facility and of the interactions among the water releases, the ecosystem (particularly as it affects fish), and the other users of the water, including the rafting community. The monitoring is well designed and focused, and will help resolve areas of disagreement among the stakeholders. Adaptive management is included in the comptroller's order, and changes in flows may be, and have been, authorized annually depending on the in-stream needs and water availability.

[11]The Cheakamus River sodium hydroxide spill is described on the BC Ministry of Environment's Environmental Emergency Program website at www.env.gov.bc.ca/eemp/incidents/2005/cheakamus_05.htm; see also Duncan and Nowlan (2008).



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Spatial data compiled by WWF-Canada. Dam location data obtained from BC Ministry of Forests, Lands and Natural Resource Operation Water Management Branch. Powerhouse and Tunnel Diversions digitized from Water Use Plans by WWF-Canada.

Figure 6. Bridge River hydropower system.

Case Study 3: The Bridge River Power Development WUP

The Bridge River Power Development WUP (also known as the Bridge or Bridge-Seton WUP) offers lessons to other flow and river restoration efforts in British Columbia and beyond.

The Bridge River power development (also known as the Bridge-Seton system) manages water from the Bridge River and Seton River watersheds in southwestern British Columbia, and also receives water from the adjacent Cayoosh Creek watershed. Both the Bridge and Seton rivers flow southeast from the Coast Mountain range to join the Fraser River near the town of Lillooet, a community of 2,321 residents (Statistics Canada, 2014) located approximately 250 km northeast of Vancouver. The watersheds are relatively thinly populated and are within the traditional territory of the St'át'imc.

The Bridge River power development is complex and consists of three impoundment dams (La Joie, Terzaghi, and Seton), three reservoirs (Downton Lake, Carpenter Lake, and Seton Lake), and four generating stations (La Joie, Bridge No. 1, Bridge No. 2, and Seton). The La Joie and Terzaghi dams fragment the Bridge River into three sections: the free-flowing Upper Bridge River, which extends from the headwaters to Downton Lake reservoir behind the La Joie Dam and generating station; the Middle Bridge River, which flows from the La Joie Dam to Carpenter Reservoir behind the Terzaghi Dam; and the Lower Bridge

River, which extends 41 km from the Terzaghi Dam to its confluence with the Fraser River. Water from Carpenter Lake reservoir is primarily diverted to the Bridge No.1 and Bridge No. 2 generating stations, and into Seton Lake reservoir via two tunnels through Mission Mountain. Water is also released from Terzaghi Dam into the Lower Bridge River. Seton Lake reservoir is impounded by Seton Dam and also receives water from the Seton River and BC Hydro's diversion of approximately two-thirds of the natural flow of Cayoosh Creek from the tailrace of Fortis BC's Walden North Project. Water from Seton Lake reservoir is primarily diverted along a power canal to Seton Generating Station, which discharges directly into the Fraser River. It is also released from Seton Dam into the Seton River, which joins the Fraser River upstream of the generating station and downstream of the confluence with the Lower Bridge River.

Altogether, the Bridge River power development has an installed capacity of 533 megawatts and generates 6% to 8% of British Columbia's electrical supply (BC Hydro, 2014b), using water from the Bridge River three times in succession.

Development of the Bridge River power development's works began in 1927 and was completed in 1960 with the raising of the Terzaghi Dam, enabling the diversion of the full flow of the Bridge River upstream of the dam to Seton Lake reservoir for hydroelectric power generation. The diversion to Seton Lake reservoir resulted in the complete dewatering of a more than three-km-long reach of the Lower Bridge River immediately downstream of the dam.

The fish community in the Lower Bridge River is largely juvenile salmonids, the most abundant being anadromous steelhead and freshwater rainbow trout (*Oncorhynchus mykiss*), Coho (*Oncorhynchus kisutch*), and chinook (*Oncorhynchus tshawytsch*a) salmon.

Restoring flows in the Lower Bridge River, a longstanding interest among the public, First Nations, and regulatory agencies, became a central consideration in the management of the Bridge River power development in the early 1990s. In 1991 and 1992, high natural inflows forced BC Hydro to spill water from the Terzaghi Dam, which removed spawning gravel, caused bank erosion, contributed sediment, and stranded and displaced fish. BC Hydro was subsequently charged by DFO under the *Fisheries Act* (Hall, Rood, & Higgins, 2009; Mullen-Dalmer, 2009, pp. 111-120).

Following eight years of litigation and research, in 1998 BC Hydro and DFO reached an out-of-court agreement for the Lower Bridge River, requiring implementation of a continuous environmental flows release and monitoring program until a WUP was completed for the Bridge-Seton watershed (BC Hydro, 2012).

There was significant scientific uncertainty about how the aquatic ecosystem, particularly the salmonid population, would respond to the environmental flows release. There were two competing hypotheses. Hypothesis 1 (high flows are better for fish), consistent with the natural-flow paradigm, posited that higher flows would increase the quantity of habitat (wetted area), support larger fish populations, and enhance other ecosystem values. Hypothesis 2 (low flows are better for fish), based on physical habitat modelling, proposed that small flow releases could better achieve fish population goals, as the quality of habitat under higher flows may decrease due to increased velocities, resulting in a net negative impact on fish populations (Bradford, Higgins, Korman, & Sneep, 2011; Bridge River Water Use Plan Consultative Committee, 2003; Failing, Horn, & Higgins, 2004). To resolve this uncertainty, an Interim Flow Management Strategy directed BC Hydro and regulatory agencies to implement an adaptive management approach for the environmental flows release for the Lower Bridge River (BC Hydro, 2012; Bradford et al., 2011; Failing et al., 2004). The release began in August 2000 based on a negotiated annual water budget equivalent to an average annual flow of three m^3/second, and ranged from a summertime peak of five m^3/second to winter flows of two m^3/second. The merits of the environmental flows release water management alternatives were reviewed during the Bridge River power development WUP consultative process (Failing et al., 2004).

The Bridge River power development WUP consultative process was initiated in September 1999 and completed in December 2001, and it followed an SDM process. The 13 members of the CC represented local residents, environmental groups, BC Hydro, and federal and provincial agencies, and reflected power, recreation, cultural use and heritage sites, fish, wildlife, water quality, and socio-economic interests.

