ADAPTATION TO SAFEGUARD SOMASS BASIN SALMON POPULATIONS

Water is one of the most precious natural assets in BC – contributing to the beauty of our landscapes, the health of our ecosystems, our healthy economy and the well-being of our citizens. Changes in BC's climate have already resulted in altered water flows, such as longer summer low flows and droughts, with impacts to fisheries, agriculture, and communities. This case study describes how governments and community organizations are working together in the Somass River basin on the west coast of Vancouver Island to understand and adapt to climate change impacts on watershed values, in particular fisheries.

SUMMARY

Water flows in the Somass basin support wild and cultured salmon populations and associated fisheries as well as hydropower generation, and community water use. Flows are regulated by dams – some of them aging and requiring modernization – constructed at several locations in the system to meet the needs of industry, fish, and flood control. Management of in-stream flows and lake levels by these structures is inextricably linked to the continuation of diverse and highly valuable fish stocks and fisheries.

In the last two decades, five significant summer droughts and related warm water events have resulted in major sockeye losses in the basin, and climate change projections suggest such events will be more frequent and more intense in future.

In 2007 Living Rivers - Georgia Basin/Vancouver Island and the BC Conservation Foundation – in partnership with basin stakeholders – initiated development of a Somass Basin Watershed Management Plan (SBWMP) to address climate change and other issues.

In 2010 the project partners identified four possible adaptation strategies:

1. Reduce fishing quotas early in the season when water is cooler;
2. Reduce existing migration bottlenecks within the Somass system;
3. Install new cold water release infrastructure at existing dams; and
4. Improve water quality at the mouth of the Somass River.

Project partners undertook studies to increase knowledge of climate change impacts on fish and to explore the identified adaptation strategies.

The SBWMP is a living document designed to be updated and implemented over time. It identifies cold water release as the most important adaptation strategy. Barriers to implementation include uncertainty regarding dam ownership, high implementation costs, and lack of jurisdictional responsibility. Project partners will work to address these barriers and to implement other, shorter term adaptation actions as resources become available.

This case study describes work in the Somass basin on Vancouver Island to better understand and prepare for climate change impacts on salmon populations. It summarizes the observations and reflections of the individuals and organizations involved in the project, and the insights they gained about advancing climate change adaptation in the context of watershed management. The project received funding from Natural Resources Canada's Regional Adaptation Collaborative (RAC) program, managed in British Columbia by the Fraser Basin Council and the B.C. Ministry of Environment, and involving almost 50 regional partners (http://www.fraserbasin.bc.ca/programs/bcrac.html).

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Climate Change Adaptation

Adjusting what we do to avoid or prepare for negative impacts of climate change and take advantage of new opportunities.

Insights regarding the adaptation process

1. ***'A broad cross section of dedicated individuals at the table and a positive start keeps the adaptation process alive through the inevitable challenges.'*** – The broad and dedicated membership of the Management Committee and a positive process thus far are the foundations for an enduring adaptation initiative.
2. ***'Stay focused on shared values and be strategic to move forward on adaptation.'*** – Shared concern about salmon and water as critical community values, and an ongoing strategic focus on priority issues have helped the project overcome multiple challenges.
3. ***Expect delays if governance is unclear and no strong champion emerges.'*** – Where water management roles are unclear, there will be uncertainty about governance, with the potential for a leadership void that can delay adaptation.
4. ***'Complex, expensive adaptation measures can exceed local capacity.'*** – Local governments support adaptation, but they do not have the resources on hand to implement complex, adaptation measures with high up-front or ongoing costs.
5. ***'Get the science rlght to make a credible case for adaptation.'*** – Especially when systems are complex, thorough scientific and technical studies are essential to verify climate change impacts, and explore the costs and benefits of possible adaptation options.
6. ***'Hire people with capacity and experience to manage the complexity.'*** – An ongoing science/management team including seasoned scientific/technical expertise, skilled group facilitation and local coordination is essential for successful adaptation in complex situations.
7. ***'Keep key stakeholders informed, with information that highlights why adaptation is needed.'*** – Engagement of and communication with stakeholders need to be carefully timed, using credible, science-based information to secure support for adaptation.
8. **'The *adaptation process may take time and need ongoing funding; you may need to wait and be ready to act when the time is right.*'** – Realistic expectations should be established up front about the time and resources needed to study and identify robust adaptations, with recognition that complex or expensive adaptation measures can only be implemented when the time is right.

