Consultative Committee Report

June 2003

Prepared on behalf of:

The Consultative Committee for the Ash River Water Use Plan

Ash River Water Use Plan

A Project of BC Hydro

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This report was prepared for and by the Ash River Water Use Plan Consultative Committee, in accordance with the provincial government's *Water Use Plan Guidelines*.

The report expresses the interests, values and recommendations of the Committee and is a supporting document to BC Hydro's Ash River Water Use Plan that will be submitted to the Comptroller of Water Rights for review under the *Water Act*.

The technical data contained within the Report was gathered solely for the purposes of developing the aforementioned recommendations, and should not be relied upon other than for the purposes intended.

EXECUTIVE SUMMARY

A Water Use Plan (WUP) is a technical document that, once reviewed by provincial and federal agencies and accepted by the provincial Comptroller of Water Rights, defines how water control facilities will be operated. The purpose of a water use planning process is to develop recommendations defining a preferred operating strategy using a multi-stakeholder consultative process.

The Ash River water use planning Consultative Committee process was initiated in September 2000 and completed in June 2002. The consultative process followed the steps outlined in the 1998 provincial government's *Water Use Plan Guidelines*. This report summarizes the consultative process and records the areas of agreement and disagreement arrived at by the Ash River Water Use Plan Consultative Committee (Consultative Committee). It is the basis for the draft Ash River Water Use Plan. Both the Ash River Consultative Committee Report and the draft Ash River Water Use Plan will be submitted to the Comptroller of Water Rights.

Ash River hydroelectric facility

The Ash River hydroelectric facility is located approximately 40 km northwest of Port Alberni on central Vancouver Island. The Ash River flows south, between Strathcona Park to the west and the Beaufort mountain range to the east, into the Stamp and Somass Rivers, and eventually into the Alberni Inlet.

The Ash River hydroelectric facility is a one reservoir system. Water flows from an intake on the south side of Elsie Lake Reservoir through 7.4 km of tunnels and penstocks to the powerhouse on the north shore of Great Central Lake.

The Consultative Committee

The Ash River Water Use Plan Consultative Committee consisted of fifteen representatives. Interests included power, fish, wildlife, First Nations archaeology and traditional use, recreation, consumptive use and water quality, and flood control. The representatives included BC Hydro, provincial and federal agencies, Tseshaht First Nation, Hupacasath First Nation, local stakeholders and industry. The main Consultative Committee and Subcommittees held a total of 23 meetings, ultimately reaching unanimous acceptance of a preferred operating alternative for the Ash River hydroelectric facility, and a specified monitoring program.

The Consultative Committee explored issues and interests affected by the operations of BC Hydro's Ash River hydroelectric facilities and agreed to the following objectives for the Ash River Water Use Plan:

- First Nations
  Maximize protection of archaeological resources and opportunities for study and traditional use in Elsie Lake Reservoir drawdown zone; and maximize traditional use in the Ash River below the Elsie Dam.

- Fisheries
  Maximize the abundance of fish in Elsie Lake Reservoir and in the Ash River below Elsie Dam.

- Flood Management
  Minimize adverse effects of flooding on personal safety and property.

- Power
  Maximize the value of power generation produced at the Ash River hydroelectric facilities.

- Recreation
  Maximize recreational opportunities in Elsie Lake Reservoir and in the Ash River below Elsie Dam.

- Wildlife
  Maximize the area of riparian habitat around Elsie Lake Reservoir

Consensus on a preferred operating alternative

The Consultative Committee developed 28 water use objectives. Performance measures were identified based on these objectives. Where possible, performance measures were modelled quantitatively. In other cases, they were described qualitatively. Operating alternatives were then developed to address the various objectives. In total, 13 operating alternatives were run through BC Hydro's operations model and the consequences for each objective were discussed by the Committee based on the agreed-to performance measures. Of the 13 alternatives, four received varying levels of acceptance from Committee members. While several Committee members chose more than one option, one operating alternative, Alternative C, was unanimously accepted, on the condition of the specified monitoring programs, by all Committee members present on 25 June 2002.[1]

The Consultative Committee recommends that the Ash River hydroelectric facility be operated as designed subject to the following operating constraints (Table 1).

[1] On 8 May 2003 Hupacasath First Nation sent a letter to BC Hydro providing comments on the final Ash River Water Use Plan Consultative Committee Report. In the letter, they declared that they were withdrawing acceptance of Alternatives C, J and I2 and fully support Alternative K.

Table 1: Recommended Operating Constraints for the Ash River Hydroelectric Facility

Facility	Operating Variable	Target	When	Comments
Elsie Dam	Minimum discharge into Ash River from Elsie Dam	3.5 m^3/s	1 May to 31 October	Discharge measured at hollow cone valve and/or sluice gate
		5.0 m^3/s	1 November to 30 April	
		10 m^3/s	Two 48 hour periods between 1 August and 30 September[1]	Migration pulse flow measured at Moran Creek gauge
	Maximum discharge into Ash River	No constraint	Year Round	
	Maximum Ramping Rate	As per BC Hydro Ramping Strategy	Year Round	
Elsie Reservoir	Maximum Reservoir Level	No constraint	Year Round	No constraint on reservoir elevations
	Minimum Reservoir Level	No constraint	Year Round	
Power Intake	Diversion flow	No constraint	Year Round	No constraint on power diversion
	Maximum annual diversion volume	No constraint	Year Round	

1. Migration pulse flows: ramp discharge from Elsie Dam to increase flow in the Ash River up to 10 m^3/s, measured at Moran Creek gauge, then back down to 3.5 m^3/s over a 48 hour period. Induce two pulses during the summer steelhead migration period (1 August to 30 September) with each pulse coinciding with natural increases inflows from precipitation.

Consequences of the preferred alternative

The expected outcomes of the final recommended operating alternative are summarized in Table 2. Benefits over the existing water licence, include increased power revenue, increased opportunities to address archaeological and heritage issues, improved habitat for fish in the Ash River, and increased riparian habitat for wildlife around Elsie Lake Reservoir.

Although the Consultative Committee had an interest in minimizing impacts to fish resources in Great Central Lake and the Upper Stamp River, the Committee acknowledged that this issue was outside of the scope of the BC Hydro Ash River Water Use Plan. Nonetheless, an additional benefit of the Ash River water use planning process is agreement to develop a communications protocol between BC Hydro and NorskeCanada. Under the protocol, BC Hydro will provide advanced notice to NorskeCanada of planned changes to operations that will affect water delivered into Great Central Lake.

The communications protocol will also lead to a definition of *threshold of critical low flow* which will trigger discussions between BC Hydro, NorskeCanada, Fisheries and Oceans Canada and the Ministry of Water, Land and Air Protection. The four organizations, in consultation with the Water Comptroller, will make recommendations on how to adjust operations on both the Ash River and Great Central Lake systems to

protect fish resources in both systems in times of very low flows. In the event that changes are required to BC Hydro's operations, Hydro would have to apply to the provincial Water Comptroller for authorization. At the conclusion of the Ash River Water Use Plan consultative Committee process, the Great Central Lake Committee needed to conduct further studies and analysis to define this threshold of critical low flow.

Hupacasath First Nation also requested that a communications protocol with BC Hydro be developed to provide Hupacasath First Nation with advance notice when the reservoir is expected to drop below 318.5 m creating opportunities for archaeological study in the Elsie Lake Reservoir drawdown zone.

Table 2: Expected Outcome of the Ash River Water Use Alternative C Relative to Existing Water Licence

Water Use Interest	Consequences
Power Generation	+ Increased power revenue of +$600,000 per year on average (approximately 6% increase) over current water licence.
First Nation Archaeology and Traditional Use	+ Opportunity to address archaeology and heritage issues through the monitoring program.
Fish in Elsie Lake Reservoir	+ Increased trout rearing habitat in tributaries to the reservoir.
Fish in Ash River	+ Increased rearing and spawning habitat for fish in the Ash River including a nearly 14-fold increase in steelhead parr rearing habitat just below Elsie Dam relative to existing licensed flows.[1]
	+ Increased opportunities for fish to migrate past Lanterman Falls and Dickson Falls.
	+ Increased minimum flows in the Ash River.
Wildlife	+ Increase in riparian habitat around Elsie Lake Reservoir.
Flood control	o Neutral - No change in expected number of flooding-days for property along the Somass River compared to expected number of flooding-days under current water licence (i.e., Alternative C does not make flooding worse).
Reservoir recreation	- Potential loss. The recommended operating alternative is expected to hold the reservoir at lower elevations during 24 May to Thanksgiving than under the current water licence. This may change the type of or reduce the quality of the recreation experience at the reservoir.

[1] The actual flows released for fish at present and over the past five years (1996-2000) are substantially higher than the licensed flows and are similar to flows under Alternative C.

Monitoring Program

The Consultative Committee discussed sources of uncertainty associated with implementing the preferred operating alternative. Through the water use planning process and trade-off process, the Committee discussed six monitoring programs to address these uncertainties. Of these six programs, two satisfied the eligibility criteria for monitoring studies under the Water Use Plan Program. These included a monitoring program to address protection of archaeological artifacts in the Elsie Lake Reservoir drawdown zone and a program to assess the effectiveness of pulsed flows to promote adult steelhead migration which may be beneficial for other species (i.e. Coho and Chinook), in the Ash River.

The Consultative Committee recommends that an Ash River Water Use Monitoring Advisory Committee be formed consisting of representatives of:

- BC Hydro
- Fisheries and Oceans Canada
- Hupacasath First Nation
- Tseshaht First Nation
- Ministry of Water, Land and Air Protection
- Ministry of Sustainable Resource Management
- Community representatives (from existing Committee, if possible)
- Representative of local government (from existing Committee, if possible)

The Consultative Committee recommends that the mandate of the Ash River Water Use Plan Monitoring Advisory Committee is to:

- Review and agree to study terms of reference
- Review annual study results and assess need to recommend an early Ash River Water Use Plan review (in Year 5).
- Recommend improvements to monitoring programs within existing water use planning budgets. The Monitoring Advisory Committee may seek additional resources to contribute to the monitoring program.
- Determine annually whether there are recommendations to BC Hydro on operational changes within the constraints of the water licence.
- Support periodic communication with the public (e.g., newsletter, annual reports).
- Ensure publication of monitoring reports.
- Nurture cooperation and collaboration to improve the environmental database and to build common understanding (ongoing).

Review Period

- Five years after the implementation of the Ash River Water Use Plan, the Ash River Water Use Plan Monitoring Advisory Committee will review the results of the monitoring program and assess the need to recommend to BC Hydro an early review of the Ash River Water Use Plan. Alternatively, if the studies suggest that a review of the Ash River Water Use Plan is not needed, the Monitoring Advisory Committee can recommend when a review should be assessed.

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1 INTRODUCTION

Water use planning was introduced by the Minister of Employment and Investment (MEI)[1] and the Minister of Environment, Lands and Parks (MELP)[2] in 1996 as an approach to ensure provincial water management decisions reflect changing public values and environmental priorities. The purpose of water use planning is to understand public values and to develop a preferred operating strategy through a multi-stakeholder consultative process. The product, a Water Use Plan, is a technical document that, following review by provincial and federal agencies and approval by the provincial Comptroller of Water Rights, defines how water control facilities will be operated. The process for developing a Water Use Plan is prescribed in the provincial *Water Use Plan Guidelines* (British Columbia, 1998).

The Water Use Plan is intended to accommodate other water use interests through incremental changes in how existing water control facilities store and release water. While there may be opportunities to undertake physical works as a substitute for changes in flow, water use planning focuses primarily on a better use of water at facilities as they exist today. Water Use Plans are not intended to be comprehensive watershed management plans or to deal with water management issues associated with other activities in the watershed such as forestry or mining. First Nations rights and title issues and historic grievances arising from the initial construction of the facilities are specifically excluded from Water Use Plans, but can be considered as part of other processes (Province of British Columbia, 2000).

The Ash River Water Use Plan consultative Committee process was initiated in September 2000 and finished in June 2002. The purpose of this report is to document the consultative process and present the recommendations of the Ash River Water Use Plan Consultative Committee. The interests and values expressed in this report will be used by BC Hydro to prepare a draft Water Use Plan for the Ash River hydroelectric facility. This Consultative Committee Report is a record of the water use issues and interests discussed, and the trade-offs between different operating alternatives to meet stakeholder objectives. Both the Ash River Consultative Committee Report and BC Hydro's draft Water Use Plan will be submitted to the Comptroller of Water Rights.

[1] The Ministry of Employment and Investment responsible for electricity policy at the inception of the Water Use Plan program is now part of the Ministry of Energy and Mines.

[2] The Ministry of Environment, Lands, and Parks was reorganized in 2001 into the Ministry of Water, Land and Air Protection and the Ministry of Sustainable Resource Management.

2 DESCRIPTION OF THE ASH RIVER PROJECT

The Ash River hydroelectric facility is part of the BC Hydro Bridge River/Coastal Generation System. The Ash River is located within the Regional District of Alberni-Clayoquot on central Vancouver Island (Figure 2-1). The Ash River flows south, between Strathcona Park to the west and the Beaufort mountain range to the east, into the Stamp and Somass Rivers, and eventually into the Alberni Inlet.

The Ash River hydroelectric facility is a one reservoir system. Elsie Lake Reservoir is approximately 40 km north west of Port Alberni (Photo 2-1). Water flows from an intake on the south side of the reservoir through 7.4 km of tunnels and penstocks to the powerhouse on the north shore of Great Central Lake. Flows are also released from Elsie Dam to maintain fish habitat in the Ash River.

The current physical structures (Figure 2-2) comprising the Ash River project include:

- **Main Dam:** This primary dam is located at the eastern end of Elsie Lake Reservoir. The earthfill dam is 189.2 m long and 30.5 m high with a crest elevation of 334.37 m above sea level.
- **Saddle Dam 1**: The second primary dam is also earthfill, 438.1 m long and 18.3 m high.
- **Saddle Dam 2**: Earthfill dam 157.9 m long and 10.7 m high
- **Saddle Dam 3:** Earthfill dam 130 m long and 3 m high.
- **Saddle Dam 4:** Earthfill dam 51.6 m long and 6.1 m high
- **Low level outlet:** The low level outlet located at the base of Saddle Dam 1 is a 2.44 m diameter steel conduit 60 m long encased in concrete. The sill of the low level outlet (invert elevation) is at 313.34 m. At the downstream end of the conduit is the hollow cone valve to control supply of water to the Ash River for fish. When the reservoir is at full pool (330.71 m) the low level outlet has a maximum discharge capacity of approximately 55 m^3/s.
- **Freecrest overflow spillway:** The freecrest overflow spillway is located close to Saddle Dam 1. (Photo 2-1 and Photo 2-2). The left, centre and right spillway crest elevations are 330.71 m, 331.45 m and 331.14 m respectively. At reservoir elevations above 330.71 m, water flows over the freecrest overflow spillway and into the Ash River. The freecrest overflow spillway has a discharge capacity of approximately 1280 m^3/s when the reservoir elevation is at 334.37 m (dam crest).