The St'át'imc Nation participated as observers in the initial meetings, the trade-off analysis discussions, and when the CC made a final recommendation on a preferred management alternative. During this period, the St'át'imc Nation were also involved in negotiations with BC Hydro over past issues with BC Hydro facilities.

In total, the CC met 13 times and was supported by the Fisheries Technical Committee, which met twelve times, the Wildlife Technical Committee, which met four times, and the recreation subgroup, which met twice. A separate table that was established for the St'át'imc Nation met seven times.

The CC reached consensus on a single recommended management alternative, which provided benefits for fisheries, wildlife, power generation, recreation and aesthetics, and flood management, while not adversely affecting any other interests.

The committee also recommended the continuation of the environmental flows adaptive management program. It considered the uncertainty regarding ecosystem response to changes in flow to be a major impediment to decision-making, as the flow regime provided to the Lower Bridge River would affect not only the aquatic ecosystem, but also hydroelectric power generation, as there is no generating station at Terzaghi Dam (BC Hydro, 2012). Therefore, management decisions on the flow release, whether correct or incorrect, carry significant consequences. The CC recommended a series of three environmental flows test releases of three, one, and six m^3 per second, to be implemented sequentially in four-year blocks, that a Bridge River power development WUP Monitoring Committee be formed, and that its mandate include a review of the Lower Bridge River environmental flow test release results every four to six years (BC Hydro, 2012; Bridge River Water Use Plan Consultative Committee, 2003).

Following the development of the draft WUP, BC Hydro and St'át'imc worked together to incorporate the interests of the St'át'imc. The draft WUP was submitted to the comptroller of water rights in 2003, but not completed until 2011.

The primary reason for the eight-year delay in the completion of the WUP was the time needed to reach a settlement agreement between the St'át'imc and the Province of British Columbia and BC Hydro (BC Hydro, 2014a), which was signed on May 10, 2011 (Levy, 2013). The settlement agreement provides mitigation, compensation, and an ongoing long-term relationship to address all past, present, and future impacts, grievances, and claims of the St'át'imc related to the construction and operation of existing BC Hydro facilities (BC Hydro, 2014a; St'át'imc, 2011). It also provides the Province of British Columbia and BC Hydro with operational certainty for these facilities into the future (St'át'imc, 2011). The settlement agreement, although independent of the WUP, was formalized following the completion of the Bridge River WUP, but they are intertwined. For example, as part of the settlement agreement, the monitoring project work attached to the Bridge River WUP was directly awarded to St'át'imc Eco-Resources Ltd., a St'át'imc resource management company (Levy, 2013).

Recommendations by the St'át'imc were ultimately integrated into the final WUP and reflect the additional objectives of a revised environmental flows release schedule from Terzaghi Dam, specific and planned drafts from Seton Lake reservoir, annual shutdowns at the Seton Generating Station during the out-migration period of Seton Sockeye smolts, and their associated monitoring programs.

Throughout the different phases of the WUP's development, one constant was the implementation of the environmental flows adaptive management program. The CC's recommended environmental flows release program was for test flows to occur in four-year blocks, with a different flow regime in each block.

As the recommended three m^3/second test-flow release block neared its completion, the multiparty Bridge River Technical Working Group, consisting of representatives from BC Hydro, DFO, the BC Ministry of Environment, and the St'át'imc Nation, was established to review monitoring results and provide recommendations on the next phase of the environmental flow test releases provided to the Lower Bridge River (Failing et al., 2013). The technical working group followed an SDM process, since, although monitoring results and expert judgment provided high-quality information, uncertainties of the response of the aquatic ecosystem to changes in flow remained, and decisions on the next phase of the flow release required making value-based choices about risks and trade-offs (Failing, Gregory, & Higgins, 2013; BC Hydro, 2012).

For example, monitoring results showed that the total number of juvenile salmonids did increase, but the gains were mainly attributed to the rewatered reach, while in the downstream reaches that had flowing water prior to the flow release, the response of individual salmon species was variable (e.g., juvenile chinook abundance decreased), and there was little change in total abundance (Bradford et al., 2011). Other monitoring results have shown signs of river restoration, as the rewatered reach immediately below the dam was immediately colonized by adult salmon and used by steelhead trout spawners. Algal and invertebrate populations became established within a month of the flow release, while juvenile black cottonwood trees displayed significant growth and cottonwood seedling recruitment was promoted (Decker, Bradford, & Higgins, 2008; Hall et al., 2009; McHugh & Soverel, 2013).

The working group recommended an environmental flows test release equivalent to an annual water budget of six m^3/second, which was also supported by local communities, and a key consideration was that this release would provide the opportunity to further test hypotheses on the response of the aquatic ecosystem to flow. This environmental flows release was initiated on May 1, 2011, based on the WUP Water Licence Order, and will be implemented and monitored for four years, until April 2015 (BC Hydro, 2012).

Following the technical working group's review process, the St'át'imc adopted the SDM-based framework that was applied as the basis for future collaborative environmental governance initiatives within their territory (Failing et al., 2013).

The Bridge River Power Development WUP established trust among multiple parties and enabled improved water governance outcomes, as shown by the consensus WUP entwinement with the settlement agreement, the technical working group consensus and community-supported recommendations, and collaborative decision-making instead of litigation.

The ongoing Lower Bridge River adaptive management program demonstrates the role of environmental flows in restoring overall river health and the importance of integrating scientific uncertainty into assessment and implementation. Delivering downscaled flow regimes to rivers where competing water uses are present to restore and sustain aquatic ecosystems may also be a strategy that could be applied to other river restoration efforts (Hall et al., 2009).

FUNDING WATER USE PLANS

During the planning stages for WUPs, BC Hydro argued that the program would bring about substantial costs for the authority (and hence its ratepayers).

Not only would there be staff time involved, as well as costs for undertaking the consultation processes, but there would also be significant loss of power production brought about by the constraints placed on the dams and power plants. The government of the day, as the sole shareholder of BC Hydro, was clear that the authority would have to cover its own costs for staff time. It would also be responsible for the consultation process, including expert facilitation and modelling, but there was some disagreement inside of government over the costs of foregone electricity.

There were two perspectives to the argument. One argued that water licences represented "rights" akin to property rights, and infringing on or "cutting back" on those rights with operational orders would amount to expropriation, and thus compensation would be required. The government would also need to acquire the legal authority to take back the rights. Based on Principle 2, BC Hydro should receive compensation if there was any change to existing legal rights.