PROJECT DESCRIPTION

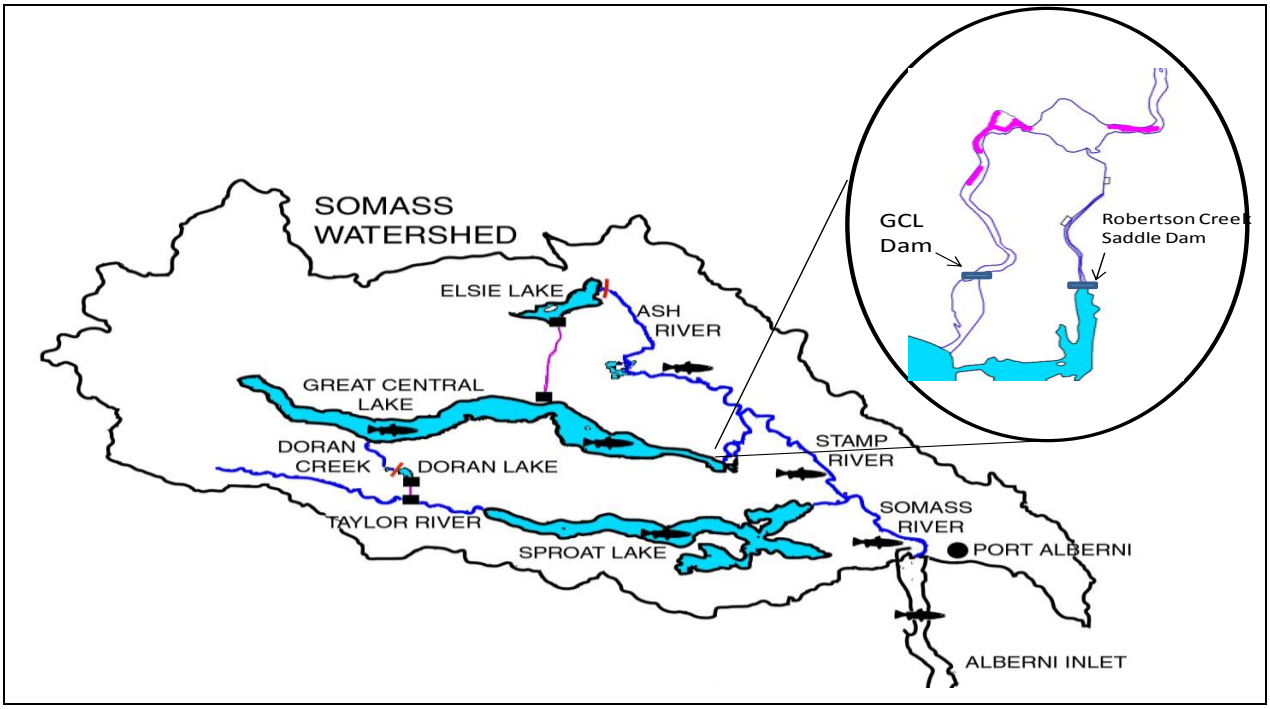
Location

The Somass River watershed is about 1,426 km^2 and drains into the head of the Alberni Inlet, a fjord on the west coast of Vancouver Island. It includes three major sub basins: Sproat (387 km^2), Great Central (651 km^2) and Ash (388 km^2). While the headwaters of the watershed are within a provincial park, much of the basin supports managed forest land, with some agricultural and rural residential areas near the mouth of the Somass River. The community of Port Alberni is located at the mouth of the river.