- **Spillway sluicegate:** As part of the outgoing dam safety upgrade program (Appendix A), in 2001 BC Hydro constructed a new spillway sluicegate close to Saddle Dam 1. The spillway sluicegate has a discharge capacity of approximately 35 m^3/s when the reservoir is at full pool and is intended to supply water for fish in the Ash River in the event the low level outlet is out of service for maintenance.
- **Power Intake:** The power intake is located at the south shore of Elsie Lake Reservoir, 5 km southwest of the Main Dam with a sill (invert) elevation at 310.0 m. The power intake is a 3.35 m x 3.35 m concrete-lined tunnel opening and is comprised of 2 trashracks, a steel operating gate, and a bulkhead gate.
- **Ash River Powerhouse:** The Ash River powerhouse is located on the north shore of Great Central Lake and contains a single 27 MW capacity vertical shaft Francis turbine generator unit (Photo 2-3). Water is delivered to the powerhouse (turbine discharge) from Elsie Lake Reservoir through a 4 km long tunnel and a 3.4 km penstock. Once through the turbine, the water is discharged from the Ash River Generating Station into Great Central Lake.
- **Elsie Lake Reservoir**: Elsie Dam impounds Elsie Lake Reservoir. The reservoir covers approximately 658 ha (6.58M m^2) at full pool and has a live, usable storage of 84 million m^3. The normal operating range of the reservoir is between 315.47 m and 330.71 m. At elevations above 330.71 m, water flows over the freecrest overflow spillway.

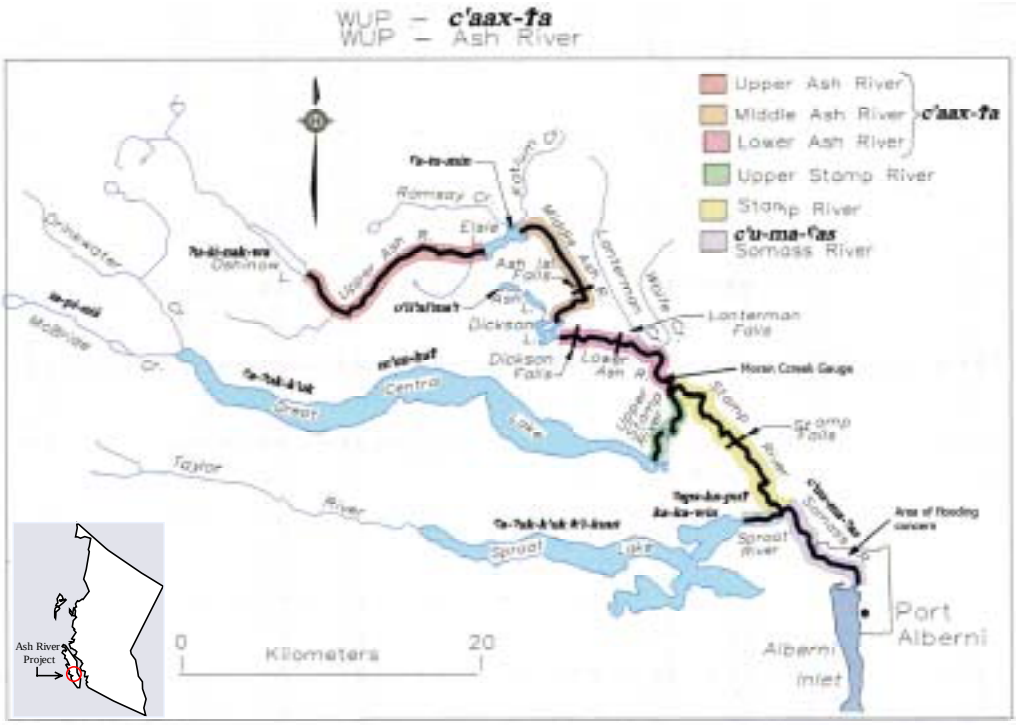


Figure 2-1: Place Names in Ash River Water Use Planning
(Map courtesy of Fisheries and Oceans Canada)

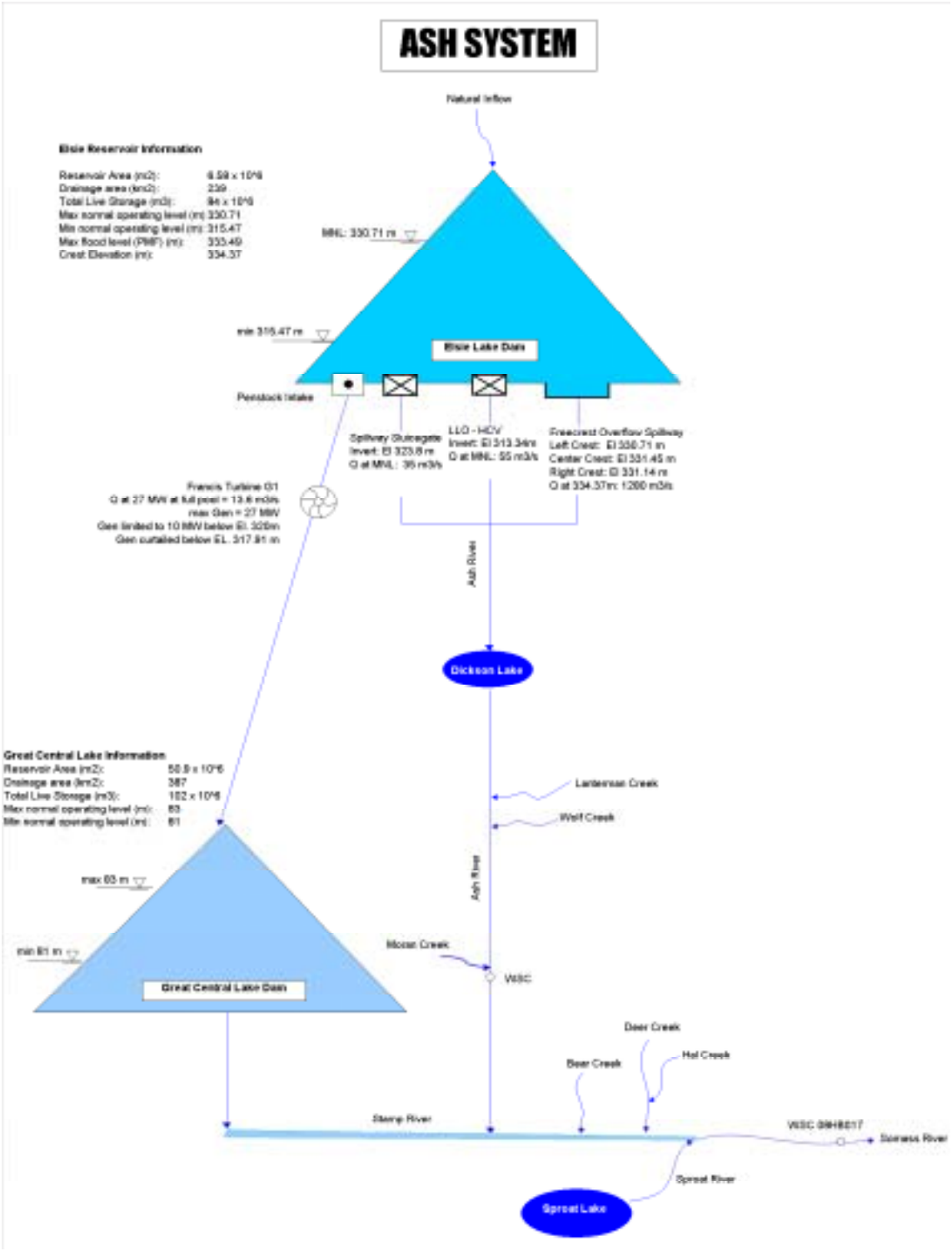


Figure 2-2: Schematic of Ash River Hydroelectric Facility

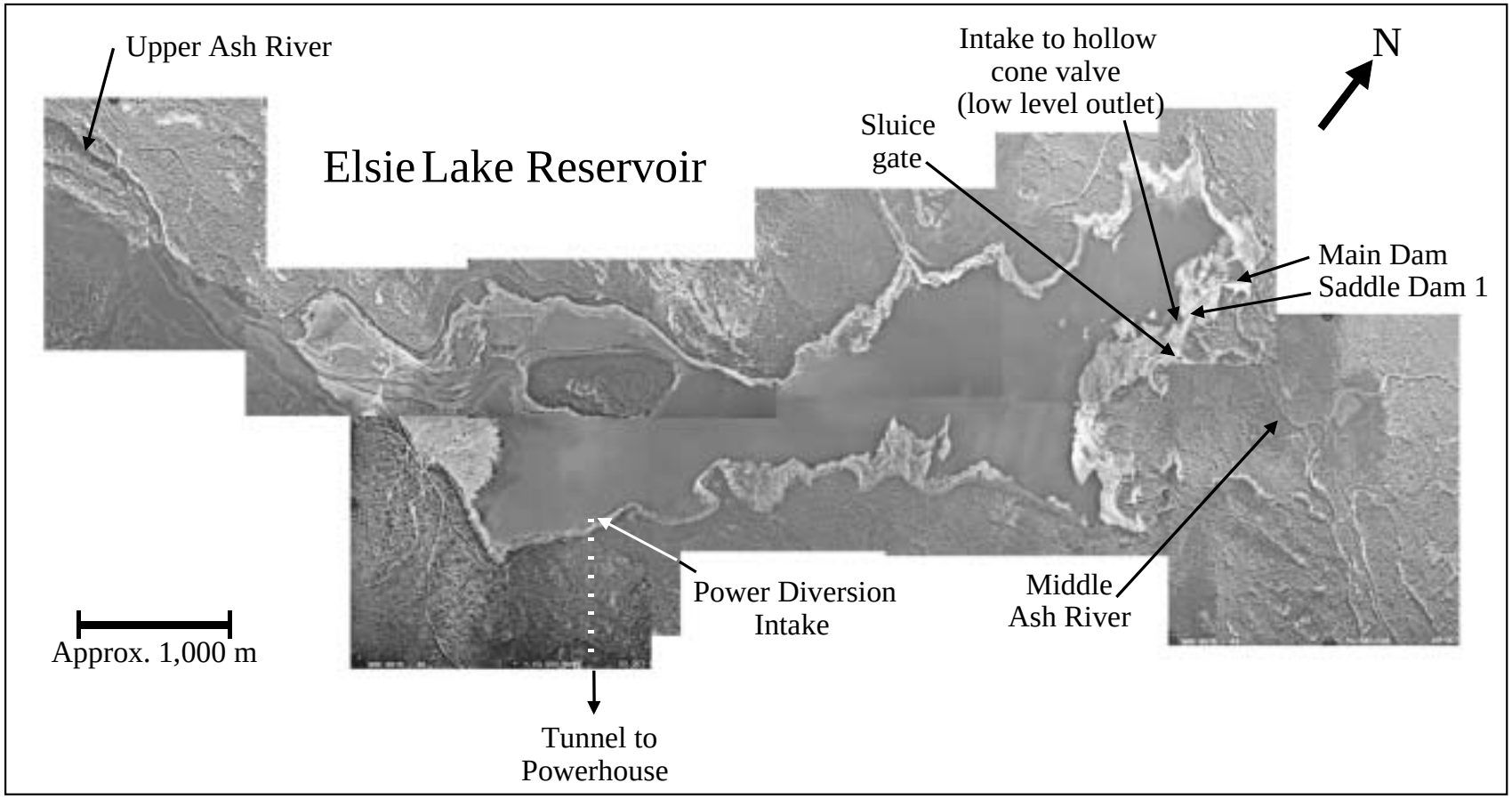


Photo 2-1: Elsie Lake Reservoir

Photo 2-2: Elsie Lake Reservoir Overflow Dam with Overflow Spillway and Sluice Gate, 2002

Photo 2-3: Ash River Powerhouse on Great Central Lake, 1999

2.1 Description of Plant Operation

Water stored in Elsie Lake Reservoir is diverted to the Ash River powerhouse on the north shore of Great Central Lake. The generating plant is normally operated as a base load plant running at relatively constant output for days or weeks at a time. At maximum generating output of 27 MW, turbine discharge is 15.01 m^3/s when the reservoir is at full pool elevation.

In addition to generating electricity, the Ash River powerhouse provides ancillary support to electricity supply on Vancouver Island. The generating station is equipped with back-up diesel generators and batteries. Following an outage the Ash River hydroelectric facility can be restarted without any external supply of electricity ("black start" capability). Once restarted electricity from the Ash River generation plant can provide electricity to restart other plants on Vancouver Island and provide voltage support for the electricity transmission system.

To have this ancillary support in reserve, generation at the Ash River powerhouse is limited to 10 MW when the reservoir drops below 320.04 m and the weather forecast does not anticipate inflows. The curtailment conserves sufficient water in storage to allow the Ash River hydroelectric facility to generate for several days in the event that other generating stations on Vancouver Island or the transmission line to Vancouver Island from the mainland are out of service.

When the reservoir elevation drops below 317.91 m generation will be curtailed to conserve water for subsequent fish flow releases. The primary purpose of curtailing generation is to conserve sufficient water to release into the Ash River for maintaining fish habitat. Also having a reserve of water in the reservoir allows the Ash River hydroelectric facility to generate electricity in the event of a system emergency such as when other generating stations or transmission lines are out of service. The Ash River hydroelectric facility can supply power to Port Alberni, Tofino and Ucleulet in the event that transmission lines between Port Alberni and the Vancouver Island Transmission Grid are out of service.

3 CONSULTATIVE PROCESS

The Ash River Water Use Plan consultative process followed the steps outlined in the provincial government's *Water Use Plan Guidelines* (Province of British Columbia, 1998). These steps provide the framework for a structured approach to decision-making (Table 3-1).