The opposing perspective was that water licences were more akin to permits to operate, and were subject to environmental regulations. If government changed its environmental regulation, then everyone would have to comply with the new regulation, including BC Hydro. An industry such as a pulp mill was not compensated if a certain process chemical was banned or restrictions were put on its use. Why should it be any different if water use conditions were changed?

In the end the choice was made to compensate for rights foregone. Initial estimates of foregone electricity value varied from $25 to $80 million per year, depending on how it was calculated. A plan was worked out with the Treasury Board to compensate BC Hydro by remitting (essentially refunding) some of the water licence fees paid by BC Hydro. At that time, BC Hydro was paying almost $300 million per year in water licence fees. As BC Hydro began implementing WUPs, costs of foregone electricity would be calculated, and that cost would be deducted from licence fees owing. As some of the electricity losses were to be permanent, such as where a changed flow requirement through a plant would reduce the ability to generate electricity, then the net present value of the stream of benefits for that lost power would be summed over the projected life of the plant and amortized over 20 years. Payments for the changed licence would be made for 20 years, and then the "loss" from the taking of the rights would be deemed to be fully compensated and payments would stop.

This was not to be a blank cheque for any power plant, however. This was as much an exercise in limiting the scope of WUP decisions as it was "recovering" costs. Without a cap, the WUP scenarios would have been impractical. Treasury Board approval was for "up to 50 million dollars per year" for all costs, including forgone energy, physical works, and monitoring. The total funding of $50 million per year over 20 years equated to $1 billion. Also, some of BC Hydro's water licenses already contained provisions for fisheries flow and/or associated requirements for monitoring. As these rights could be modified by the comptroller of water rights, costs (energy or monitoring) would not be covered by remissions and would be wholly at the expense of the ratepayer. At no time, however, were the remissions values to exceed the water licence fees paid in respect of any individual plant.

In 2001 the provincial government changed, and by 2002 a "core review" of government services was underway. Although annual remissions for interim orders were under $3.6 million, they were soon expected to grow as WUPs were completed and, as remissions were shown on the expenditure side of the provincial budget, approval for the larger expenditure was required.

Also at this time, the WUP CCs asked for two additional expenditure requirements: first, approval for monitoring programs to remedy the lack of information, particularly with respect to fisheries, to determine the most effective operational parameters—an increased cost that BC Hydro was not prepared to pay, and second, funding for projects to change the approved "works" of BC Hydro to provide better fisheries benefits without compromising the ability to generate electricity. Such projects included modifications to the spillways, adding a low-level outlet, constructing a fish way, or habitat improvements downstream of a dam, which could save money over the alternative of constraining electricity production. Requests were made to government to include monitoring and changes to works as activities for which remissions could be paid, as both items were not originally compensable.

In November 2002, the Treasury Board approved continuation of the program and approved the BC Ministry of the Environment to increase its expenditures over the next years to increase the remissions value to $50 million by fiscal year 2007/08, when enough WUPs were expected to be completed to require such expenditure. Also approved were monitoring and other "increased costs" due to implementation of WUPs. Further, the ministry was requested to bring to Cabinet a draft regulation to give legal authority for the expenditures.

In order to legally refund or remit *Water Act* rental payments, the *Water Regulation* was amended by BC Regulation 824 on July 22, 2004 to allow for remissions payments.[12]

In the end, probably less than $500 million will actually be remitted from BC Hydro's licence fees during the life of the WUP program, rather than the billion dollars originally approved. There are two reasons for this.

First was the effect of the licence review. Remissions are only paid for electricity foregone where an operational change affects licensed rights. As previously stated, staff from the comptroller's office reviewed all BC Hydro's old water licences (some were 80 years or more old) a lengthy process where every word was scrutinized by BC Hydro staff, their lawyers, the comptroller's staff, and government lawyers. The result, sometimes after much debate, was a common understanding of the rights as they were granted at the time the licence was issued, including what was permitted, what was prohibited, and what was unstated. Only the difference between these former rights and the rights in the new licence generated remissions. The result of this interpretation was that fewer rights were affected than were initially estimated.

Second, in some places physical work could be done, such as stream-channel improvement or changes to the spillway or outlet works on the dam, making needed habitat improvements without compromising electricity generation. In many cases, the one-time capital cost was much lower than the loss of generation over the remaining life of the facility. This, too, reduced the remissions that were allowed.

[12] Remissions were only payable in respect of electricity foregone or "increased costs" as a result of implementing interim orders or implementing a WUP under certain conditions. The conditions included: that BC Hydro was operating under an interim order or that the comptroller had completed a review of the water licence and made changes necessary to provide a clear description of the rights and obligations of the licensee, that the licensee had completed a WUP and that the comptroller had ordered or authorized BC Hydro to operate in a manner as contemplated in the WUP, and that such operation had caused a net loss of revenue to BC Hydro. The amount to be remitted was to be determined by applying a methodology as agreed by BC Hydro and the comptroller or, failing agreement, "…as may otherwise be established by the comptroller."

The structured framework for costing changes to operations in real dollars took the uncertainty out of the process and allowed creative solutions involving operational changes with financial benefits.

Finally, during core review, government decided that BC Hydro ratepayers, not the taxpayers of British Columbia, were the beneficiaries of the heritage hydroelectric power and should pay for the necessary improvements to the operations. Because 95% of BC residents get their power from BC Hydro, this is almost the same group, but the people who get power from other sources, such as Fortis and others, do not directly benefit from the BC Hydro facilities. Because of this, government began raising the water licence fee rental rate on the largest power licensees (which only affects BC Hydro) to bring in additional revenue to compensate for the fees that were being remitted.

INTERIM ORDERS (ISSUED BEFORE THE FINAL WUPS)

The water use planning process was underway by 1997. Early on the government approved immediate changes that could benefit fisheries.

In August 1997, the Treasury Board approved payment of up to $3.6 million per year in remissions before the WUPs were completed for interim orders for minimum flows and water releases on eight systems, as shown in Table 1. The orders directed BC Hydro to operate the works primarily to provide certain flows to benefit fish and aquatic habitat values, consider public safety, and prescribe specific operating requirements. Interim orders were to be replaced by new orders when WUPs were complete.