The area has a long history of First Nations settlement and use. Fisheries and forestry have been the backbone of the local economy, with fisheries and tourism becoming more important as the forest sector declines. Water flows in the basin support salmon populations and associated fisheries, as well as aquaculture, hydropower generation, and community water use. Sproat Lake and the lower Somass River are popular recreation/tourism destinations.

The Somass Basin supports the largest sockeye salmon population on British Columbia's

southwest coast, and significant chinook, coho, steelhead, and resident trout populations. The local Tseshaht and Hupacasath First Nations have relied for generations on salmon for food, social and ceremonial purposes, and the basin supports a significant aboriginal fishery. The economic value of commercial and recreational fisheries in the basin was estimated in 2003 as $4-9million per year.



Levels in all three major lakes have been managed for decades. BC Hydro maintains and operates a storage facility in the upper watershed that diverts water from Elsie Lake to a hydro-electric plant on the north shore of Great Central Lake (GCL). Catalyst Paper Corporation operates two dams below GCL, and a weir below Sproat Lake.

The GCL main dam was built in the 1950s primarily to store water that the company could use during periods of low flow to dilute the concentration of pulp mill effluent released into the Alberni Inlet. The dam also allowed GCL levels to be managed during the fall-winter sockeye salmon spawning period to ensure that eggs deposited on shallow beaches around the perimeter of the lake remained covered. By 2004, new pulp mill technology had eliminated the need for industrial water releases, and the Catalyst water licence was amended to serve the general purpose of fish conservation.

The Robertson Creek saddle dam works in conjunction with the GCL main dam. (A saddle dam is an auxiliary dam built at a low point on the perimeter of a reservoir to prevent water from escaping.) The downstream Robertson Creek Hatchery – which produces significant numbers of young chinook, coho, and steelhead – draws its water supply from GCL. Dam safety concerns identified in 2008 resulted in constraints on maximum water levels in GCL, on ability to provide optimal levels for wild fish populations, and on water supply to the hatchery. Upgrading of the saddle dam was identified as a priority for action.

The weir at Sproat Lake supports the provision of water for the pulp mill, and for downstream fish passage. (A weir is a small overflow dam often used within a river channel to create a lake from which water can be withdrawn.)

Decades ago, the construction and operation of these dams substantially increased summer in-

stream flows in the Somass Basin, enhancing salmon spawning success and fisheries productivity. Continued management of lake levels and in-stream flows is inextricably linked to the continuation of diverse and highly valuable stocks and fisheries. The dams also provide downstream flood control benefits, and in future may support micro-hydro and augment community water supplies. Catalyst Paper Corporation no longer needs these dams.

Adaptation Issue

Between 1990 and 2009, five significant summer droughts and related warm water events led to major sockeye pre-spawning mortality, disease, and loss of reproductive fitness. Climate change projections suggest such events will become more frequent and intense.

Fish are sensitive to temperature, which regulates many of their physiological processes. In general, salmon prefer temperatures between 12°C and 15°C. Sockeye are particularly sensitive, and water temperatures above 15°C can deplete their energy reserves, make them more susceptible to disease, and reduce their capacity to produce viable eggs and sperm. Temperatures above 18°C can impair their swimming ability, and sockeye can die from several days' exposure to temperatures between 22°C and 24°C or from brief exposure to temperatures above 24°C.

While the Great Central Lake dams provide for optimal flows that can offset warm water impacts on salmon, steelhead and other resident fish, stakeholders in the basin were concerned about:

- the condition of these aging structures, and their long term ownership and operation;
- the ability of existing infrastructure to maintain adequate ecosystem flows in the face of more intense drought and warm water events;
- bottlenecks to fish migration within the basin, in particular at existing fishways and fish counting facilities; and
- potential impacts of poor water quality at the mouth of the Somass River, where migrating sockeye wait when river temperatures reach or exceed 19°C. A disintegrating mat of pulp waste in the water consumes dissolved oxygen, reducing its availability to fish.