Table 3-1: Water Use Planning Process

Step	Components of Water Use Planning Process
1	Initiate Water Use Plan
2	Scope water use issues and interests
3	Determine consultative process
4	Confirm issues and interests of specific water use objectives
5	Gather additional information
6	Create operating alternatives for regulating water use to meet different interests
7	Assess trade-offs between operating alternatives
8	Determine and document areas of consensus and disagreement
9	Prepare a draft Water Use Plan and submit for regulatory review
10	Review the draft Water Use Plan and issue a provincial decision
11	Authorize Water Use Plan and issue federal decision
12	Monitor compliance with the authorized Water Use Plan
13	Review the plan on a periodic and ongoing basis

3.1 Initiation and Issues Scoping

On 11 September 2000, BC Hydro issued a news release to publicly announce the Ash River water use planning process and a public Open House held 27 September 2002. A newspaper advertisement followed in the *Alberni Valley Times* and in *The Pennyworth* to support the news release.

A copy of the news release was also mailed to approximately 200 residents in the Ash/Stamp/Somass watershed who had expressed an interest in the Elsie Dam Safety Upgrade Project. BC Hydro also solicited interest in the Ash River Water Use Plan from First Nations, agencies, organizations, industries, local governments, and other groups. Those contacted also suggested others in the community who may be interested. As well, BC Hydro responded to individuals who inquired about the advertisement or news release. Respondents received a questionnaire asking about their interests and issues. The local First Nations and tribal council were contacted directly to determine if they wished to participate in the process and to identify their interests.

BC Hydro summarized the identified interests and issues and submitted a summary report (*Issues Identification Report*, BC Hydro, 2001) to the Comptroller of Water Rights. This report completed Step 2 of the *Water Use Plan Guidelines*. Key interests identified:

- Power
- Fish
- Consumptive Use and Water Quality
- Recreation
- First Nations Archaeology and Traditional Use
- Wildlife
- Flood Management

3.2 Consultative Committee Structure and Process

The Ash River Water Use Plan Consultative Committee consisted of main table members and observers (Photo 3-1, Appendix B). Observers attended on a drop-in basis and provided input but could not participate in decision making. The Consultative Committee began with 20 members. Over the course of the water use planning process, some members opted to change their status, to observer from Committee member, or to alternate for another Committee member. Those who moved to observer status were comfortable that their interests were represented by other Consultative Committee members. Fifteen members actively completed the Ash River water use planning process.

In addition to the Consultative Committee, participants formed several Subcommittees (see Appendix B) to focus on specific issues and to provide technical advice to the Committee. These Subcommittees included:

- Fish Technical Subcommittee addressed fish and fish habitat issues in Elsie Lake Reservoir and the Ash River.

- First Nations Archaeology and Traditional Use Subcommittee addressed traditional use and archaeological issues at Elsie Lake Reservoir and the Ash River.

- Wildlife Technical Subcommittee addressed wildlife issues at Elsie Lake Reservoir and along the Ash River.

- Flood Control Subcommittee investigated flood impacts along the Somass River in the Beaver Creek Improvement District adjacent to the City of Port Alberni.

- Recreation Subcommittee addressed recreation concerns, including sport fishing, in Elsie Lake Reservoir and the Ash River.

Photo 3-1: Facilitator and members of the Ash River Water Use Plan Consultative Committee, 2002

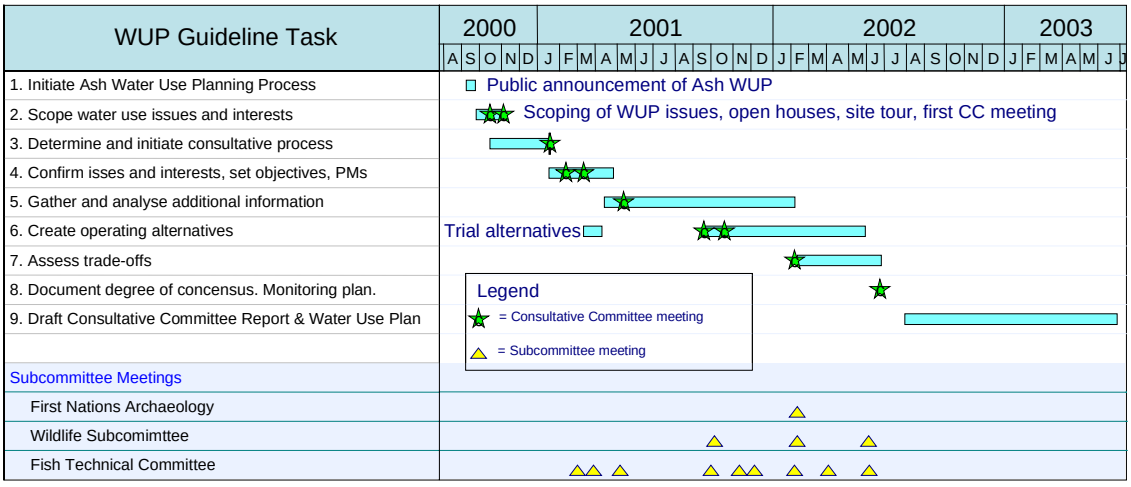


Figure 3-1: Schedule of Ash River Water Use Plan Consultative Committee and Subcommittee Meetings

In January 2001, the Consultative Committee developed and adopted a Terms of Reference and a consultation work plan. The Terms of Reference were included in the *Proposed Consultative Process Report: Ash River Water Use Plan*

(BC Hydro, 2001) and submitted to the Comptroller of Water Rights to fulfil Step 3 of the *Water Use Plan Guidelines*.

The Consultative Committee and Subcommittees met between October 2000 and June 2002 to complete the water use planning process. A site tour of the Ash River hydroelectric facilities was held on 8 November 2000. The consultative process included ten Consultative Committee meetings, nine Fish Technical Subcommittee meetings, three Wildlife Technical Subcommittee meetings, and one meeting of the First Nation Heritage and Archaeology Resources Subcommittee (Figure 3-1 and Appendix C). The Subcommittees also held conference calls and communicated by email.

Detailed meeting notes recorded the discussions and decisions made at meetings including conference calls. See Appendix D for a list of documents, including meeting notes, produced during the water use planning process.[1]

3.3 First Nation Involvement

The Ash River hydroelectric facility is in the claimed traditional territory of two First Nations, the Hupacasath First Nation and the Tseshaht First Nation. These bands are affiliated with the Nuu-chah-nulth Tribal Council (NTC). BC Hydro held introductory meetings in July 2000 with First Nation representatives from these two nations plus the Nuu-chah-nulth Tribal Council.

Based on discussions with Tseshaht First Nation representatives during the introductory meetings, and throughout the consultative process, BC Hydro understood that the Tseshaht First Nations' claimed traditional territory extended up the Somass River to near the confluence with the Sproat River. Since there was a potential for facility operations to affect the lower Somass River, Tseshaht First Nation representative joined the Consultative Committee. During the comment period for the draft Ash River Water Use Plan Consultative Committee Report, Tseshaht First Nation provided additional information indicating that their claimed territory included the Ash River hydroelectric facility.

An Aboriginal Relations Task Manager was assigned to the Ash River Water Use Plan. The Aboriginal Relations Task Manager worked closely with the Community Relations Task Manager and the Consultative Committee facilitator to: ensure information was provided to First Nations in a timely manner; offer assistance in reviewing the information; determine if resources were required to support First Nations involvement; and coordinate any tasks that involved the First Nations.

Two representatives from Hupacasath First Nation, one representative from the Tseshaht First Nation, and an NTC fisheries advisor to the Hupacasath First

[1] Kator Research Services prepared a reference list summarizing existing documents and reports related to the Ash River Hydroelectric facility.

Nation and Tseshaht First Nation participated at the main table of the Consultative Committee. In addition, representatives from the two First Nations and the fisheries advisor participated as members of the Fish Technical Subcommittee. Representatives from the Hupacasath First Nation were members of the First Nation Heritage and Archaeology Resources Subcommittee and the Wildlife Technical Subcommittee.

As part of the exchange of information in the Ash River water use planning process, the Hupacasath First Nation delivered a cultural awareness presentation to the Consultative Committee. The presentation described the historic relationship between First Nations people and the natural resources, and how people traditionally used and managed those resources.

In the initial stages of the Ash River water use planning process, the Hupacasath First Nation raised a number of historic grievance issues. When the historic issues raised by the Hupacasath First Nation were not resolved bi-laterally between BC Hydro and the Hupacasath First Nation, the Hupacasath First Nation commenced legal action as described in Section 3.5.

As per the provincial *Water Use Plan Guidelines* (British Columbia, 1998), the Consultative Committee Report is a record of the water use issues and interests discussed, and the trade-offs among different operating alternatives to meet stakeholder objectives. The purpose of this report is to document the consultative process and present the recommendations of the Committee to the BC Comptroller of Water Rights. First Nation rights and title issues and historic grievances arising from the initial construction of the facilities are specifically excluded from Water Use Plans as they are considered part of other processes.

3.4 Community Awareness and Communication

In September 2000, BC Hydro held a public open house in Port Alberni to promote awareness of the Ash River water use planning process and to invite potential participants.

During the Ash River water use planning process, BC Hydro issued four news releases and three newsletters to inform the public in the Alberni Valley about developments in the Ash River Water Use Plan. An update news release and newsletter were issued at the end of the following key consultative milestones - Steps 3, 6 and 8 of the *Water Use Plan Guidelines* Steps.

Materials related to the Ash River Water Use Plan and the consultative process were made available at the Port Alberni Library which served as a local resource for those who wanted to find out more about the work of the Consultative Committee and the Ash River water use planning process. The BC Hydro Water Use Plan Web site also provided information to those interested in the Ash River plan as well as those interested in other Water Use Plans for other BC Hydro facilities in the province.

As noted previously, the Aboriginal Relations Task Manager worked closely with the Community Relations Task Manager and Consultative Committee Facilitator to ensure information was provided to First Nations in a timely manner and to assist them, when requested to interpret the information provided.

3.5 Without Prejudice Agreement

On 10 January 2002, the Hupacasath First Nation filed a writ naming BC Hydro and the Province of British Columbia. Subsequently, on 25 February 2002, the Hupacasath First Nation filed a Statement of Claim citing unresolved past and ongoing impacts of BC Hydro Ash River hydroelectric facilities on aboriginal rights and title. The Hupacasath First Nation stated that they felt that those issues that could not be addressed in the Water Use Plan needed to be addressed. From the Hupacasath First Nation's perspective as there was no other forum to address their concerns, they commenced legal action. BC Hydro filed a Statement of Defence on 22 March 2002.

On 5 April 2002, BC Hydro sent a letter to the Consultative Committee notifying them of its decision to conclude the public consultative Committee phase of the water use planning process for the Ash River hydroelectric facility. BC Hydro concluded that the ongoing litigation with the Hupacasath First Nation would compromise what was intended to be an open, collaborative and inclusive process. In addition, BC Hydro did not want to risk further legal exposure by engaging in a public forum where one of the participants was actively pursuing a concurrent legal action to address issues concerning Ash River hydroelectric facility operations.

On 5 April 2002, BC Hydro issued a news release on its decision to conclude the public consultation Committee phase of the water use planning process for the Ash River hydroelectric facilities.

On 8 April 2002, BC Hydro communicated an action plan to the Consultative Committee in which project team members would contact Committee members on an individual basis to review the operating alternatives, conduct the trade-off analysis and receive input into the Consultative Report. BC Hydro also telephoned each Consultative Committee member to discuss the change in the consultative process.

During April and May 2002, the project team met with a number of the Consultative Committee members to review the operating alternatives and conduct the trade-off analysis. Several Consultative Committee members also formed the Alberni Valley Ash River Consultative Committee (AVARCC) to continue discussions and to make recommendations as a group to BC Hydro regarding a preferred operating alternative for the Ash River hydroelectric facilities. In late April 2002, BC Hydro and the Hupacasath First Nation initiated discussions to develop an agreement that would allow the consultative process to continue in an open and collaborative manner.

On 7 May 2002, BC Hydro and the Hupacasath First Nation signed a *without prejudice agreement* that enabled both parties to resume meetings of the Ash River Water Use Plan Consultative Committee. The Consultative Committee held its final meeting on 24 and 25 June 2002.

4 ISSUES, OBJECTIVES AND PERFORMANCE MEASURES

As per Step 4 of the provincial *Water Use Plan Guidelines,* the Consultative Committee stated specific **objectives** for the desired outcomes in dealing with water use issues. In defining the objectives, the participants articulated what they sought to achieve through incremental changes in BC Hydro operations (e.g., maximize fish production). For each water use objective, the Consultative Committee defined one or more **performance measures** to quantify how the objective will be measured (e.g., square metres of fish habitat). The Committee then used the performance measures to compare the benefits and trade-offs between different operating alternatives for the Ash River hydroelectric facility.

This section of the report provides a summary of the interests, objectives, and performance measures. Note that the presentation order of issues here does not imply any priority or relative importance among the issues.

For each issue below, we provide descriptive context for the issue followed by the objectives and performance measures**.** The performance measure column specifies how the performance measure will be calculated (e.g., number of days reservoir is above 329.5 m). Some performance measures have additional information such as of the location where the performance measure is calculated (e.g., gauge at Moran Creek) or the relevant time of year (e.g., 24 May to 15 October for reservoir recreation interests).

The fourth column in the tables is the **Minimum Significant Incremental Change** (MSIC). MSIC is the amount by which two alternatives must differ on a performance measure score before one alternative can be considered to perform significantly better than the other. A difference equal to or less than the MSIC means the two alternatives perform equally on that objective.

For instance, consider two operating use alternatives. Alternative X provides $10.0 million in power revenue and Alternative Y provides $10.1 million. Based on the power revenue performance measure it would appear Alternative B provides a gain of $100,000 in revenue. However, there is variation in the amount of electricity generated depending on differences from year-to-year in weather and inflows. Furthermore, the market price of electricity is based on estimates and assumptions. Therefore, the power revenue estimate has an error or MSIC of ± $200,000. If the difference between the two alternatives is equal to or less than the MSIC, the Committee should consider the two operating alternatives to provide the same power revenue.

The measure of a significant difference is defined to be the largest of the following sources of uncertainty:

- Statistical variation arising from annual fluctuations in inflows

- Modelling error in calculating discharge from the reservoir and reservoir elevations
- Modelling error in the calculation of Performance Measures
- Uncertainty in the link between the performance measure and the fundamental objective[1]
- Measurement error

This section of the report also describes studies the Consultative Committee undertook to better understand the relationship between BC Hydro operations and the resource values. For example, how does fish habitat in the river vary with water discharge. The studies also provided information to assist the Consultative Committee in establishing and calculating performance measures. See Appendix D for a list of documents generated by the Ash River water use planning process. See Appendix E for the eligibility criteria for water use planning studies.