SYSTEM	DATE OF INTERIM ORDER
CAMPBELL RIVER	October 3, 1997
ALOUETTE RIVER	October 3, 1997
PUNTLEDGE RIVER	November 10, 1997
COQUITLAM RIVER	December 16, 1998
STAVE/RUSKIN	December 22, 1998
HEBER RIVER	December 22, 1998
SALMON RIVER	December 22, 1998
BRIDGE RIVER	July 28, 2000

Table 1. Interim orders issued from 1997 to 2000.

THE CONSULTATION PROCESS: COLLABORATIVE WATER GOVERNANCE IN PRACTICE

The design of the water use planning process provides a good model for other collaborative water governance processes.

Critical to its success was the involvement of a wide range of stakeholders, including BC Hydro, federal and provincial government agencies, other orders of government, members of the public, environmental organizations, and First Nations, all interested in the decision-making process of creating new operating orders for the hydroelectric facilities. The principles espoused inclusiveness and transparency. The process was designed to solicit a wide variety of viewpoints, and then to assist participants in making the necessary trade-offs to achieve the agreed-upon balance of opposing viewpoints.

The first notable step was the development of principles and guidelines, described on pages 17 to 19. Getting to a decision involved the process called structured decision-making, or SDM.

STRUCTURED DECISION-MAKING

Balancing society's demands for water above and below BC Hydro's existing dams while ensuring enough water was left in the river for fish and aquatic biodiversity preservation was a challenge that required balancing input from diverse viewpoints and the often "passionately held societal values" (Failing & Long, 2010) of First Nations, local residents, fish biologists, engineers, stream-keeper groups, regulators, and policymakers through a defensible methodology that could effectively integrate widely differing types of knowledge: scientific, local, traditional, technical, and cultural.

Public processes can founder when people do not have the information or ability to see the benefits and costs of different ways of approaching a highly technical problem such as operation of a hydroelectric facility. Their values of keeping fish abundant or preserving a traditional way of life can easily be lost in complicated discussions about flow rates, littoral productivity, tributary access, entrainment and stranding, and maximization of revenues from power generation.

SDM, a process to reach decisions on complex public policy issues that benefit from wide public involvement, is the methodology that was used to overcome this problem.

SDM is designed to elicit all the alternatives, put them on the table, and evaluate each alternative using a rigorous approach and analytical methods such as objective hierarchies, means-ends diagrams, consequence tables, Bayesian belief networks, cost-benefit analysis, and ecological risk assessment (Gregory et al., 2012). Equally important are best practices for deliberation, which include ground rules to bring participants to the table early in the

6 STEPS IN STRUCTURED DECISION-MAKING

1. Clarify the decision context
2. Define objectives and measures
3. Develop alternatives
4. Estimate consequences
5. Evaluate trade-offs and select preferred alternatives
6. Implement, monitor, and review

Figure 7. Six steps in SDM.

process; assist them in creating the content—which may involve clarifying the distinction between facts and values and disaggregating complex problems into a set of single objectives—and finally, evaluate the alternatives (Gregory, Fischhoff, & McDaniels, 2005).

When SDM was put into practice in water use planning processes, it followed the six steps set out in Figure 7. These steps are reflected in the WUP guidelines (pages 18-19) and were to be applied in an iterative manner.

The members of each WUP CC identified a range of alternatives related to dam operations and their effect on a range of environmental (e.g., fisheries) and social performance measures, and evaluated trade-offs among those alternatives to arrive at a final decision.

Operating scenarios were developed to address power and non-power interests. In each case,

Nature-based tourism is an important economic activity to be considered in decision-making for hydropower development.

detailed operational constraints on the hydroelectric facilities intended to meet certain and required (e.g., dam safety) objectives were specified. In addition, a range of physical works alternatives to mitigate effects were specified for management of operational effects on key interests in lieu of operating changes, where cost-effective.

SDM is a lengthy, deliberate process based on analysis. For example, the Cheakamus WUP CC reviewed 25 operating alternatives based on multiple performance measures related to power, First Nations, recreation, flooding, fish, and aquatic ecosystems. The alternatives were run through the BC Hydro operations model to determine its effect on the performance measures the CC had agreed upon.

Through this process, members of each CC became confident that their issues were fairly considered, and they could make choices between different options whose expected consequences were clear from models of facility operation, revenue, and ecological and social use. A clear benefit of the process is that it requires the people at the table to be explicit about their choices and about the final recommendation, and that they become educated on how different objectives influenced each other positively or negatively.

Adoption of SDM is widely credited as a key factor in the success of the water use planning process (Failing, Gregory, & Harstone, 2007; Gregory, 2005; McDaniels, Gregory, & Fields, 1999; Scodanibbio, 2011). Of the 23 facilities involved in the process, 22 reached a consensus final recommendation for the comptroller of water rights, a remarkable record of achievement. A key factor of the SDM success was a financial limit to the proposed alternatives. This helped focus alternatives and make reasonable societal trade-offs.

CONSULTATIVE COMMITTEES

The CCs included key players from government, First Nations, industry, and each local community, another notable feature of the water use planning process. The WUP guidelines (Province of British Columbia, 1998) recognized that the WUPs would require trading off benefits across a wide range of cultural, economic, environmental, safety, and social objectives, so an equally wide range of participants with diverse water uses and interests was recruited for the process.

Participants were given "…the responsibility of:

- articulating their interests in water management;
- listening and learning about other water use interests;
- developing an information base for discussion and review;
- exploring the implications of a range of operating alternatives; and
- seeking compromise across water uses." (Province of British Columbia, 1988)

The guidelines went on to state that "each process will strive for, but not require, consensus on all aspects of a WUP. Consultations are intended to encourage more open and accessible water management decisions. The consultative process should foster an atmosphere of shared resource stewardship among the interested parties. This may lead in the long term to a better understanding and acceptance of, as well as support for, resource decisions." WUP participants were advised that First Nations' issues would be considered and that the water use planning process had to incorporate appropriate strategies for consulting with First Nations whose rights and title might be affected by the facility.

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Participatory decision-making was a key element to the success of the WUP process.

Participants were chosen by responses to public notices asking for concerned groups to become involved, and targeted invitations were extended to knowledgeable and active groups. First Nations and federal and provincial government representatives were selected internally. BC Hydro was represented at the table on an equal basis to all other participants, another unique feature of the water use planning process.