Project Partners

The British Columbia Conservation Foundation (BCCF) established the Living Rivers – Georgia Basin/ Vancouver Island (Living Rivers) initiative in 2007 to advance the vision of "healthy watersheds and sustainable fish populations through shared responsibility, stewardship and wise use of water" and to undertake projects and develop new governance models that will facilitate adaptation to climate change. Living Rivers established a collaborative planning process for the Somass watershed and led the development of the Somass Basin Watershed Management Plan (SBWMP).

An ad hoc SBWMP Management Committee – including representatives from: Fisheries and Oceans Canada; BC government agencies responsible for water resources, flood and freshwater fisheries management; BC Hydro; the Hupacasath and Tseshaht First Nations; the Alberni-Clayoquot Regional District; the City of Port Alberni; Catalyst Paper Corporation and a recreational sports fishing organization – guided the process and provided input to the plan.

A public Forum including a broader group of stakeholders met periodically to share information and provide input to the SBWMP.

Project Details

In 2007 Living Rivers and key partners initiated a comprehensive watershed management planning process for the basin after establishing that there was broad support for such an effort. They convened an ad hoc Management Committee representing diverse water interests

in the Somass Basin, and a public Forum open to all interested stakeholders.

In 2010 Living Rivers produced an overview report that provided background on water and salmon management issues (including climate change impacts) in the Somass Basin, described initial steps to galvanize community support for a proactive water management plan, and identified four potential adaptation strategies for conserving sockeye salmon populations:

1. During drought and other warm water years, reduce salmon harvesting in June to increase the number of salmon that successfully migrate and spawn during the early part of the summer, when water is usually cooler.
2. Reduce existing migration bottlenecks within the Somass Basin, for example by installing lights at fishways to encourage migration at night when water is cooler;
3. Install new cold water infrastructure at the Great Central and Sproat Lake dams to reduce water temperature during the June to August migration period, and
4. Improve dissolved oxygen levels in the upper Alberni Inlet.

The Management Committee recognized early in the planning process that Strategy 1 would be divisive and politically difficult to implement, and therefore chose not to pursue it.

Living Rivers and partners commissioned scientific and technical studies to improve understanding of climate change impacts and other pressures, and of the other three identified adaptation strategies. They also initiated ongoing discussions between all levels of government regarding creation of a Somass Basin water management board or council, similar to those existing for some other priority watersheds in B.C., to lead ongoing development and implementation of the SBWMP.

Project Milestones

- BC Parks and DFO – through an experiment at the Stamp Falls fishway – found that nighttime lighting encouraged migrating sockeye to travel at night when water temperature was cooler.A technical report on the impacts on salmon of low dissolved oxygen levels at the mouth of the Somass River, completed in May 2010, established that low dissolved oxygen levels in these waters should not significantly impact salmon, and that management strategy d) would be only partially effective. It identified the costs of technology to increase dissolved oxygen as $1-4million.
- Modelling work undertaken under contract and completed in June, 2010 established that it is technically feasible to reduce water temperatures on the Somass River when river temperature exceeds 20°C. Cold water release infrastructure would pipe cold water from the depths of the lakes into the river system. The study estimated the cost to construct such infrastructure at the Great Central Lake dam as $5-5.5million, and at the Sproat Lake weir as $0.8-1.2million.
- The first draft of the SBWMP, released in December 2010, identified the four possible adaptation strategies, summarized the results of initial scientific and technical studies, and introduced a four-stage SBWMP implementation plan. The SBWP was designed as a “living” plan that is updated as new information and resources become available.
- The Management Committee reviewed the draft SBWMP in June 2011, and identified Strategy 3 – cold water release from Great Central and Sproat lakes – as the most important adaptation option. They also agreed at that time not to proceed with detailed engineering design related to new cold water infrastructure until long-term ownership of the existing dams was clarified and existing water licenses were transferred.