4.1 Power Generation

4.1.1 Issue - Power Generation

The Ash River powerhouse currently generates approximately 193 GW.h annually providing electricity to central and west coast Vancouver Island. The output from the facility can supply the equivalent of approximately 20 000 homes. The estimated value of this electricity exceeds $9 million per year.

In addition to generating electricity, there are two issues around the ancillary support that the Ash River hydroelectric facility provides to electricity supply on Vancouver Island. First, the Ash River powerhouse self-sufficient in restarting generation following an outage (see Section 2.1 for details). Once restarted, the Ash River powerhouse can then provide an external supply of electricity to restart other hydroelectric facilities on Vancouver Island. Second, the Ash River powerhouse provides voltage support to the transmission system to induce the flow of electricity. Any operating alternatives needed to consider these ancillary services provided by the facility.

A third issue around power is the efficiency with which different operating alternatives were also to achieve from the inflows into the reservoir. Is the water being stored and used for generation when needed, or does a particular operating alternative cause water to be spilled unnecessarily?

[1] For example, will increasing the square metres of fish habitat lead to higher fish production?

4.1.2 Objectives and Performance Measures - Power Generation

The Consultative Committee developed three power objectives (Table 4-1). The first is to **maximize the value of electricity** with a performance measure of **dollars of electricity revenue per year.**

The second power objective is to **maximize the ancillary services**. The performance measure was based on an index derived from the ability of the Ash River powerhouse to provide startup electricity to other generating stations and to provide voltage support for the transmission system. The index sums the number of days the reservoir contains enough water for several days of emergency generation (i.e., elevation greater than 318 m) weighted by a factor (0.5 or 2.0) depending on time of year.

Plant availability index = sum of:

0.5 × [Days reservoir is > 318 m 1 April to 30 June]
2.0 × [Days reservoir is > 318 m 1 July to 9 September]
0.5 × [Days reservoir > 318 m 10 September to 30 November]
2.0 × [Days reservoir is > 318 m 1 December to 31 March]

The third power objective is to **maximize the efficient use of inflows to the reservoir**. Given a finite amount of water flowing into the reservoir each year, how efficiently is the water used for generation? The performance measure is the ratio of **MW.h generated per acre-foot of inflow**.

Table 4-1: Objectives and Performance Measures - Power Generation

Objectives	Performance Measures	Location	Minimum Significant Incremental Change
Maximize the value of electricity to BC Hydro and the province	Dollar Value of energy production	Ash Generating Station	± $200,000
Maximize availability of voltage support, black start capability and local generation	Plant availability index	Ash Generating Station	± 24 index units
Maximize utilization of inflow to reservoir	MW.h generated per acre-foot of inflow	Ash Generating Station	± 0.1 MW.h per acre-foot

4.1.3 Power Studies

A key precursor to calculating performance measures for power and other interests was to have data on inflows into the reservoir. Historic inflows were not recorded directly by instruments. BC Hydro Resource Management estimated reservoir inflows from records on reservoir elevations and discharges from Elsie Dam. This process recreated 38 years (1963 to 2000) of inflow data for modelling the various operating alternatives.

4.2 Recreation

Recreation interests focussed on recreation on Elsie Lake Reservoir and recreation on the Ash River. Ultimately, river recreation was not pursued as an Ash River water use planning issue and the rationale is described in Section 4.7.1.

4.2.1 Issue - Reservoir Recreation

Elsie Lake Reservoir is utilized for boating, fishing, camping, viewing of the reservoir and wildlife, and to a lesser extent for swimming. For fishing, the reservoir offers rainbow and cutthroat. There are several large, gently sloping beach areas suitable for picnicking and wilderness camping. The reservoir is approximately 40 km from Port Alberni and is accessible by logging roads.

There are two recreation periods of interest. The first is during a spring trout fishery in the reservoir from April to June. The second period is summer recreation from 24 May to 15 October, which also includes a fall fishery from September to October. Fishing success in the reservoir is lower in the summer because of elevated water temperatures.

The interest is in maintaining the appropriate reservoir level during the summer recreation periods. The reservoir should be high enough to cover the stumps and the drawdown zone for visual aesthetics and provide easy access to carry cartop boats to the water. At the same time, the water should not be too high as to limit the area of usable beach.

4.2.2 Objectives and Performance Measures - Reservoir Recreation

The Consultative Committee developed two reservoir recreation objectives (Table 4-2) based on desired reservoir elevations.[1] For the fishing interest, the objective is to **maximize reservoir fishing experience** with a performance measure of **number days the reservoir is above 329.5 m from 1 April to 30 June**.

For recreation the objective is to **maximize the recreation opportunities on Elsie Lake Reservoir**. Previous studies (McDaniels Research 1995, Van Dijk 1995), which consulted local users, identified two preferred reservoir elevations for recreation activities. The preferred elevation is above 329.5 m. Second, less preferred but acceptable levels are elevations above 327.5 m. Hence, the performance measures counted the **number of days each operating alternative maintained the reservoir at/or above 329.5 m and 327.5 m from 24 May to 15 October**.

[1] Desired reservoir elevation levels from the BC Hydro Ash River Project Recreation Assessment (Van Dijk, 1995).

Table 4-2: Objectives and Performance Measures - Elsie Lake Reservoir Recreation

Objectives	Performance Measures	Location	Minimum Significant Incremental Change
Maximize reservoir fishing experience	No. days reservoir elevation is above 329.5 m, 1 April to 30 June	Elevation measured at the intake to the power diversion	± 25 days
Maximize recreation opportunities in Elsie Lake Reservoir (covers boat access, boating safety, aesthetics)	No. days reservoir elevation is: ▪ Above 329.5 m (preferred) ▪ Above 327.5 m (acceptable) 24 May to 15 October	Elevation measured at the intake to the power diversion	± 25 days

4.3 Flood Control

4.3.1 Issue - Flood Control

There are several areas along the Somass River susceptible to flooding. These areas include 12 properties along Ferguson Road, parts of the Hupacasath First Nation Reserve, parts of the Tseshaht First Nation Reserve, a large farm on Bigmore Road near the cedar mill, Collins Farm, Beaver Creek Trailer Park - Busby's, and Stamp Falls Park that flood periodically. Residents in the Ferguson Road area recount that the last large flood occurred about 10 years ago with a smaller flood 3 years ago.

The Consultative Committee identified a number of factors that likely contribute to flooding of properties along the Somass River. First, there is a bedrock constriction in the Somass River at Paper Mill Dam which restricts river flows and cause river flows to back up above the constriction. Second, high marine tides contribute to backing up water above Paper Mill Dam. Third, during periods of high river discharge, the high flows add to the water backed up above Paper Mill Dam. All three factors contribute to property flooding along the Somass River upstream of the constriction.

The number of consecutive days of high Somass River discharge is also a factor in whether or not high discharge leads to flooding. If the high discharge greater than 650 m^3/s lasts one day, the flood plain can absorb much of the flow over the banks. However, if flooding lasts several days, the water continues to back up behind Paper Mill Dam leading to flood damage.

To some extent, BC Hydro controls discharge from Elsie Lake Reservoir, either through the hollow cone valve (low level outlet) or through the diversion to the generating station. However, once the reservoir is full and begins to spill over the spillway, outflows are largely a factor of inflows to the reservoir from precipitation and snow melt. Simultaneous releases from Elsie Lake Reservoir and Great Central Lake coupled with high marine tides and heavy rainfall can cause the Somass River to back up and flood properties. While the influence of

BC Hydro operations to further reduce flooding is small, the Consultative Committee did not want to select an operating alternative that made flooding worse.

The Consultative Committee investigated the contribution of releases from Elsie Lake Reservoir to the number of flood days along the Somass River. A review of discharge records from the Somass Water Survey of Canada gauge over 33 years of available data (33 years of usable data between 1963 and 2000) showed a total of 12 017 flood-free days when flows in the Somass River were less than 650 m^3/s. Of the total 12 045 days in the 33 year period, there were 28 days when discharge was 650 m^3/s or greater.

Releases from Elsie Lake Reservoir into the Ash River contribute marginally to flooding along the Somass River. If Ash River flows are subtracted from Somass River flows, the number of flood-free days increases by four days to 12 021 flood-free days (conversely flooding days decrease by 4 days). The analysis showed that the majority of flow in the Somass River during flooding is from Great Central Lake and unregulated tributaries to the Ash, Stamp, and Somass Rivers. Nonetheless, releases into the Ash River can exacerbate flooding along the Somass River. Note that Elsie Lake Reservoir has limited storage capacity and once it is full and begins to spill, there is no capability to hold back water to reduce flows in Ash River.

While the Consultative Committee acknowledged that BC Hydro's influence on Somass River levels during flooding was small, releases from Elsie Lake Reservoir into the Ash River may exacerbate flood problems by adding incremental discharge to exceed 650 m^3/s in the Somass River or by keeping the Somass River high for an extended period. Hence, the Committee included a Performance Measure to check that operating alternatives did not make flooding worse.

4.3.2 Objectives and Performance Measures - Flood Control

The objective is to **maximize the number of flood free days**. The Consultative Committee reviewed resident's records of flood events and the data from the Water Survey of Canada (WSC) gauge on the Somass River near Ferguson Road. The data suggested that flooding occurred when river flows rose above 650 m^3/s. Therefore, the flood control performance measure is the **number of days flows measured at the Somass Water Survey of Canada gauge were less than 650 m^3/s over the 38 years of simulated operations** (Table 4-3).

Table 4-3: Objectives and Performance Measures - Flood Control

Objectives	Performance Measures	Location	Minimum Significant Incremental Change
Minimize the negative impacts of flooding on property	No. days discharge is less than 650 m^3/s over 38 years of simulated operations	Somass Water Survey of Canada gauging station	± 1 day

4.4 First Nations Archaeology and Traditional Use

4.4.1 Issues - First Nation Archaeology and Traditional Use

First Nation communities have traditionally depended on the natural resources on the land and in the water. There is evidence of such resource use in and around Elsie Lake Reservoir. An archaeological overview survey, conducted as part of the water use planning process, revealed 26 archaeological sites in the reservoir drawdown zone. Eleven of the sites contained lithic (stone chips) scatters and stone tools, including one site containing over 1000 artifacts. The lithics and stone tools are estimated to date between 1500 and 7000 years before present. Fifteen of the sites contained culturally modified tree stumps. The trees had been logged during construction of the reservoir, but the stumps of these culturally modified trees showed that First Nations were collecting bark and planks between 1737 and 1889. There are likely other First Nation archaeological resources along the banks of the original Ash River, now covered by reservoir waters, and possibly along the existing Ash River below the dam.

First Nation interests around archaeology resources focussed on protecting archaeological values and providing opportunities for traditional use in the reservoir drawdown zone. One issue is the potential risks of reservoir operation and wave action on the archaeological resources. However, the impact of reservoir operations and wave erosion remains to be quantified. A second issue is the risk of unauthorized persons (collectors) removing artifacts from the sites. The Hupacasath First Nation are also interested in providing for continued archaeological study in the drawdown zone and for community education around the archaeology sites.

In addition to protecting heritage resources, both the Hupacasath First Nation and the Tseshaht First Nation are interested in providing ongoing opportunities for spiritual and traditional use in and around the reservoir and Ash River. Traditional uses included gathering plant materials that grew around the lake before the creation of the reservoir. There is an interest in creating conditions around the reservoir where these traditionally used plants could grow again. Spiritual practices in and along the river included spiritual bathing and seeking spiritual solitude. For the Hupacasath First Nation, the regulated flows in the Ash River do not offer the same river conditions as historically, particularly in fall and winter, which are suitable for spiritual bathing and other traditional uses. Spiritual bathing is thought to require higher winter flows though the desired river characteristics remain to be defined.

Downstream, the Tseshaht First Nation were interested in installing fish weirs on the Somass River near Paper Mill Dam. However, summer flows today are augmented by releases from Elsie Lake Reservoir and the Tseshaht First Nation deemed the flows too high to fish in this traditional manner.

Within the scope of Ash River Water Use Plan, the Consultative Committee addressed archaeological resources and traditional use interests around the reservoir and spiritual/traditional use interests along the Ash River.

4.4.2 Objectives and Performance Measures - First Nations Archaeology and Traditional Use

There are four archaeology and traditional use objectives (Table 4-4). Two objectives focussed on **maximizing protection of First Nation archaeological resources from unauthorized collection** and **maximizing protection of First Nation archaeological resources from wave erosion**. The performance measure is the **number of days the reservoir was above 328 m** to cover and protect the sites with water. The performance measure for protection from wave erosion is the **number of days reservoir elevation was outside the range 327.0 to 328.5 m.**

A third objective is to **maximize opportunities for study and traditional use in the drawdown zone** by providing access to the drawdown zone and provide opportunities to collect reed vegetation. The performance measure is **number of days the reservoir was less than 317.5 m.** Note that many of these objectives conflict with one another, some requiring a high reservoir while others required a low reservoir at the same time. The relative priorities were discussed in the trade-off process.

The fourth objective is to **maximize traditional use in the Ash River** by providing opportunities for traditional activities, such as spiritual bathing in the Ash River. The performance measure is **whether an operating alternative offered a more naturalized flow pattern in the Ash River (1 = yes) or not (0 = no)**. A more naturalized flow pattern would create conditions similar to those before construction of Elsie Dam.

Table 4-4: Objectives and Performance Measures - First Nations Archaeology and Traditional Use

Objectives	Performance Measures	Location	Minimum Significant Incremental Change
Maximize protection of First Nation archaeological resources in Elsie Lake Reservoir drawdown zone from unauthorized collection	No. days reservoir is above 328 m, year round	Measured at intake to power diversion	± 20 days
Maximize protection of main archaeological site from wave erosion	No. days reservoir is outside the range 327.0 to 328.5 m, year round	Measured at intake to power diversion	± 15 days
Maximize opportunities for study and traditional use in the Elsie Lake Reservoir drawdown zone	No. days reservoir is < 317.5 m, year round	Measured at intake to power diversion	± 15 days
Maximize traditional use in the Ash River	1 = yes naturalized flow pattern 0 = no naturalized flow pattern	Total releases from Elsie Dam	Any difference is significant

4.4.3 Studies - First Nation Archaeology

The Hupacasath First Nation conducted an archaeological inventory and impact assessment in the reservoir drawdown zone in the summer and fall of 2001. The timing of the study coincided with remediation work on Elsie Dam which required drawing down the reservoir. The low reservoir levels exposed the drawdown zone to approximately the 317.5 m level. The survey identified and recorded numerous archaeological sites in the drawdown zone. The survey was carried out with a permit issued under the Heritage Conservation Act and conducted to Heritage Branch standards.