FIRST NATIONS CONSULTATION

Both the provincial and federal governments have fiduciary and constitutional obligations to consult with First Nations on proposals and projects that may infringe on aboriginal rights and title. Early on, the Province recognized that First Nations would need to be consulted, and it stated its intention to address First Nations' issues during the water use planning process.

The Province decided to limit the water use planning process to current operational issues and not historical grievances over dam location, construction, and resultant flooding, if any, that may have infringed on First Nations rights ("footprint" issues). The government decided that claims of past infringement should be dealt with outside the water use planning process by direct negotiation between the parties, either through the treaty process or directly between the First Nation and BC Hydro. For example, in 2011 the Province of British Columbia, BC Hydro, and the St'át'imc reached a settlement agreement that provides mitigation, compensation, and an ongoing long-term relationship to address all past, present, and future impacts, grievances, and claims of the St'át'imc related to the construction and operation of existing BC Hydro facilities. It is notable that the settlement agreement is intertwined with the Bridge River power development WUP, specifically the awarding of the monitoring project work, which further highlights the role of the water use planning process in reaching water governance solutions.

This meant the focus of WUPs for First Nations was on forward-looking opportunities to alter operations to help reduce impacts or mitigate past infringement. These matters would be considered during the water use planning process and would be part of the decision analysis that would occur through public consultation. For this reason, it was important that First Nations representatives participate in the WUP public consultation sessions.

A First Nations WUP committee was set up to help incorporate First Nations views in the design of the water use planning process and to advise on consultation with potentially affected First Nations. First Nations representatives were involved in the management structure of the program. First Nations were encouraged to have their members participate in the CCs to learn about the issues associated with the particular facilities, make their interests known to the committee, and participate in the discussions of the trade-offs that were being made in the development of the plans. The government acknowledged that participation in the CCs did not constitute consultation on a government-to-government basis. The First Nations WUP committee was also used to advise on communication with First Nations and with making arrangements for the comptroller of water rights or one of the deputy comptrollers to undertake government-to-government consultations on the final WUP before any implementation orders were signed.

In cases where WUPs did not include First Nations at the earliest stage, problems arose. For example, the Cheakamus First Nation was not involved in the decision to implement the interim flow in the Cheakamus water use planning process. They supported the decision to increase the flows in the Cheakamus River after the fact, but then struggled with the discussions about reducing this flow. Earlier involvement of the First Nation would have improved the process by ensuring that they were aware of the temporary nature of the interim flow order.

Though it did not address First Nations' historical grievances over dam construction on their traditional territories, the priority given to First Nations' concerns through creation of the First Nations WUP Committee and recognition that First Nations had to be included in all CCs was a positive feature of the water use planning process and a good model for other resource planning processes in British Columbia. In some cases, commissioned traditional use studies contributed to the final decisions of the CCs. A review completed shortly after the conclusion of most water use planning processes noted that despite reservations about the adequacy of the process, First Nations did not block consensus in most cases, as they perceived the WUPs to be improvements over the status quo (Quadra Planning & Nowlan, 2004).

WUPS AS A MODEL OF COLLABORATIVE WATER GOVERNANCE

The water use planning process measures up well to the factors of success identified in collaborative water governance literature: legal basis for delegation, rescaling, participation, collaboration, and science-based decision-making.[13]

The WUPs were authorized by an agreement between the Province and BC Hydro, and so had a defined legal basis for the limited delegation that took place. Committees were not authorized to change the terms of a BC Hydro water licence; that authority was retained by the Province. However, CCs were able to explore a full range of management alternatives, and many of their advisory recommendations were adopted by the comptroller of water rights, resulting in additional *Water Act* orders that added constraints to the existing licences and monitoring requirements. The funding for the thorough processes was also secured, a key factor in producing the comprehensive plans that eventually resulted in gains for fish.

On the issue of rescaling, the creation of a separate committee at each facility kept the process manageable and focused on outcomes for a relatively manageable geographical area.

[13] This analysis is based on Nowlan and Bakker (2010).

WUPs embodied good practice for public participation. The committees managed to maintain volunteer commitment throughout a lengthy process and ensured there was environmental representation at the table. The Cheakamus WUP indicates how important it is to be very inclusive in choosing the makeup of the WUP CC. Different commercial sectors that were using the Cheakamus River were invited to send a representative to the process, but at the time, there was either no rafting association, or it was inactive. Individuals from the rafting industry who became involved late in the process were focused on getting the flows they required to support their rafting enterprises, and they missed the analysis of options and the process of making trade-offs. In the end, the rafters refused to endorse the WUP. This was the only non-consensus report that BC Hydro submitted to the comptroller for decision.

By maintaining clear government accountability for the final decision and employing detailed guidelines and principles to shape the process, the WUP committees paved the way for substantive outcomes. They also devoted the necessary significant time and resources to obtain results. Most notably, the process respected aboriginal rights, a hallmark of resource decision-making in Canada today.

WUPs are particularly commendable for their strong science- and values-based decision-making. The Fisheries Advisory Committee, comprising staff from DFO, the Province, BC Hydro, and First Nations, produced many technical reports that guided much of the work. Obtaining baseline studies, establishing technical committees, and the use of SDM all contributed to the success of the plans. A measurable improvement in fish populations is the ultimate mark of success for these processes, and, while monitoring is still continuing, the trends to date are promising. An additional report documenting the overall monitoring results from the water use planning process in another 10 years would provide more definitive results.

WUP DEVELOPMENT

For the WUP process, BC Hydro's facilities were grouped into 24 sets of facilities, with each set comprising the dams and generating stations related to a single river system or related river systems connected by the facilities.

For example, the Columbia River WUP includes hydroelectric facilities at Mica, Revelstoke, and Hugh Keenleyside dams. WUPs were prepared for 23 of these 24 sets of facilities.

The one WUP that has not been undertaken is for the Kootenay River. The complexity of the operation on this short stretch of river, the fact that several private operators were involved, and the limited opportunities for any benefits to be derived from changed operation led the government to conclude that it was not worth pursuing a Kootenay WUP. The Province did not direct the private companies to undertake water use planning as they did BC Hydro. Recently, however, the Columbia Basin Trust has expressed support for a water use planning process for the Kootenay River, mostly in the hope that it would include consideration of Kootenay Lake levels as well (Kindy Gosal, Columbia Basin Trust, personal communication).