A Compelling Case Can Now Be Made

"…if current climate change trends persist or accelerate as projected …, engineered cold water release facilities will be essential to the maintenance of sustainable Sockeye and Chinook production in the Somass within 20 years or less. Given these results, a very compelling case can now be made for the need for cold water release infrastructure in the foreseeable future." SBWMP, 2012

- At the June 2011 Management Committee meeting, Catalyst Paper Corporation assumed responsibility for reconstruction of the Robertson Creek saddle dam. The Hupacaseth First Nation agreed to assume ownership of the Robertson Creek saddle dam after its reconstruction, based on the assumption that the dam could support micro-hydro generation. Catalyst completed field work, planning and reconstruction of the saddle dam in September, 2011 at a cost of more than $2million.
- A technical and financial assessment of the potential for micro-hydro development at the Great Central Lake and Elsie Lake dams, completed in January, 2012, found that options are limited by the low head available at the dams. Detailed financial analysis of the most suitable options concluded that at both locations, the financial return on investment would be below the target range for projects of this type.
- Living Rivers updated the SBWMP in June, 2012 based on new information and input from stakeholders. This plan summarizes additional scientific and technical studies, and identifies management objectives and recommended actions – completed, short term, and long term – for Great Central Lake, Sproat Lake, the Stamp River-Somass River system, the Somass estuary, and the entire basin.

How the project has advanced adaptation

The project has established a credible scientific and technical foundation to support adaptation. It has:

- confirmed that there are "doable" adaptation measures at the fishways (Strategy 2), including the installation of lights to encourage nighttime migration;
- verified that there is sound science to support cold water release infrastructure at two locations in the basin (Strategy 3); and
- established that the fibre mat in the upper Alberni Inlet is a relatively low barrier to salmon migration and spawning success (Strategy 4).

Reconstruction of the Robertson Creek saddle dam – identified as a priority adaptation measure – allows for continued use of the dam to maintain higher water levels on Great Central Lake and protect sockeye, coho and trout eggs deposited on shallow beaches around the lake.

The project has produced a "living" SBWMP that can be updated as new information emerges and implemented as opportunities and resources become available. The 2012 SBWMP identifies management objectives and adaptation measures for five portions of the Somass River system, including measures that can be implemented in the short term.

Members of the Management Committee are fully informed about issues and adaptation options in the basin, and using the information generated by this project to inform their decisions, where relevant. The strong working relationships amongst Management Committee members are expected to expedite the creation of a new board or council when the time is right.

There are a number of outstanding issues, including significant barriers to SBWMP implementation:

- Catalyst Paper no longer needs the dams and would like to transfer their ownership and the related water licences. The Hupacasath First Nation has agreed to assume ownership of the Robertson Creek saddle dam. No new owner for the GCL dam has come forward.
- It is not clear where the capital to improve and upgrade dams, and the funds to operate them will come from. A new dam owner(s) must at a minimum have the resources to operate and maintain the existing infrastructure. Ideally they will be able to afford extensive renovations to improve function and provide for increased cold water flows.
- A detailed basin-wide "business case" for long term maintenance and improvement of the dams, and construction of cold water release infrastructure, does not exist.
- Implementation of some other adaptation measures is hampered by economic, environmental and related regulatory uncertainties.

Project Cost and Financial Support

The BC Conservation Foundation, from the BC Living Rivers Trust Fund and the Pacific Salmon Commission Southern Endowment Fund, provided initial project funding of $200,000 to start the SBWMP process. This was augmented by $100,000 from Natural Resources Canada Regional Adaptation Collaborative (RAC) program, additional funding from Living Rivers, and in kind contributions from local stewardship groups and local and senior governments. RAC funding supported technical work to verify the feasibility and effectiveness of the proposed adaptation options, facilitation of Management Committee and stakeholder Forum meetings; efforts to advance watershed governance, and refinement of the SBWMP.

More Information

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Somass Basin Watershed Management Plan status overview report (June, 2012)
http://www.bccf.com/fisheries/reports/sbwmp-status-overview-report

INSIGHTS ON ADVANCING ADAPTATION

These insights reflect a review of project documents and interviews with eight project collaborators. They include only the most significant insights – this is not an exhaustive list.