The study provided information confirming the presence of archaeological resources. It also helped establish the desired reservoir elevations in the performance measures that would protect those archaeological resources and provide access for study and collection.

4.5 Fish

Elsie Lake Reservoir and the Ash River provide a variety of habitats for numerous species of fish and other aquatic organisms. In addition, fish in Elsie Lake Reservoir and Ash River support an active recreational fishery and contribute to fish stocks for the west coast commercial fishery. BC Hydro operations can affect fish populations through changes in water levels in the reservoir and changes in flows in the Ash River. Fish issues in the reservoir and in the Ash River are described separately below.

4.5.1 Elsie Lake Reservoir - Fish

Rainbow trout (*Oncorhynchus mykiss*), cutthroat trout (*O. clarki*), and steelhead (*O. mykiss*) are present in the Elsie Lake Reservoir. Kokanee (*O. nerka*), though not common, have also been observed in the reservoir (Triton, 1995). Trout and kokanee reside in the reservoir. A steelhead stocking program ended a number of years ago. Other species, such as Pacific lamprey, have inhabited the reservoir but it is unknown if the species is still present. The Fish Technical Subcommittee discussed no net loss of trout habitat in the reservoir. In the absence of detailed information on Elsie Lake Reservoir, the Fish Technical Subcommittee suggested that managing for trout would also benefit other species (e.g., kokanee) in the reservoir.

Throughout the discussions at the Fish Technical Subcommittee the Hupacasath First Nation reported that according to Traditional Ecological Knowledge there were coho in the reservoir historically.

4.5.1.1 Issues - Reservoir Fish

Based on the available information on trout habitat and populations in the reservoir, the Fish Technical Subcommittee judged that the limiting factors were primary food production, spawning habitat and rearing habitat.

Two distinct areas in and around the reservoir were analysed: the tributary streams and the reservoir proper. For the purposes of analysis, the reservoir was divided into two zones: the euphotic zone, which is the sunlit uppermost layer of water in the reservoir; and the littoral zone, the sunlit shallow areas along the margin of the reservoir. Both zones support primary production and are used by fish and invertebrates. However, only the littoral zone supports periphyton (algae attached to rocks) and macrophytes (rooted aquatic plants). The littoral zone is affected by reservoir drawdown, because the dewatering can kill periphyton and macrophytes, so littoral habitat was weighted based on whether it was wetted continuously throughout the growing season (March through September). This weighted littoral zone was called the 'effective littoral zone'. Different operating alternatives can affect the primary productivity of the euphotic and littoral zones of the reservoir.

There was little specific information on the life stage needs of trout specific to Elsie Lake Reservoir. However, based on knowledge of the behaviour of these species on Vancouver Island, the Fish Technical Subcommittee suggested that within specific periods of the year the trout spawned and reared in the streams and the upper Ash River that flow into the reservoir. At issue was access into the tributaries, the relationship between reservoir elevations and inundation of the tributary habitat, and the timing of these events (Figure 4-1).

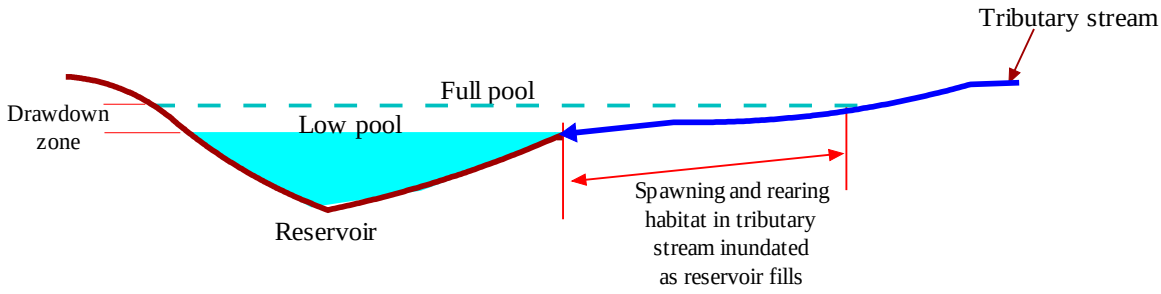


Figure 4-1: Trout Spawning and Rearing Habitat in Tributary Streams to Reservoir Inundated as Reservoir Fills

There are 20 tributaries, including the upper Ash River, flowing into the reservoir. The upper Ash River accounts for 87% of the available trout spawning habitat. The Consultative Committee considered trout out-migration from the tributaries into the reservoir, but deemed this was not an obstacle for trout movement.

Reservoir Fish Issues Investigated but Not Pursued

The Fish Technical Subcommittee discussed the issue of fish being entrained into the intakes of the hollow cone valve and the power intake. The entrainment issue did not include fish carried over the spillway. Fish can survive being carried over the spillway whereas fish entrained into the hollow cone valve or power intake suffer high rates of mortality. Entrainment was thought to be more of a problem during low reservoir levels when the fish are concentrated into a smaller volume of water. This suggested that the relative effects of entrainment could be

modelled over time. However, there was little information on the number of fish killed by entrainment. The Consultative Committee agreed that possible solutions to entrainment, including improved screening on the intakes, were outside the scope of the Ash River Water Use Plan. The Consultative Committee did not pursue entrainment for three reasons:

(1) this is a regulatory issue, and the regulatory agencies and BC Hydro are continuing to look at entrainment on a province-wide basis;

(2) improvements to the entrance to the low level outlets, as a result of the dam safety works in 2002, would reduce entrainment; and

(3) the Water Use Plan Management Committee and the Fisheries Advisory Team are continuing to look at entrainment on a province-wide basis.

4.5.1.2 Objectives and Performance Measures - Reservoir Fish

There are four objectives for managing fish in Elsie Lake Reservoir (Table 4-5). Two objectives focussed on maximizing primary production by maximizing euphotic volume and maximizing effective littoral zone. Production in the euphotic zone is maximized with a full reservoir (maximum surface area of the reservoir). Therefore, the performance measure for euphotic volume is measured in millions of m^3 days of reservoir volume to a depth of 11 m. The 11 m depth is the estimated depth of light penetration, a value approximated by the Secchi depth.[1]

Annual littoral production is maximized when the reservoir is stable and the littoral ecology can develop undisturbed from year-to-year. When water levels fluctuate because of reservoir operations, the ability for algae, macrophytes and associated aquatic communities to establish is limited by the duration that the zone is wetted and receives sufficient sunlight. Both decreases in water levels (exposure and desiccation) and increases (too deep for light penetration) will limit littoral production. Another factor is the shape of the reservoir bottom with littoral area increasing rapidly between 315 m and 326.6 m reservoir elevation reflecting the gentle slope of the reservoir basin between those elevations. The littoral zone performance measure is the **hectares of effective littoral zone** (to 11 m water depth).

The third and fourth objectives are to maximize trout spawning habitat and maximize trout rearing habitat in tributary streams within the drawdown zone. The trout spawning Performance Measure measures the area of trout spawning habitat (m^2) available in tributaries within the drawdown zone. When the reservoir level is at full pool, there is no stream habitat within the drawdown zone for spawning. At lower reservoir levels, there is substantial habitat in streams within the drawdown zone for spawning. If trout spawned in streams within the

[1] Secchi depth: The depth at which a disk, painted in a high contrast black and white pattern, disappears from sight. Secchi depth is a proxy for water clarity and the depth to which sunlight can penetrate.

drawdown zone and reservoir water levels rose, the eggs could be inundated, which would reduce oxygen-rich stream flow around the eggs, and kill them. The spawning Performance Measure measures the area that remained a wetted stream during the period March to August. This Performance Measure scores highly on operating alternatives that keeps the reservoir low during the spawning season and maintained the same or lower levels during egg incubation. The trout spawning Performance Measure considers the accessibility of spawning habitats in streams within the drawdown zone. The location of barriers and spawning habitat along streams relative to reservoir level was measured and used to quantify the spawning habitat that was available to trout at a particular reservoir elevation.

The fourth objective is **to maximize trout rearing habitat in tributaries within the drawdown zone**. As reservoir elevation increases, rearing habitat in streams within the drawdown zone diminishes. The quality of rearing habitat was not assessed, and the Consultative Committee acknowledged that more fish biology would be needed. Therefore, rearing habitat is measured as the number of linear metres of stream available for rearing fish. The rearing habitat performance measure measures the **linear rearing habitat (m) from April to September**. The locations of barriers was not factored into the measurement of rearing habitat because rearing fish could access habitat by migrating from reaches upstream of the drawdown zone.

Table 4-5: Objectives and Performance Measures - Elsie Lake Reservoir Fish

Objectives	Performance Measures	Location	Minimum Significant Incremental Change
Maximize euphotic volume	Millions m^3.days (11 m Secchi Depth)	Elsie Lake Reservoir	± 15%
Maximize effective littoral zone	Hectares (11 m Secchi depth)	Elsie Lake Reservoir	± 25%
Maximize trout spawning habitat in tributaries within drawdown zone	Square metres of trout spawning habitat	Reservoir tributaries within drawdown zone	± 10%
Maximize trout rearing habitat in tributaries within drawdown zone	Metres of trout rearing habitat	Reservoir tributaries within drawdown zone	± 10%

4.5.1.3 Studies - Reservoir Fish

The Consultative Committee undertook two studies during the summer of 2001 to quantify trout production in the reservoir and provide data to calculate the performance measures. The first study identified the location of barriers and spawning habitat in streams. A field crew walked the 19 tributary streams and the upper Ash River between 318.7 m elevation and the upper limits of the drawdown zone. The crew collected information such as stream gradients, wetted channel width, water temperature, and observations of fish. The crew also identified the location of barriers and spawning habitat. Obstacles or high stream gradients that could block fish passage were assessed. This data was used to

calculate the available spawning and rearing habitat performance measures under different operating alternatives.

The second study collected water samples from four sample points in the reservoir: at the power intake, at the deepest point in the reservoir, at the second deepest point in the reservoir, and at the intake of the hollow cone valve. The sampling period coincided with a safety upgrade to Elsie Dam when the reservoir was held low below 318 m or about 13 m below full pool. The samples provided data on Secchi depths and the lab analyses reported on physical, chemical, and biological water quality parameters. The sampling also collected measurements of dissolved oxygen and temperature through a vertical profile of the water body at each of the four sampling points. The water quality data confirmed that suspended sediment concentrations were low, eliminating this as an issue, and provided information to calculate the euphotic productivity Performance Measure under different operating alternatives. The Secchi depths also were used to calculate the littoral zone performance measures.

4.5.2 Ash River - Fish

The Ash River provides habitat for a variety of resident and anadromous fish including steelhead, coho, chum, chinook, and various species of trout. The Consultative Committee's choice of operating alternative would affect the amount and timing of water to be released for fish and the amount stored in the reservoir.

BC Hydro releases water from Elsie Dam into the Ash River, by spilling water over the spillway, by releasing water through the spillway dam sluicegate and by releasing water through the hollow cone valve (low level outlet). The fourth point of release is at the power intake, which diverts water from the reservoir to the generating station into Great Central Lake. At the confluence of the Stamp and Ash Rivers water released from Elsie Dam into the Ash River rejoins with water routed through the generating station and Great Central Lake. For the purposes of the Ash River Water Use Plan the scope of fish issues in the Ash River extended from Elsie Dam downstream to the confluence with the Stamp River.

BC Hydro stores water in the reservoir for generation during the drier summer and fall months. Some of this stored water is released into the Ash River to provide flows for fish habitat and as a result flows in the Ash River are higher during the summer months compared to natural flows before construction of Elsie Dam. Figure 4-2 shows the pattern of inflows to the reservoir. Flows down the Ash River in the absence of Elsie Dam would follow a similar pattern with high flows in the fall, winter, and spring then low flows from August through November. With augmentation, base flows (red line, Figure 4-2) during the dry summer months generally are higher than naturally occurring flows (blue lines below red line). The assumption examined during the Ash River water use planning process was that higher minimum flows would provide more fish habitat.

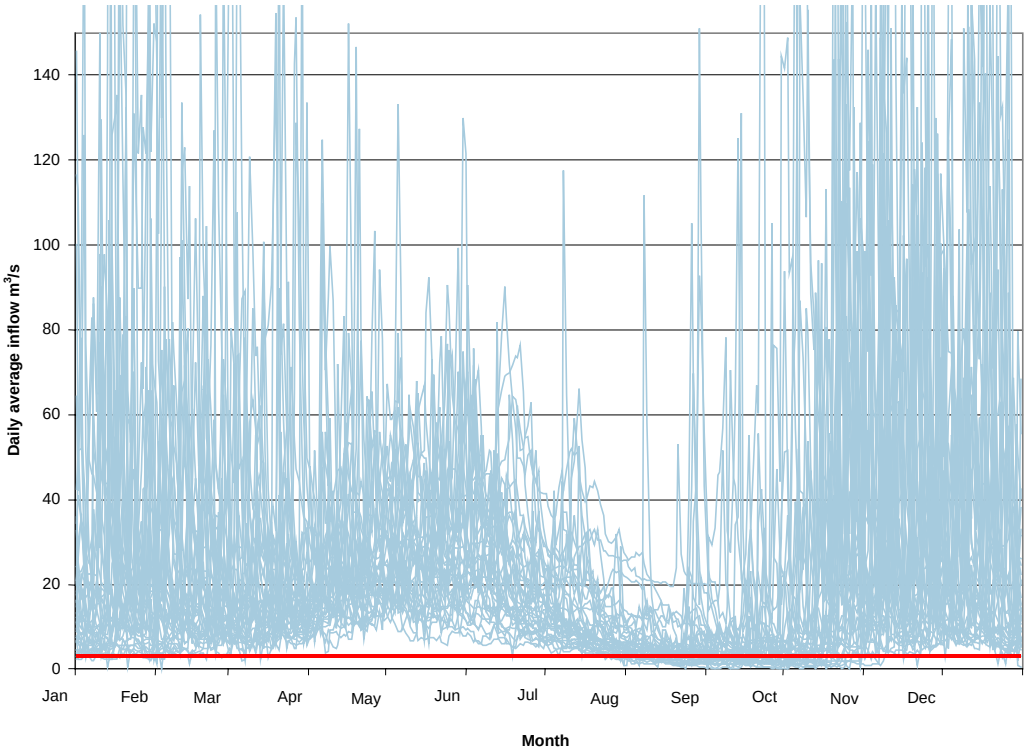


Figure 4-2: A 38 Year Profile of Inflows to Elsie Lake Reservoir (1963 to 2000)

1. Red line represents a 3 m^3/s minimum flow released from Elsie Lake Reservoir, typical of operations in 2002. Blue lines are inflows (m^3/s) with peaks representing major rainstorm or period of snow melt. Low points in blue line represent low inflow periods.