The water use plan for the Revelstoke dam also included the Mica and Hugh Keenleyside dams.

PROJECT	WUP Initiation	Licence Rights Clarified	CC Report	WUP Report	Comptroller Draft Orders & Public Review	First Nation Consultation Completed	WUP Ordered
7-Mile	2000		Feb 2003		Jul 2006	Oct 2006	Dec 2006
Aberfeldie	2002	Mar 2004	Dec 2003	Nov 2005	Sep 2004	Apr 2005	May 2005
Alouette	2005	Mar 2009	Aug 2006	Apr 2009	Oct 2007	Nov 2007	Apr 2009
Ash	2000	Dec 2003	Jun 2003	Oct 2004	Apr 2004	Jun 2004	Oct 2004
Bridge Seton	1999		Sep 2003	Mar 2011	Mar 2005		Mar 2011
Campbell River	1999	Mar 2009	Mar 2004	Nov 2012	Jun 2007	Aug 2007	Nov 2008
Cheakamus	1999	Apr 1999	May 2002	Oct 2005	Jul 2004	Jun 2005	Feb 2006
Clayton Falls	2002	Jun 2003	Jul 2003	Nov 2004	Sep 2004	Nov 2004	Dec 2004
Clowhom	2002	Jan 2003	Nov 2003	Apr 2005	Sep 2004	Feb 2005	Apr 2005
Columbia	2001	Feb 2009	Jul 2005	Jan 2007	Jul 2006	Dec 2006	Jan 2007
Coquitlam	1999	Apr 2004	Jun 2002	Apr 2005	Jul 2004	Apr 2005	Apr 2005
Duncan	2001	Mar 2009	Sep 2005	Dec 2007	May 2007	Jun 2007	Dec 2007
Elko	2002	Mar 2004	Nov 2003	Apr 2005	Sep 2004	Apr 2005	Apr 2005
Falls River	2002	Jul 2005	Jul 2003	Apr 2006	Dec 2004	Jan 2006	Apr 2006
Jordan River	2000	Jan 2003	Feb 2002	Apr 2003	Aug 2003	Mar 2004	Jul 2004
Peace River	2001	Apr 2008	Dec 2003	Aug 2007	Mar 2007	Jun 2007	Aug 2007
Puntledge	2001	Mar 2004	Dec 2003	Dec 2004	Aug 2004	Oct 2004	Jan 2005
Shuswap	2000	Apr 2004	Dec 2002	Aug 2005	Jan 2005	Apr 2005	Oct 2005
Spillimacheen	2002	Mar 2004	Aug 2003	Jul 2005	Nov 2004	Apr 2005	Jul 2005
Stave	1998	1999	Oct 1999	Dec 2003	Sep 2002	Mar 2003	May 2004
Wahleach	2000	Jan 2003	Nov 2003	Dec 2004		Dec 2004	Jan 2005
Walter Hardman	2003	Mar 2004	May 2004	Mar 2006	Oct 2004	Feb 2005	Mar 2006
Whatshan	2002	Dec 2003	Oct 2003	Jun 2005	Jul 2004	Feb 2005	Jul 2005

Table 2. The 23 WUPs and the timing of the various steps that led to the WUP order.

WUP REVIEWS

Adaptive management was a key component of water use planning, especially in light of the paucity of information that was available to support some of the planning processes.

All WUP orders are intended to be reviewed after a set period of time, which varies depending on the monitoring studies that were required, the time to get the information required to make further operational changes, and the time needed by BC Hydro and the Province to assess the costs and benefits of the operational and physical changes.

BC Hydro completed 23 WUPs between 1999 and 2007. For BC Hydro, WUP order reviews were recommended within five to 20 years of the issuance of the WUP order. Expiry of the DFO *Fisheries Act* authorizations, which come from the WUP, is generally tied to the review date, with the authorization typically set to expire two years from the commencement date of the WUP order review.

The cycle of WUP order reviews began in 2013. The table below shows the date the WUP was ordered, the plan review period, and the current review schedule (Pieter Bekker, deputy comptroller of water rights, personal communication). An earlier review may be triggered for any WUP if significant issues arise. The review date column shows the review year that the WUP contemplated and the actual review year that BC Hydro and the Province agreed upon in 2012 after an internal review of the current state of WUP monitoring.

Water Use Plan	Date Ordered	Recommended Review Period (years)	Estimated[14] Review Date
7-Mile	Dec 2006	10	2016
Aberfeldie	Nov 2006	15	2021
Alouette	Apr 2009	15 (coincide with Stave)	2015
Ash	Oct 2004	5	2009/2013
Bridge Seton	Mar 2011	10	2021
Campbell River	Nov 2008	10 (5-year evaluation)	2022
Cheakamus	Feb 2006	5	2011/2013
Clayton Falls	Dec 2004	10	2009/2014
Clowhom	Apr 2005	20	2015/2025
Columbia	Jan 2007	13 (5-year evaluation)	2020/2021
Coquitlam	Apr 2005	15	2020
Duncan	Dec 2007	10	2017/2019
Elko	Apr 2005	10	2014
Falls River	Apr 2006	10 (5-year evaluation)	2016/2018
Jordan River	Jul 2004	6	2010/2012
Peace River	Aug 2007	10 (5-year evaluation)	2012/2019
Puntledge	Jan 2005	10 (5-year evaluation)	2015/2017
Shuswap	Oct 2005	10 (5-year evaluation)	2015
Spillimacheen	Jul 2005	10	2014/2015
Stave	May 2004	10	2014/2015
Wahleach	Jan 2005	10 (5-year partial review)	(2010)/2015
Walter Hardman	Mar 2006	6	2012/2015
Whatshan	Jul 2005	10 (5-year evaluation)	2015

Table 3. Timeline for the review process of 23 WUPs.

[14] Review dates were estimates, and reviews will be undertaken when all monitoring and physical works are completed.

CONCLUSIONS

This review of BC Hydro's water use planning process document shows it enabled the achievement of environmental and social objectives, in addition to the power generation and flood-control objectives that were generally the only two components used in the design of most BC Hydro facilities.