1. ***'A broad cross section of dedicated individuals at the table and a positive start keeps the adaptation process alive through the inevitable challenges.'*** **– The broad and dedicated membership of the Management Committee and a positive process are the foundation for an enduring adaptation initiative.**

A number of federal and provincial agencies, one regional district, one municipality, two First Nations and private interests have jurisdiction over lands, forests, water and infrastructure in the Somass basin. Several groups represent local environmental and use interests (e.g. naturalists, commercial fishers).

The project leaders first consulted senior and local government staff, First Nations and local stewards to determine their interest in pursuing a collaborative SBWMP. Following a very positive response, they convened the ad hoc Management

Committee with membership including representatives of the jurisdictions in the lower reaches of the basin, as an initial focus.

This breadth of involvement is a fundamental strength of the Committee and of the initiative. All of the individuals interviewed for this case study emphasized that their involvement in the Committee has been positive, and that they are committed to continuing even though there have been frustrations and disappointments.

2. *'Stay focused on shared values and be strategic to move forward on adaptation.'* – Shared concern about salmon and water as critical community values and an ongoing strategic focus on priority issues have helped the project overcome multiple challenges.

Strong, shared concerns about the future for salmon and water in the Somass basin initially brought the participants in this project together. Almost immediately they faced the need to be strategic in their decisions. Although there was interest in tackling a wide range of adaptation issues in the basin -- including integrated land use, stream-side riparian area management and recreation management – the Management Committee chose to focus on water management and related infrastructure.

The project has maintained a consistent focus on developing solutions and implementing actions that will improve salmon survival in the face of future warm water events. It focused scientific and technical studies on the four potential adaptation strategies identified for the basin.

This narrow and sustained focus, along with a shared interest in improved water management and fish survival, has kept the Management Committee together and the project moving forward despite significant challenges.

The 2012 SBWMP identifies four priorities related to implementation: i) rebuild the Robertson Creek saddle dam (completed); ii) identify a new owner for the Catalyst dams; iii) establish a robust water management structure; and iv) upgrade critical infrastructure at the GCL and Sproat Lake dams. It also identifies additional adaptation actions that partners can implement while they work to resolve the barriers blocking implementation of these priorities

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3. *'Expect delays if governance is unclear and no strong champion emerges.'* – Where water management roles are unclear, there will be uncertainty about governance, with the potential for a leadership void that can delay adaptation.

Living Rivers organized a meeting, early in the planning process, designed to clarify roles and responsibilities of the organizations represented on the Management Committee.

This meeting and a Letter of Understanding between BCCF and the Hupacaseth First Nation created a solid understanding of interests, jurisdictional responsibilities, and potential roles.

Management Committee members recognize the seriousness of the issues in the Somass basin, and have collaborated effectively in creating the SBWMP.

It has not been possible, however, to clarify which organization(s) will be responsible for the highest priority adaptation measures – modernizing one dam and constructing cold water release infrastructure.

- Catalyst Paper Corp. no longer needs to maintain its water licenses and dams to meet its operational requirements, and there is uncertainty about who will take on this responsibility;
- While Fisheries and Oceans Canada has a mandate to address risks to salmon populations, the department is exercising this mandate less aggressively than in the past;
- the provincial government does not have an obvious governance role in this situation; and
- while the proposed adaptation measures address economic, cultural, water supply and flood hazard issues, and will likely benefit regional, municipal and First Nations governments, they are currently not a priority, particularly when the local economy and municipal tax revenues have declined with the severe downturn in

the forest sector.

No champion has yet stepped forward to lead this initiative or to press for resolution of this governance void.

The Management Committee sees the creation of a watershed management board or council – similar to those existing for other BC watersheds – as the solution. Committee members have invested significant effort in exploring this option; they remain optimistic that this void will be filled 'when the time is right', and they hope this will happen before another fisheries crisis occurs

4. *'Complex, expensive adaptation measures can exceed local capacity.'* – Local governments support adaptation, but they do not have the resources on hand to implement complex adaptation measures with high up-front or ongoing cost.

The Somass system is biologically complex, and management must meet water flow needs for wild salmon and other fish species, aquatic ecosystems, and hatchery operations, and provide for community water supply and flood control. The water management infrastructure in the system adds engineering complexity. No one agency or organization has all of the high-level skills required to manage this system.