4.5.2.1 Issues - Ash River Fish

The key interest was managing flows in the Ash River to improve the quantity and quality of fish habitat. The Fish Technical Subcommittee compared the life stages of the main species present (chinook, coho, steelhead, and trout) with the hydrograph pattern of the Ash River. The comparison showed that spawning and rearing habitat were most at risk during the dry summer and early fall months (August-November), particularly for rearing juvenile summer run steelhead. Habitat was at less risk during the fall, winter, and spring when inflows to the reservoir are naturally higher from rain and snow melt. When released from Elsie Dam, these inflows increase flow in the Middle Ash River adding to the natural inflows from tributaries downstream of Elsie Dam. Therefore, the Consultative Committee focussed on managing flows for steelhead and coho spawning and rearing habitat during the critical stream flow period (August to September). The understanding was that improving habitat for the most vulnerable species would improve conditions for other species as well.

A second issue was providing flows for migrating fish to surmount barriers such as Lanterman Falls and Dickson Falls. Flows in the Ash River are typically low during the summer and early fall when early returning steelhead and salmon migrate upstream. Releases from the reservoir can augment these low flows and improve conditions for fish to migrate past the obstructions.

The Fish Technical Subcommittee discussed whether other species such as coho and chinook could surmount the barriers. However, the information available proved contradictory. Information from both the Hupacasath First Nation's Traditional Ecological Knowledge and non-native sources report that large fish have been observed above Dickson Falls and in Dickson Lake. For historical context the Ash River hydroelectric facility was constructed in the late 1950's. In earlier times, weather conditions and the configuration of the falls may have facilitated coho migration above the falls. Biologists have recently assessed Lanterman and Dickson Falls and suggest that with the current configuration of the barriers, fall run coho would not have the strength or swimming speed to overcome Dickson Falls, but they can surpass Lanterman Falls. Furthermore, 30 years of stock assessments on the Ash River show no record of coho adults or fry above Dickson Falls.

The Fish Technical Subcommittee discussed that conditions at the falls may change again through erosion or buildup of debris allowing fish to pass. Future stock assessments will detect if coho are able to reach Elsie Dam. Therefore, migration issues focussed on summer run steelhead which have the strength and speed to overcome the barriers and reach as far upstream as Elsie Dam. The Consultative Committee agreed to develop an operating alternative that would benefit species currently known to be present in the system (steelhead) given the present condition of the obstructions.

An additional consideration in this decision was that even in the event that coho are able to migrate past the falls, coho tend to rear in low velocity habitats in rivers and lakes rather than in the high velocity habitats in rivers preferred by steelhead. Therefore, the Consultative Committee focused primarily on providing rearing habitat in the river for steelhead rather than for coho.

Fish Issues Investigated but Not Pursued

The Consultative Committee discussed, but did not pursue, three other fish issues. First was fish habitat in Great Central Lake and the Upper Stamp River. The Consultative Committee agreed that BC Hydro does not have any control over operation of NorskeCanada's dam on Great Central Lake or on the Stamp or Somass River.[1] A separate Great Central Lake Committee (GCL Committee) conducted a parallel planning process to develop a new rule curve for operating Great Central Lake Dam.

Some members of the Ash River Consultative Committee also sat on the Great Central Lake Committee. While the Consultative Committee agreed that decisions about operations at Great Central Lake were outside the scope of the Ash River Water Use Plan, many Consultative Committee members remained aware of the potential impacts of how operating the Ash River hydroelectric

[1] Issues around flood control were the exception to limiting the geographic scope of the Ash River Water Use Plan downstream to the confluence of the Ash and Stamp Rivers. The Consultative Committee agreed that releases from Elsie Dam had the potential to exacerbate flooding along the Somass River. See Section 4.3 above.

facility could affect flows into Great Central Lake and the Stamp River. At times of low inflows, releases from the Ash River generating station can contribute up to 70% of flows from Great Central Lake into the Stamp River (Great Central Lake Committee, 17 April 2002 meeting notes).

The Stamp River and Great Central Lake support important fisheries, particularly for sockeye. However, the Consultative Committee did not pursue an operating alternative designed specifically to manage fish habitat in Great Central Lake or the Upper Stamp River. The Committee developed several Performance Measures to measure the quantity of water diverted into Great Central Lake as a proxy for effect on fish habitat in the lake and the Upper Stamp River.

The second issue discussed, but not pursued, was determining appropriate ramping rates when changing the rate of release from the hollow cone valve. The current ramping rates are conservative relative to natural rates of changes in flows. Therefore, the Consultative Committee will recommend that the current ramping rate be adopted (see Appendix F).

The third issue discussed, but not pursued, was providing coho and steelhead access into Elsie Lake Reservoir thereby providing fish access to spawning locations within the Upper Ash. Elsie Dam does not have a fishway or other such mechanism to provide fish passage. As this would require a physical change to Elsie Dam, it was agreed that the fishway issue would be dropped as it falls outside the scope of water use planning.

The final issue discussed, but not pursued, was water temperatures in the Upper Stamp River between Great Central Lake and the confluence with the Ash River. Warm water during the late summer and fall was thought to deter migrating salmon, particularly sockeye, from moving up the Stamp River into Great Central Lake. The Fish Technical Subcommittee investigated the feasibility of cooling the Stamp River by releasing cool water from Elsie Lake Reservoir. Based on expert opinion and technical assessment by the Fish Technical Subcommittee it was determined that:

1. Flows diverted from Elsie Lake Reservoir through the powerhouse into Great Central Lake would not significantly influence water temperatures in the Upper Stamp River. Flows from Great Central Lake into the Upper Stamp River are surface flows. Any cool water introduced through the powerhouse would move deep into Great Central Lake and not cool any outflows.

2. Increasing releases from Elsie Lake Reservoir into the Ash River (via the low level outlet) would likely have very little influence on temperatures in the Stamp and Somass Rivers unless flows are significantly greater than current flows. The released water would warm considerably before reaching the Stamp River by absorbing ambient heat from the air. Furthermore, it was discussed that heating would occur in Dickson Lake which may further reduce any benefits of cooler water being released. The flows required for cooling would exceed the

optimum flows for fish rearing and would reduce the ability to provide optimum and adequate minimum flows later in the season.

3. BC Hydro's influence on Great Central Lake levels and Upper Stamp River flows are more pronounced in dry years as their flow contribution relative to total inflows may be more significant. It was also acknowledged that in extreme dry years all river and lake systems would experience reduced inflows. There would therefore be a finite and limited amount of water available for all systems in the area.

4.5.2.2 Objectives and Performance Measures - Ash River Fish

Based on the issues identified, the Consultative Committee developed nine objectives for managing fish habitat in the river. The first objective is to **enable migrating steelhead** to pass obstructions in the Ash River. To aid in migration, the pulse flows would increase flows from background flows to 10 m^3/s measured at Moran Creek gauge then back to background flows over a 48 hour period. There would be two pulses during the migration period. For modelling purposes, these pulses were modelled on 15 August and 15 September. In practice, the pulses would be timed to coincide with natural rainfall events. The **migration pulse Performance Measure was set at a value of one (1) to show operating alternatives featuring the pulses. Operating alternatives that did not have the pulse had the Performance Measure set at zero (0)**. The assumption underlying this binary performance measure was that pulse flows would allow migrating steelhead to pass. Observations during the water use planning studies suggested that steelhead would move in response to these pulses.

The remaining fish objectives are **maximize spawning and rearing habitat** for two species: steelhead and coho (Table 4-6). These objectives and accompanying performance measures were calculated at two locations: the Ash River immediately below Elsie Dam and the Ash River near Moran Creek. In total, there are eight water use objectives and accompanying performance measures for maximizing spawning and rearing habitat. Releases from Elsie Dam are the only source of flow supporting fish habitat in the first 800 m of the Ash River directly below the dam. There are no significant tributaries to the Ash River here. The Ministry of Water, Land and Air Protection consider this 800 m reach to be important steelhead and trout habitat. The second location for the Performance Measures, on the Ash River near Moran Creek, reflects fish habitat supported by Elsie Dam (minimum releases and spills) and local inflows from several tributary streams.

The performance measure for the eight fish habitat objectives is **Weighted Usable Width - WUW (m)** calculated at representative transects just below Elsie Dam and at Moran Creek. Note that the Performance Measure for steelhead rearing habitat is actually measuring the width of riffle habitat. Riffle habitat is important for producing food for fish in rearing stages.

Table 4-6: Objectives and Performance Measures - Ash River Fish

Objectives	Performance Measures	Location	Minimum Significant Incremental Change
Enable migrating steelhead to pass obstructions.	Provide migration pulse flows of 10 m^3/s over 48 hours	Measured at Moran Creek gauge	Any difference is significant
	1 = yes; 0 = no		
Ash River just below Elsie Dam			
Maximize steelhead rearing habitat	Metres Weighted Usable Width	Selected transects immediately below Elsie Dam. Reflects riffle habitat.	± 20%
Maximize steelhead spawning habitat	Metres Weighted Usable Width	Selected transects immediately below Elsie Dam	± 20%
Maximize coho fry rearing habitat	Metres Weighted Usable Width	Selected transects immediately below Elsie Dam	± 20%
Maximize coho spawning habitat	Metres Weighted Usable Width	Selected transects immediately below Elsie Dam	± 20%
Ash River at Moran Creek			
Maximize steelhead rearing habitat	Metres Weighted Usable Width	Selected transects on Ash River near Moran Creek. Reflects riffle habitat.	± 30%
Maximize steelhead spawning habitat	Metres Weighted Usable Width	Selected transects on Ash River near Moran Creek	± 30%
Maximize coho fry rearing habitat	Metres Weighted Usable Width	Selected transects on Ash River near Moran Creek	± 30%
Maximize coho spawning habitat	Metres Weighted Usable Width	Selected transects on Ash River near Moran Creek	± 30%

4.5.2.3 Auxiliary Performance Measures

Auxiliary performance measures provided additional information for interpreting the performance measures (Table 4-7). The auxiliary measures were calculated to help distinguish between alternatives with similar scores in the key performance measures. The auxiliary measures were required partly because the summary statistic for the Performance Measure scores for river fish were median values calculated over 38 years of simulated facilities operations with each annual value equal to the median daily value within the year. Median scores represent the typical condition: half of the time the performance measures will score less than the median value, and half the time they will score more than the median value. Although the median captures the typical year, it does not capture extreme conditions, that although rare, may have large impacts on fish and habitat. For example, the median flow within one year may be 5 m^3/s, and the same the next

year, except that for five days the flow is reduced to zero. The median value does not differ between these two years, even though the latter case would have significant negative impacts on fish. The auxiliary performance measures showed which operating alternatives cause flows to drop below desirable levels.

There are three auxiliary performance measures. The first is the **number of days that a minimum flow of at least 3.5 m^3/s is provided during the year**. Based on the professional opinion of biologists with the Ministry of Water, Air, and Land Protection, the Consultative Committee selected 3.5 m^3/s as the acceptable minimum base flow. Operating alternatives that could achieve 3.5 m^3/s year round were preferred over alternatives that caused base flows to drop below 3.5 m^3/s for any part of the year.

The second auxiliary performance measure reported the **minimum flow released from Elsie Dam** during any of the 38 simulated operating years. Preferred operating alternatives were those that did not cause Elsie Lake Reservoir to "run out of water" such that flow releases could not be provided.

The third auxiliary performance measures reported the **minimum flow during the Critical Stream Flow Period** (CSFP) during August and September observed in 38 years of simulated operation. Preferred operating alternatives avoided low flows during the CSFP.

The auxiliary performance measures were calculated for two locations: just below Elsie Dam and on the Ash River at Moran Creek corresponding to the locations of the river fish Performance Measures.

Table 4-7: Auxiliary Performance Measures to Interpret Fish Performance Measures

Auxiliary performance measures	Interpretation
Number of days minimum flow of 3.5 m^3/s provided in the year	Prefer higher number of days that minimum flows are provided
Minimum flow released from Elsie Dam during the year m^3/s	Prefer avoiding operating alternatives that cause the reservoir to "run out of water" anytime of the year
Mean flow during the Critical Stream Flow Period (CSFP) August and September	Prefer to avoid low flows during CSFP

4.5.2.4 Studies - Ash River Fish

The Consultative Committee undertook several fish related studies to better understand impacts of operations on fish habitat and to provide data for calculating fish performance measures. The Ash River fish studies are summarized below with more details in Appendix G.

Table 4-8: Summary of Ash River Water Use Plan Studies

Study	Description
Hydraulic review	General information on annual inflow patterns, proportion of water from Elsie Lake Reservoir diverted between the Ash River and Great Central Lake, and periods of critical low flows for fish.
Fish key life stages and timing	Summary of life stages in the Ash River for steelhead, coho, chinook showing the timing of migration, spawning, emergence from eggs, and rearing. Included Traditional Ecological Knowledge. Information used in calculating performance measures of available habitat area or width during fish life stages most affected by operations or low river flows.
Instream flow studies	Instream flow studies at 17 transects between Elsie Dam and confluence of Ash River and Stamp River. Transects sampled twice, at 3.5 m^3/s and 7 m^3/s release from Elsie Dam. Information used to calculate performance measures of available spawning and rearing habitat for steelhead and coho under different flow regimes.
Migration past Lanterman and Dickson Falls	Field observation of adult steelhead migration at Lanterman and Dickson Falls. Also, an expert judgement exercise to estimate required flows to support steelhead passage at Lanterman and Dickson Falls. Information used to develop specifications of migration pulse flows (10 m^3/s over 48 hours).
Evaluation of ramping rates	Comparison of draft BC Hydro ramping strategy to ramping rates in natural, unregulated systems. BC Hydro ramping strategy considered conservative. Consultative Committee recommended adopting BC Hydro ramping strategy.
Place names in Ash River system	Standardized names of river sections, tributary streams and lakes for consistency in the water use planning process.