Our review shows that inclusive SDM processes can achieve consensus trade-offs that balance water use with environmental and other benefits. This does come at an economic cost; however, with a fixed budget, a set of rules, and effective consultation, reasonable compromises can be reached to improve the performance of hydroelectric facilities at acceptable costs.

The two main conclusions from this analysis of WUPs are that improvements to fish and fish habitat are possible through SDM water planning for hydroelectric facilities, and that employing the factors of success identified by the literature on shared water governance can lead to successful outcomes. We discuss these two conclusions below. The report ends with final thoughts on key plan elements that can be transferred to other water use planning processes.

IMPROVEMENTS TO FLOW AND FISHERIES, AND OTHER ENVIRONMENTAL BENEFITS FROM THE BC HYDRO WATER USE PLANNING PROCESS

All BC WUPs are expected to benefit aquatic ecosystems, particularly fish, relative to prior operating conditions. The full range of fish and other aquatic ecosystem benefits resulting from the *Water Act* orders after completion of WUPs are currently being monitored and will take years to determine.

Monitoring program results for each WUP are regularly reported and made publicly available.[15] A report from the Pacific Fisheries Resource Conservation Council (2001) noted that water use planning had already been remarkably successful in redressing past losses in salmon and steelhead habitat, and that significant gains had been realized through interim flow orders at the Puntledge, Campbell, Alouette, Stave/Ruskin, Salmon, Heber, Coquitlam, and Cheakamus rivers. A preliminary assessment of results in 2004 showed that many of the WUPs were positive for fish in terms of more available water and habitat, or increased knowledge that will assist in narrowing the range of uncertainties and in better managing impacts on fish. An analysis of seven WUP outcomes (Quadra Planning & Nowlan, 2004, p. 44) reported that "the recommended flow alternatives were sometimes, although not always, the best choice for fish conservation, but they were usually better than the status quo."

Although flow-ecology relationships continue to be inherently uncertain in British Columbia, as is the case around the world, it is believed that improved flow regimes for fish and other aquatic biota are now being provided in many rivers as a result of the BC Hydro water use planning process. For example, as part of the Bridge River power development WUP, flows have been restored to the Lower Bridge River after a 40-year period with no continual flow release; these flows are restoring multiple components of the aquatic ecosystem, and

[15] See BC Hydro's WUP website at bchydro.com/about/sustainability/conservation/water_use_planning.html.

an adaptive management program is underway to inform long-term flow management decisions. As part of the Ash River WUP, increased minimum flows will be provided to the Ash River and are expected to result in an increase inrearing and spawning habitat for fish, including an estimated 14-fold increase in steelhead parr rearing habitat. As part of the Puntledge River project WUP, minimum and pulse flows will be provided to increase rearing and spawning habitat and opportunities for fish to migrate past natural barriers. The Wahleach WUP led to implementation of new minimum flow targets requiring maintenance of fall spawning and incubation/rearing flows of 1.1 m^3/s (September 15 to November 30), and 0.6 m^3/second for the rest of year, and the Elko WUP includes a minimum flow release of 0.50 m^3/second year round. Protecting and restoring environmental flows is central to sustainable water management (Hirji & Davis, 2009), and flow improvements implemented through the BC water use planning process are key outcomes.

And as one participant said, "Although attending over 70 meetings may not be glamorous work, the WUP resulted in significantly improved flows for fish downstream of BC's oldest dam—a major achievement" (Craig Orr, Watershed Watch, member of the Coquitlam-Buntzen WUP consultative committee).

The water use planning process has set a positive precedent for the implementation of environmental flows, and key outcomes have been flow and habitat improvement for fish and other species from new operating conditions placed on existing infrastructure and dams across British Columbia. Implementation of environmental flows assessment under the water use planning process is collaborative and inclusive, integrating science and social values, monitoring, and adaptive management. While fish remain the focus of flow restoration, over time other social and environmental objectives have been integrated, which reflects the ongoing evolution of environmental flows assessment and implementation around the world.

The following sections summarize the conditions that are necessary to successfully apply the BC Hydro water use planning process to other hydroelectric facilities where stakeholders wish to improve environmental and social outcomes beyond generating electrical energy.

FACTORS OF SUCCESS IN SHARED WATER GOVERNANCE

The water use planning process fully incorporated the five factors of success identified in water governance literature, and though causation is difficult to prove, these factors likely influenced the eventual success of the process overall. It is possible that an alternative process where flows were managed solely for fish and habitat would outperform SDM from the fish habitat point of view. However, whether such an alternative process would have received the same level of public acceptance is not as clear. Our comparison of the WUPs to factors of success identified by academic literature showed a high degree of correlation between the theory and practice in this case. The discussion below highlights how WUPs incorporated the five factors of success.

Delegation

There needs to be a set of rules that both the facility owner and the participants respect and obey. These rules are best established in law and regulations presided over by a neutral government agency. The office of the comptroller of water rights was the final decision-maker and was the agency that oversaw the process. BC Hydro, as the facility owner, ran all consultation and produced all the WUP reports, but they were submitted to the comptroller for approval and implemented by an order of the comptroller. The comptroller was also the individual charged with determining compliance with the revised plans and ordered operations procedures, and with approving the remissions payments to compensate for power foregone.

British Columbia's *Water Sustainability Act* provides an opportunity to apply lessons learned through the WUP process.

Collaborative, delegated water governance processes are more likely to be successful if the process has a defined outcome. In the case of WUPs, the endpoint was clear: the CCs were to prepare a WUP, a non-binding, voluntary agreement on identifying hydro operations that recognize multiple uses. The WUPs typically resulted in a recommendation for a voluntary, but compensated, diminishment of BC Hydro's water rights at a particular facility in order to increase flows for fish, and the comptroller of water rights issued an order that accordingly changed the terms of the applicable water licence.

Funding is often a roadblock for delegated water governance processes. In this case, funding provided to BC Hydro and remissions for diminished rights from the provincial government facilitated the water use planning process and better outcomes for the water resources BC Hydro has the responsibility of managing. There are two major cost areas: first, the consultation process, including costs of expert facilitation, participant funding, information gathering and modelling; and second, the ongoing loss of power through implementation of operating constraints.

Scale-Management Structure

The success of the WUPs program is partly attributable to a management structure that acted at the correct scale: it recognized responsibility for issues within different areas of government and brought the key responsible people to one table to manage the process. The process used project management principles, including having a project plan and tracking resources on a monthly basis to ensure the project was kept moving. Senior-level support within government meant that a discipline could be applied to the process to ensure that problems could be solved.