Regional, municipal and First Nations governments represent stakeholders who may benefit from improved management and infrastructure improvements. These governments, however, do not currently have the resources to manage such complexity.

Local leadership is further hampered by the high costs of the identified adaptation options, particularly for dam modernization and reconfiguration to provide cold water releases.

The Hupacaseth First Nation explored the option of creating revenues to support adaptation by adding micro-hydropower capacity to the system. While a decision is pending on this option, the return on investment did not meet financial expectations.

Management Committee members have discussed other ways to build local capacity and fund adaptation, including development cost charges.

The ongoing liabilities associated with operating major dams have also discouraged local leadership.

The resource challenge combined with the jurisdictional gap has led the Management Committee to seek the creation of a water management board or council. Committee members also recognize that a new form of management may be required.

5. *'Get the science rlght to make a credible case for adaptation.'* – Especially when systems are complex, thorough scientific and technical studies are essential to verify climate change impacts, and explore the costs and benefits of adaptation options.

A primary objective of this project was to create a solid scientific and technical foundation for adaptation and identify feasible adaptation options. Studies focused on three potential adaptation strategies:

- Reduce existing migration bottlenecks within the Somass Basin;
- Install cold water infrastructure at two dams, and
- Improve dissolved oxygen levels in the upper Alberni Inlet.

Scientists from Living Rivers and the BC Conservation Foundation worked with Fisheries and Oceans Canada scientists and contractors to evaluate these strategies. They also recognized the value of local knowledge and compared scientific results with local views. Their scientific experience and respectful conduct were identified as fundamental to the credibility and acceptance of the completed studies and the recommended adaptation measures, particularly when the results were not consistent with local perspectives.

An outcome of the studies has been to 'bust community myths' about the factors affecting salmon productivity in the basin. One myth was that removal of the existing dams would allow the system to return to its natural state without affecting salmon productivity. A study found, however, that salmon productivity in the Somass system is higher today than before the dams were built. By ensuring adequate in-stream flows, and in most years,

tolerable temperatures for salmon migration during the summer, the dams have enhanced salmon productivity.

The credibility of the studies confirming the feasibility of cool water release is viewed as critical, because of the projected costs - an estimated $9-12 million to modernize the Great Central Lake dam, and an additional $5.3-6.7M to construct cold water outlets in Great Central ($5-5.5M) and Sproat lakes ($0.8-1.2M).

The studies also revealed that there are doable 'fixes' for the existing salmon migration barriers at fishways, and that the decomposing fibre mat at the mouth of the Somass River is likely not a significant barrier to migration

6. ***'Hire people with capacity and experience to manage the complexity.'* – An ongoing science/management team including seasoned scientific/technical expertise, skilled group facilitation and local coordination is essential for successful adaptation in complex situations.**

Experienced scientific personnel from Living Rivers and the BC Conservation Foundation have managed the project from its inception to now, reflecting and demonstrating the commitment of these organizations to the Somass planning process and its outcomes.

An experienced facilitator guided the initial work of the Management Committee, set the stage for positive working relationships between Committee members, and drafted the initial SBWMP report.

These project leaders, though committed, are all from outside the Somass basin. Living therefore hired a local coordinator, a respected resident of the Alberni area who knows people in the community, has connections, and is able to provide insight into what the community is thinking. Project partners recognize this individual as essential to the success of the project and Management Committee members appreciate access to this trusted local point of contact.

7. ***'Keep key stakeholders informed, with information that highlights why adaptation is needed.'* – Engagement of and communication with stakeholders need to be carefully timed, using credible, science-based information to secure support for adaptation.**

Through involvement in the SBWMP process, Management Committee and Forum members increased their knowledge about the Somass basin, climate change, flow regulation and adaptation options to support salmon resilience. Many informally shared their learning with colleagues, increasing transfer of knowledge within the basin.