4.6 Wildlife

The terrestrial margins of Elsie Lake Reservoir and the Ash River provide pockets of riparian habitat for wildlife. Species frequenting the reservoir margins range from large mammals such as bear and deer to waterfowl that nest in the wetlands to amphibians such as salamanders and frogs (Robertson Environmental, 2001). The pockets of riparian vegetation occur on the gently sloping narrow shorelines where the upper Ash River flows into the reservoir and on two gently sloping areas on the north shore of the reservoir. Generally, these riparian areas are represented by grass-sedge ecosystems at the reservoir edge changing to willow-sedge ecosystems approximately 50 m from the reservoir. Other scattered riparian areas have developed on old alluvial fans on the south shore (Oikos, 2001)

Hupacasath First Nation representatives reported that elders recall beaver inhabiting the area around the former Elsie Lake (the Hupacasath First Nation name for Elsie Lake is "a-tu-min" or place of beaver). Beaver no longer inhabit the reservoir area. However, a few beaver are known to den around Dickson Lake. Elk formerly roamed a larger area including the Ash River project area. Now elk are mainly found in Strathcona Provincial Park to the north.

Downstream of Elsie Dam, there is little floodplain ecosystem along the Ash River to Dickson Lake (Oikos, 2001). However, there is an important old-growth flood plain ecosystem where the Ash River flows into Dickson Lake.

The shoreline of Dickson Lake is typically wetland ecosystems that are inundated for part of the year.

The BC Conservation Data Centre report there are several at-risk species, including red-legged frogs and Vancouver Island water shrew, in the general area of the Ash River hydroelectric facility. However, the Consultative Committee did not have specific information on the presence or absence of provincially Red- or Blue-Listed species specifically at risk from BC Hydro operations. Therefore, the Committee did not specifically address any at-risk species.

Members of the Consultative Committee who formed the Wildlife Technical Subcommittee were not unanimous on key wildlife issues. The area around the reservoir falls within the Hupacasath First Nation claimed traditional territory and individuals in the Hupacasath First Nation community were interested in improving habitat around the reservoir for wildlife, such as deer, and for traditional use such as gathering plant materials. The Hupacasath First Nation also expressed an interest in attracting elk back into the traditional territory. Hupacasath First Nation representatives focussed on wildlife issues around the reservoir when setting Ash River Water Use Plan objectives.

Representatives of the Ministry of Water, Land, and Air Protection (MWLAP) considered the riparian habitat around Dickson Lake and along the Ash River more important to wildlife than riparian habitats around Elsie Lake Reservoir. MWLAP interest was to ensure changes to flows did not negatively affect these riparian areas. Further for deer, MWLAP considered there were more pressing concerns on the hillsides in the extensive second growth forests which currently offer little habitat for deer. The upslope areas are large (thousands of hectares) and therefore, have greater importance to deer production. However, these upslope areas are outside the zone of influence of the Ash River hydroelectric facility and outside the scope of the Ash River Water Use Plan. The Ministry focussed on seeking benefits to riparian zones downstream of Elsie Dam.

4.6.1 Objectives and Performance Measures - Wildlife

Based on Hupacasath First Nation interest in improving wildlife habitat around Elsie Lake Reservoir, the objective is to **maximize the area of the exposed drawdown zone** (Table 4-9). The assumption is that the greater the area exposed, and the longer the exposure, the greater the opportunity for terrestrial vegetation to establish and for wildlife to use these habitats. The performance measure is calculated as the **average area of drawdown zone exposed between April to September each year (Lewis, 2001c).** The Consultative Committee did not develop specific riparian-wildlife objectives for the Ash River below Elsie Dam or for Dickson Lake as there was little specific information on the linkages between BC Hydro operations and riparian resource values at these locations.

Table 4-9: Objectives and Performance Measures - Wildlife, Elsie Lake Reservoir

Objectives	Performance Measures	Location	Minimum Significant Incremental Change
Maximize area of exposed drawdown zone	Mean daily average hectares of exposed drawdown zone	Reservoir drawdown zone	± 10%

4.6.2 Studies - Wildlife

The Consultative Committee carried out three wildlife studies. The first was a review of wildlife issues to provide background information on wildlife and wildlife at risk in the Ash River Water Use Plan project area (Robertson Environmental Services, 2001).

The second study involved a one-day field assessment by a riparian ecologist (Oikos, 2001). This study identified issues that may impact the health of riparian ecosystems within the Elsie Lake Reservoir, along the Ash River, and around Dickson Lake. This study qualitatively described the riparian habitat in the Ash River Water Use Plan study area.

The third study was part of the Traditional Ecological Knowledge (TEK) study conducted by the Hupacasath First Nation. The TEK provided information on species present in the study area and how different animals were hunted and used.

Upon completion of the wildlife studies, the Hupacasath First Nation stated that they felt there was not enough data on all types of wildlife, this made it difficult for the Wildlife Technical Subcommittee to be unanimous on key wildlife issues. The Hupacasath First Nation recommended a monitoring program to determine if wildlife were impacted by the Ash River hydroelectric facility and water flows. (See Section 7.0 Monitoring Programs).

4.7 Other Water Use Planning Issues Identified But Not Pursued

The Consultative Committee initially considered a wide range of water use issues. After discussion and analysis the Committee agreed two of these issues need not be pursued.

4.7.1 Issue - Recreation on the Ash River and Great Central Lake

Early in the Ash River water use planning process, the Consultative Committee considered river recreation as a Ash River Water Use Plan issue. The participant's interest was in providing adequate flows to canoe in the Ash River above Dickson Lake. However, in subsequent discussions, the Consultative Committee understood that the underlying interest was to ensure sufficient flows to provide fish habitat. Having sufficient water for canoeing was a proxy for having sufficient water for fish. Given this understanding, the Consultative Committee did not pursue river recreation as an Ash River Water Use Plan issue.

Also early in the consultative process, preliminary issues included recreation on Great Central Lake. Some of the issues included a recreation site near the Ash River powerhouse and boat access to Great Central Lake. However, the Committee agreed that the Ash River water use planning process did not include Great Central Lake and the Committee did not pursue recreation issues on Great Central Lake.

4.7.2 Consumptive Water Use

The representative from the Beaver Creek Improvement District identified domestic water withdrawals from the Somass River as a potential Ash River Water Use Plan issue. The concern was that BC Hydro operations could limit the water available for domestic use. An analysis of water licences and river discharge data (Appendix H) showed that domestic water withdrawals represented less than 2% of river discharge during the lowest flows observed over 43 years of data. Hence, the Consultative Committee did not pursue consumptive water use as an Ash River Water Use Plan issue.

5 OPERATING ALTERNATIVES

In Step 6 of the water use planning process, the Consultative Committee created and evaluated various operating alternatives for satisfying the water use planning objectives described in Section 4 above. The BC Hydro project team simulated these operating alternatives using computer models of the Ash River hydroelectric facility. The Committee used the modelling results and performance measures to compare how well each alternative performed in satisfying the water use planning objectives. This section describes the specifications of the Ash River water use **operating alternatives** and the water use modelling process.

5.1 Specifying Water Use Operating Alternatives

In general, the specifications for Ash River operating alternatives were relatively simple requiring minimum releases into the Ash River and desired Elsie Lake Reservoir elevations at different times of the year. Once these constraints were satisfied, the next priority was to maximize power generation.

For discharge into the Ash River, BC Hydro can control releases while the reservoir elevation is at or below 330.71 m. When the reservoir surcharges above 330.71 m water begins to spill over the spillway dam and there is no control over the rate of release into the Ash River assuming constant power generation. Control over discharge returns when water levels drop below 330.71 m and water is only flowing from the hollow cone valve. Given that the water use issues involving the Ash River are related mostly to the impacts of low flows in the river, the Consultative Committee was focussed on maintaining minimum flows into the Ash River.

5.2 Trial Alternatives

In the first round of operating alternatives the Consultative Committee developed five Trial Alternatives. The Trial Alternatives demonstrated how the Ash River hydroelectric facility responded when certain target flows in the Ash River or reservoir elevations were imposed. The Trial Alternatives also demonstrated to the Consultative Committee the process of specifying operating alternatives and interpreting the resulting model outputs and Performance Measures.

Each of the five Trial Alternatives (Table 5-1) maximized for a single water use objective. For instance, Alternative No. 3 maximized power generation while Alternative No. 4 specified desired flows for fish, to the exclusion of other interests. The Trial Alternatives were not intended to be viable operating regimes given none considered multiple interests. Besides the instructional value, the Trial Alternatives also suggested approaches for more realistic alternatives to satisfy multiple water use objectives.

Table 5-1: Specifications for Five Ash River Water Use Plan Trial Alternatives

Alternative Name	Objective	Reservoir elevations	Fish flows	Modelling priority	Water licence constraint on diversion for generation?[1]
1	Maximize year round reservoir recreation opportunities	329.5 m year round	None specified	Reservoir elevation	None
2	Provide 60 day period for archaeology study in drawdown zone	317.5 m for 60 consecutive days summer/fall	None specified	Reservoir elevation for 60 days	None
3	Maximize power generation	None	None	Power	None
4	Maximize fish habitat[2]	None	70% of Mean Annual Discharge or 19.45 m^3/s year round	Fish flows	None
5	Maximize fish habitat	None	5 m^3/s year round	Fish flows	None

1. The existing water licence limits diversion volume to 3 926 m^3/s-days or 76.5 million m^3 per year
2. The Consultative Committee specified 70% of Mean Annual Discharge (MAD=27.8 m^3/s) or 19.45 m^3/s to be discharged over several days during the fall migration and spawning period. However, the alternative was actually modelled as 70% of the *previous day's inflow*.

5.2.1 Lessons from Trial Alternatives

There were several lessons from the modelling results:

- Elsie Lake Reservoir cannot be drawn down much below 317 m even though the lowest outlet is at 309.8 m (i.e., the invert elevation of the power diversion intake). Diversion to the Ash River power house is curtailed when the reservoir drops to 317.91 m to conserve water for fish releases. This leaves the hollow cone valve with an intake (invert) elevation of 313.34 m to release water from the reservoir. However, discharge is minimal with a low reservoir as there is very little hydraulic head. Meanwhile, there are continuous year round inflows from upper Ash River and tributaries adding water to the reservoir. When constant inflows reach a balance with discharge from the hollow cone valve, the minimum achievable reservoir elevation is about 317 m. In the summer of 2001, the reservoir dropped to 317.5 m partly due to the dam upgrade project and partly due to a dry summer.

- Placing a priority on maintaining 5 m^3/s discharged year round from Elsie Dam (Trial Alternative No. 5) to provide fish habitat in the Ash River reduces the value of power generation by about $1.6 million relative to operation under the existing water licence.

- The Trial Alternatives demonstrated potential trade-offs given multiple demands for a limited quantity of stored water. For example, in Alternative 1, holding back water to keep Elsie Lake Reservoir high year round for recreation, means having to curtail releases for fish habitat in

the Ash River and curtailing diversion to the power plant. The emphasis on reservoir recreation reduces power revenue by approximately $2.8 million and reduces fish habitat in the Ash River.

5.3 Round 2 Alternatives

Based on the learning experience of the Trial Alternatives, the Consultative Committee developed and evaluated more realistic alternatives in Round 2 and 3 to seek a balance between competing water use objectives. All six Round 2 operating alternatives were subsequently carried into Round 3 and are described below. The "Round 2" and "Round 3" labels are retained here to correspond with references to those labels in other Ash River Water Use Plan documents such as Consultative Committee meeting notes.

5.4 Round 3 Alternatives

The Consultative Committee developed and evaluated a total of 13 operating alternatives (Table 5-2). Each alternative was a combination of one or more constraints on operating the Ash River hydroelectric facility to achieve a suite of water use objectives described in Section 4 above. The range of constraints are described in Columns 4 through 11 in Table 5-2 and the check marks (✓) show which combination of constraints made up each operating alternative. Each alternative specified up to four constraints:

- Desired reservoir elevations (Column 4 in Table 5-2)
- Desired fish flow(s) in the Ash River (Columns 5, 6, 7, or 8)
- Presence of pulse flow to assist fish migration in the Ash River (Column 9)
- Maximum volume of water diverted for power generation (Column 10)

Table 5-2: Specification of Constraints for Ash River Water Use Plan Round 3 Alternatives

1	2	3	4	5	6	7	8	9	10	11
				5 Possible Fish Flow Regimes						
No.	**Alt Name**	**Objective**	**Constraint on Reservoir Operation?**	**0.71 m^3/s Jun to Aug 0.29 m^3/s Sept to May**	**3.5 m^3/s year round**	**3.5 m^3/s May to Sept 5 m^3/s Oct to Apr**	**3.5 m^3/s May to Oct 5 m^3/s Nov to Apr**	**5 m^3/s year round**	**Fish migration pulse flow?[1]**	**Constraint on diversion for generation?**
1	WL	Current water licence	None	✓						76.5 million m^3
2	G2	Power	None	✓						None
3	E	Fish	None		✓				✓	None
4	B	Fish	None			✓			✓	None
5	C	Fish	None				✓		✓	None
6	F	Fish	None					✓	✓	None
7	D	Reservoir recreation	327 m 15 March to 30 June 329.5 m 1 July to 14 October elevations ± 0.5 m	✓					✓	None
8	I1	Wildlife stable reservoir	Max 320 m year round			✓			✓	None
9	I2	Wildlife stable reservoir	Max 320 m May to October Normal operation November to April			✓			✓	None
10	I3	Wildlife stable reservoir	Similar to I2, adjusted to allow power generation max. 323 m elevation			✓			✓	None

1. Migration pulse flow. Modelled as 10 m^3/s discharge from Elsie Dam for 48 hours, once on 15 August and once on 15 September. In practice, would be timed with natural rainfall and natural high inflow and discharge to be measured at Moran Creek gauge.

1	2	3	4	5	6	7	8	9	10	11
				5 Possible Fish Flow Regimes						
No.	**Alt Name**	**Objective**	**Constraint on Reservoir Operation?**	**0.71 m^3/s Jun to Aug 0.29 m^3/s Sept to May**	**3.5 m^3/s year round**	**3.5 m^3/s May to Sept 5 m^3/s Oct to Apr**	**3.5 m^3/s May to Oct 5 m^3/s Nov to Apr**	**5 m^3/s year round**	**Fish migration pulse flow?[1]**	**Constraint on diversion for generation?**
11	J	Naturalized flow pattern - river	None			See Figure 5-1 and Appendix I for flows and timing			✓	None
12	H	Archaeology protection (qualitative assessment)	Minimize time elevation between 327 m and 328.5 m (based on Alternative B)			✓			✓	None
13	K	Fish wildlife traditional use	Max. 320 m April to October Nat hydrograph November to March			See Figure 5-1 and Appendix I for flows and timings			✓	None

2. Migration pulse flow. Modelled as 10 m^3/s discharge from Elsie Dam for 48 hours, once on 15 August and once on 15 September. In practice, would be timed with natural rainfall and natural high inflow and discharge to be measured at Moran Creek gauge.