Participation

The benefits of public participation are well documented and include legitimization of policy and a greater sense of ownership for the participants, which can, in turn, avoid or minimize conflict. The benefits must be weighed against the drawbacks of lengthy and time-consuming processes, volunteer burnout, and uncertainty about whether an advisory process will lead to concrete results that are implemented. Public involvement was initiated at an early enough stage to influence problem definition. Each CC was inclusive, involving government agencies that included federal, First Nations, provincial, local, and regional representatives, as well as key stakeholders from industry and environmental and recreation interest groups. In our three case studies, participation remained high throughout the years required to complete WUPs.

Consultation and Collaboration

The likelihood of success for a collaborative process can be increased by following the practices used by the Province and BC Hydro. Building on early pilot experiences such as Alouette and Stave, which resulted in broadly accepted solutions, was a good starting point. The process was designed by experts who used decision science to guide the efforts of each CC, and it was well-funded and thorough. Expert facilitation and the use of SDM increased the odds of success. Procedures designed to recognize the unique legal position of First Nations were needed to complete the plans, and though these procedures were not completely adequate according to some First Nations, they were a step in the right direction.

One of the key aspects of the WUPs program was the multistakeholder attendance of an analytical process, where the stakeholders learned about the environment, the facility, and the complex interactions between the two. This provided a foundation to understand trade-offs, one that was missing at the start of the process. By participating in the process, the stakeholders better understood their own interests and those of others, which in turn allowed them to appreciate and ultimately respect those other interests. Many participants believed that consensus was primarily a result of this structured, cooperative-learning aspect of the process. The Cheakamus River example, the only example of a non-consensus WUP, shows how the absence of shared learning can negatively affect consensus.

Science-Based Decision-Making

Baseline studies before a water use planning activity is undertaken will help focus on what is needed, and are necessary for comparison to determine the success of the process. Obtaining this information requires a commitment by citizens, the facility operator, and government agencies to gathering information.

It is hard to overstate the importance of baseline studies. Without a "before" picture, you cannot determine what has changed when you look at the "after" picture. The monitoring that is taking place post-WUP implementation is comparing the effects of changing from an interim flow to a WUP flow, when the real question is: are there improvements from before the interim flow to current flows? In the absence of baseline studies, the only thing that can be determined is whether or not there are healthy, sustainable fish populations and other aquatic biota in the system now. Subsequent to the baseline studies, information needs to be assembled to evaluate the effects of current operating procedures over the range of non-power interests identified in the consultation processes. The range of interests is wide and usually includes air quality and community health (dust); erosion and land stability; First Nations' heritage and traditional use, including cultural and spiritual use; industrial water use and effluent discharge; power generation; public safety, flooding, and ice management; parks, recreation, and tourism; transportation; water supply and quality; and fish and wildlife, including commercial and recreational fisheries, protection of species, and sustaining aquatic ecosystems.

It is also important that the algorithms that allow the calculation of cost of power foregone when operations are changed are reasonable and are reviewed by an independent agency. In addition, studies will be needed to determine if changes can be made to the physical works to provide the desired benefit to the value component, and thus incurring only a single capital cost instead of losing the recurring energy loss from a change of operations.

In response to uncertainty, an adaptive management approach should be adopted. Where the benefits of certain alternative options are more certain, they should be adopted immediately. These generally include operating rules for reservoir elevations, downstream minimum flow releases, and special operating procedures to manage releases for ice formation. Where benefits are less certain, coordinated information-gathering studies should be undertaken to guide future decisions about implementation of mitigation measures. These studies may include pilot application programs with before-and-after monitoring to guide development of full-scale implementation measures.

In all cases of operational or alternative physical-work-based mitigation programs, monitoring is necessary to determine the effectiveness of the changed regime. These programs should be designed early and implemented as soon as the change is made. Ideally, there will be baseline studies of the unchanged regime for comparison purposes. Where adaptive management programs are in place, this monitoring is essential to determine if further changes are necessary.

A review of the WUP should be conducted after a specified number of years. The review is undertaken to interpret the results of information and management plans. The results of that review can in turn be taken into account in determining the effectiveness of follow-up actions, and to decide whether there is any need to reconsider operational constraints or apply other mitigation measures in lieu of operating changes.

FINAL THOUGHTS ON BENEFITS OF WATER USE PLANNING

In the end, a number of factors made WUPs work. The timing was right, there were enough resources for lengthy and comprehensive planning tables, and careful design of the structure and process led to change. BC Hydro had a significant incentive for change due to history and changed societal conditions, as well as the legal precipitating events of lawsuits by DFO, the CEC complaint, and a greater focus on balancing competing water uses. There was also a strong social desire to see change and a great number of people who volunteered their time to participate on the CCs to make the process work.

Legacy water rights often place a barrier to reconciling past water management practice with a broader range of interests desired in today's social context. There are often many different understandings of the meaning of these legacy rights. A structured process of examining those rights and rewriting them in modern language, involving both the rightsholder and the regulator, is essential to building a common understanding before moving forward. This process will define what can be done without affecting rights, and if rights must be affected, it defines where and by how much they are affected. In short, rather than being constrained by legacy water rights, the water use planning process addressed them to enable the achievement of better water management outcomes.

Results from the WUPs' adaptive monitoring programs will provide additional evidence in the future of the value of these plans, assuming that the anticipated improvements to fish, habitat, and other ecosystem functioning do materialize. Improved trust, greater willingness to engage in dialogue about resource management options, and deeper understanding of the complexities of values and trade-offs are other, more intangible benefits from the water use planning process. Though harder to quantify, these benefits are proof that collaborative decision-making can lead to more sustainable outcomes.

Showcasing regional success stories where fish and biodiversity appear to be improving in areas of high hydropower generation is important at a time when globally, water supply crises are on the rise (World Economic Forum, 2013); freshwater biodiversity is decreasing (Dudgeon et al., 2006); climate change is altering hydrological systems, affecting water resources in terms of quantity and quality (Field et al., 2014); and the case for more investment in renewable energy is becoming stronger (IRENA, 2014). The BC Hydro water use planning experience can be added to the list of water governance success stories and deserves broader recognition.

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