Several Management Committee members identified public and political communication and engagement as areas they wished they had been able to focus on more. To this end, the 2012 SBWMP identifies 'raising broad awareness of the issues' as a critical requirement to moving forward and includes specific actions including construction of an interpretive centre in the basin and public outreach and education through open houses, public Forum meetings and media.

Several Committee members noted that there is currently little current public concern about the resilience of Alberni salmon – in part because there have been record salmon runs in recent years, and in part because the community is dealing with the immediate impacts of a downturn in the forest sector. There is a sense that until the Committee begins to make plans to implement specific short-term actions, the public won't be interested in the SBWMP process.

Local elected officials have attended some Management Committee meetings, and local government staff members attend regularly. It is possible that elected officials might have engaged more effectively if an economic study of the current value of Alberni salmon, and the potential impacts of spawning failures was available and clearly communicated.

The Somass River has been described as the most valuable salmon producing river on Vancouver Island. A 2003 report estimated the aggregate economic value of Somass wild and hatchery salmon in commercial and recreational fisheries at $4-9M/year. Updated information about the value of Alberni salmon, and who benefits from this resource is not readily available.

The 2012 SBWMP recognizes that 'before proceeding to the next level of detailed infrastructure design and costs, a compelling salmon conservation and economics case will need to be made with strong support from governments (including First Nations) and non-government organizations.' The plan does not, however, identify development of such a business case as a specific action.

8. 'The *adaptation process may take time, and needs ongoing funding; you may need to wait and be ready to act when the time is right*.' – Realistic expectations should be established up front about the time and resources needed to study and identify robust adaptation measures, with recognition that complex or expensive adaptation measures can only be implemented when the time is right.

Although the project partners and members of the Management Committee have expressed frustration with the seemingly slow pace of this process, and the lack of on-the-ground adaptation action to date, some individuals realize that the original timelines were likely optimistic. In such a complex adaptation context, it takes time to identify and respectfully engage stakeholders, to build relationships amongst partners and to clarify roles and responsibilities.

The partners then need to create a common understanding of the system, fill information gaps, identify potential adaptations, do feasibility studies, go back to the community for support and secure resources before they can implement the most robust adaptation measures, and monitor their effectiveness over the long term. It is reasonable to expect that this chain of activities will take a number of years in a such a complex system.

Partners recognize that the existing absence of an organization willing to take on ownership of the dams is a barrier to dam modernization and the development of cold water release mechanisms, and could delay implementation of adaptation measures by 5 to 10 years. There is a chance that another warm weather event could occur during this period, resulting in another disruption to salmon spawning.

The length of the process also underscores the need for ongoing funding, or the ability to readily access funds when needed. Security of ongoing funding for this initiative is lacking. Project partners have suggested that there is now enough information in place to justify developing a 5 year financial and funding plan, and ensuring that the Committee has projects 'on the shelf' and can move swiftly 'when the timing is right'.

CONTINUING TO ADVANCE ADAPTATION

The SBWMP is considered a "living plan" that will evolve as new information emerges and will be implemented in stages as resources become available.

SBWMP partners plan to augment the existing body of scientific and technical work completed to date if and when funding can be obtained.

The next priority stage of the project calls for identifying a viable long-term owner for the Great Central Lake dams – an owner with the financial resources to operate and maintain the existing infrastructures, to complete necessary renovations, and to provide for the cold water flows to support the long-term survival of sockeye populations in the basin.

In the interim the project partners expect to move forward on those aspects of the plan that can be implemented with available resources. The 2012 SBWMP identifies 20 actions to achieve management objectives for defined segments of the system. These actions include continuing to monitor local climate and salmon behavior, commissioning further technical studies, and engaging with the forestry, agriculture and development sectors to promote maintenance of streamside riparian vegetation to minimize stream temperatures.

The Management Committee will review results from further technical studies, monitor developments regarding dam ownership and water license transfer, and continue to work towards establishment of a local watershed management board or council to provide long-term community leadership, accountability and governance.

The shared values, goodwill and solid working relationships established through the SBWMP process, as well as the clear and credible directions in the 2012 SBWMP, provide the momentum for the Management Committee to continue to advance adaptation in the basin.