5.4.1 Water Use Alternative Themes

The 13 operating alternatives fall into seven themes. Alternatives were labelled Alternative WL and Alternative A through Alternative K. Appended numbers indicate refinements to an alternative, for instance Alternative I1 led to Alternative I2 and then Alternative I3. Similarly, Alternative G2 is a refinement of Alternative G.

Theme: Power Generation

WL Existing water licence: Limits diversion to maximum of 3 926 m^3/s-days per year (or 76.5 million m^3/year). Base flow releases from Elsie Dam for fish flows in the Ash River of at least 0.29 m^3/s September to May and 0.71 m^3/s June to August such that there is 3.5 m^3/s flow measured at the Moran Creek gauge.[1] No pulse release for fish migration.

G2 Maximize power generation, no constraint on maximum diversion volume. Fish flows as per current water licence (0.29 m^3/s, September to May and 0.71 m^3/s, June to August). No pulse release for fish migration.

Theme: Provide Flows For Fish Habitat in Ash River (In Order of Increasing Flows)

E 3.5 m^3/s base flow year round. Migration pulse flow (*all other operating alternatives hereafter have the migration pulse flow*)

C 3.5 m^3/s May to October, then 5.0 m^3/s November to April

B 3.5 m^3/s May to September, then 5.0 m^3/s October to April (increase to 5.0 m^3/s one month earlier than Alternative C)

F 5.0 m^3/s year round (highest of the fish base flows)

Theme: Reservoir Recreation

D Bring Elsie Lake Reservoir to preferred elevation (329.5 m) for reservoir recreation activities from July to 14 October with intermediate stage at 327 m 15 March to 30 June. Fish releases in Ash River as per the existing water licence.

[1] BC Hydro monitors the gauge at Moran Creek daily. If measured flows are more or less than 3.5 m^3/s a crew person goes to Elsie Dam and adjusts the hollow cone valve accordingly.

Theme: Restore Vegetation to Elsie Lake Reservoir Drawdown Zone

I1 Maximum reservoir elevation of 320 m year round to allow upper half of drawdown zone to revegetate and provide wildlife habitat. Fish flow releases in Ash River as per Alternative B.

I2 Modified Alternative I1 to balance for other interests. Maximum reservoir elevation of 320 m May to October. Normal reservoir operations remainder of year. Fish flow releases in Ash River as per Alternative B.

I3 Modified Alternative I2 to allow more power generation by raising maximum reservoir elevation (generation curtailed when reservoir drops to 320 m). Maximum reservoir elevation of 323 m May to October, normal operation remainder of year. Fish flow releases in the Ash River as per Alternative B.

Theme: Naturalized Flow Pattern in Ash River

J Provide a more naturalized hydrograph to flows in the Ash River to restore conditions for First Nation traditional use and gathering in and along the river.[1] Also captures potential ecological benefits of a naturalized flow regime that may improve fish and wildlife habitat. See blue line in Figure 5-1.[2]

Theme: Protect Reservoir Archaeology Resources

H Minimize time that reservoir is between 327.0 m and 328.5 m to protect First Nations Archaeology resources from potential wave erosion. Fish flow releases in the Ash River as per Alternative B.

Theme: Fish, Wildlife, and Traditional Use

K Blend of Alternatives B (fish), I2 (restore upper drawdown zone), and J (naturalized flow pattern in Ash River). Attempt to satisfy a wide range of water use objectives.

Maximum reservoir elevation of 320 m April to October then normal operations remainder of the year. Naturalized flow pattern (Figure 5-1) November to March. Fish flows as per Alternative B, April to October.

[1] See Lewis 2002b for development of natural flow pattern.
[2] Note that under Alternative J, during April to 15 October base flow releases from Elsie Dam are 3.5 m^3/s consistent with fish objectives. A base flow of 3.5 m^3/s is greater than historical natural flows in that period of about 1.9 m^3/s.

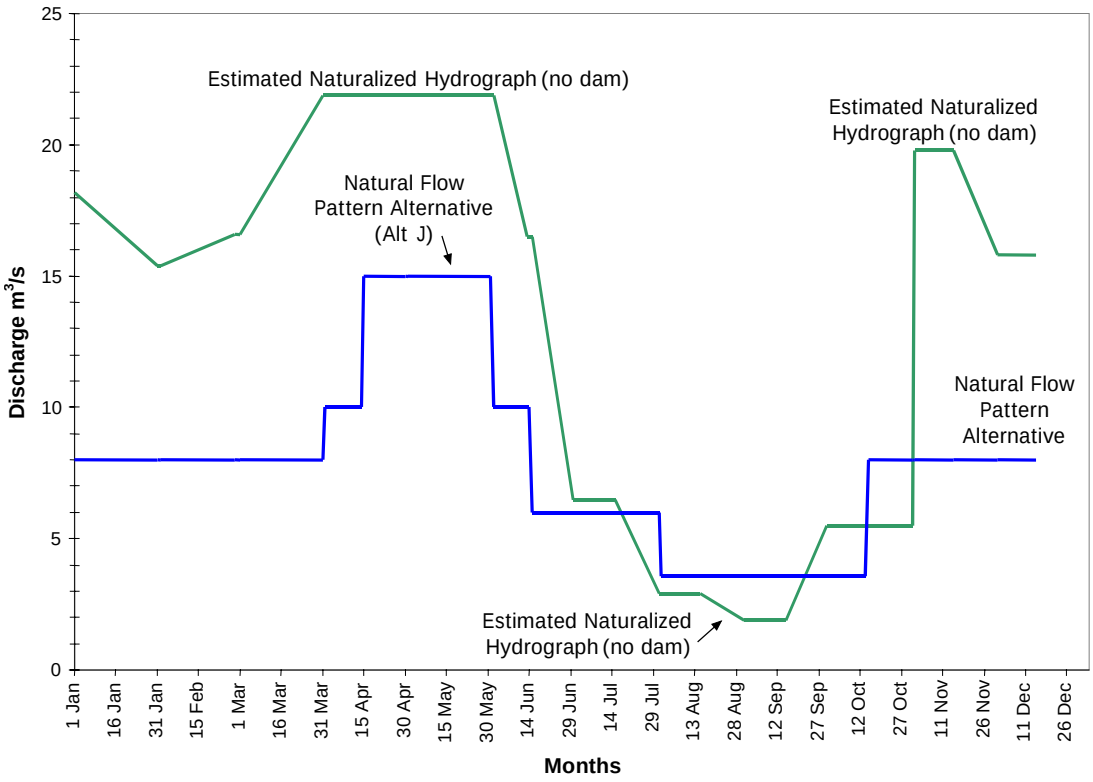


Figure 5-1: Comparison of the Natural Flow Pattern Alternative to the Estimated Naturalized Hydrograph

5.4.2 Three General Fish Flow Patterns

There were three general fish flow patterns among the 13 operating alternatives (Figure 5-2). In decreasing order of flow magnitude they were:

- A naturalized flow pattern alternative (featured in Alternatives J and K) provides higher base flows in fall, winter, and spring following the shape of the naturalized hydrograph. From 15 August to 15 October the base flow is 3.5 m^3/s flows to maintain fish habitat in the river.

- Various combinations of 3.5 m^3/s and 5 m^3/s base flows (Alternatives B, C, E, I1, I2, I3, F, and H). Minimum releases for fish range from 3.5 m^3/s year round to 5 m^3/s year round. Other variations were 5 m^3/s in fall, winter, and spring decreasing to 3.5 m^3/s during drier periods of the year. Note there are one month variations when flows change between 3.5 m^3/s and 5 m^3/s.

- Existing water licence (Alternatives WL, D, G2) with 0.29 m^3/s, September to May and 0.71 m^3/s, June to August, minimum fish flow releases.

For comparative purposes the upper most line in Figure 5-2 shows the estimated naturalized hydrograph in the Ash River if Elsie Dam did not exist.

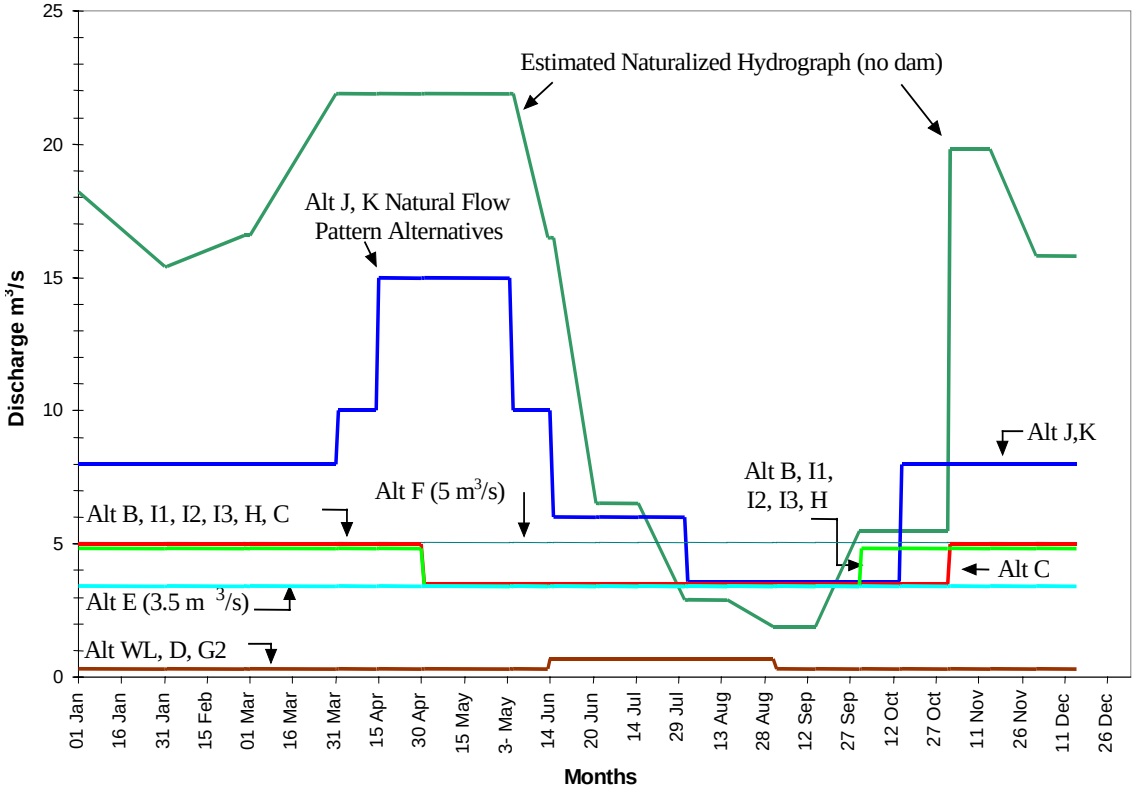


Figure 5-2: Discharge from Elsie Dam into Ash River Under 13 Ash River Water Use Operating Alternatives

5.4.3 Additional Constraints Added to Each Ash River Operating Alternative

In addition to the specifications developed by the Consultative Committee, BC Hydro modellers introduced additional constraints into all 13 operating alternatives to reflect actual operations:

- 21-day generating plant shutdown for maintenance in August to account for annual curtailment of flows from Elsie Lake Reservoir to the power plant and into Great Central Lake. In practice the date of the shutdown period will vary from year-to-year, but generally lasts about three weeks.

- Physical limitation of the Ash River hydroelectric facility (Table 5-3).

Table 5-3: Physical Constraints of the Ash River Hydroelectric Facility

Facility	Operating Variable	Physical Limits & Comments
Elevation Elsie Lake Reservoir	Reservoir Level	Max 330.71 m Min 315.47 m
Discharge down Ash River	Hollow Cone Valve Discharge (Low level outlet)	Min 0 m^3/s Max 55 m^3/s at full pool
	Sluice Gate Discharge	Min 0 m^3/s Max 35 m^3/s at full pool
	Total Controlled Discharge from outlets	Min 0 m^3/s Max 90 m^3/s at full pool
Diversion to Power Plant	Diversion flow to generating plant	Min 0 m^3/s Max 15.01 m^3/s

All the operating alternatives were specified based on the capabilities of the Ash River hydroelectric facility assuming the current dam safety upgrade to Elsie Dam had been completed. The Ash River Water Use Plan and the dam safety upgrade were happening concurrently. The end result of the upgrade would not change the storage capacity of the Elsie Lake Reservoir, but would result in one more water release mechanism - the sluicegate.

5.5 Modelling Operating Alternatives

Modelling the operating alternatives involved a number of steps and computer programs. First the modellers used the BC Hydro Power Optimization Model[1] to simulate operating the hydroelectric facility according to the specifications of the operating alternative. The power model optimized power generation subject to operating constraints specified by the Consultative Committee such as preferred flows ranges and reservoir levels. The modellers also considered the physical operating characteristics of the system such as reservoir storage volume, and discharge capacities of the power intake and the low level outlet.

The power model simulates the operation of the Ash River hydroelectric facility under each operating alternative. The simulations are based on 38 years (1963 to 2000) of estimated historic Elsie Lake Reservoir inflow data. These historic inflows are then "routed" through the Ash River hydroelectric facility in accordance with physical capacities and with consideration for the Consultative Committee's preferred discharges into the Ash River and desired reservoir elevations. The modellers ran numerous iterations to develop an optimum operating solution which minimized deviations from the preferred operations within the physical limits of the hydroelectric facility.

[1] The Power Optimiztion Model was sometimes referred to as the "AMPL model" during the Water Use Plan process as the model was developed using "**A M**athematical **P**rogramming **L**anguage".

For the optimal solution for each operating alternative, the model provided the daily reservoir elevation, daily spill discharge, daily turbine discharge and daily generation output files over 38 years of simulated operation. Average daily reservoir elevations, discharges from Elsie Dam into the Ash River, and turbine discharges into Great Central Lake served as inputs to environmental simulation models to calculate the performance measures for each operating alternative. Another model calculated the value of energy (VOE) produced in each of the 38 years. The Consultative Committee used the resulting performance measures to compare the relative performance and trade-offs between the operating alternatives.

6 TRADE-OFF ANALYSIS

In the trade-off process, the Consultative Committee compared the merits of the 13 operating alternatives for the Ash River hydroelectric facility. The Consultative Committee sought the alternative that best satisfied the suite of water use objectives. The alternatives varied in the benefits they provided. Natural rates of inflow and reservoir storage impose limits on how much water is available to satisfy the range of water use objectives. Necessarily, there are trade-offs on what can be achieved with a finite supply of water. For instance, maintaining high flows for fish habitat in the river means under some conditions there may be less water available for generation or for supporting a large, productive littoral zone along the margins of the reservoir. The trade-off process involved discussions of the relative value among water use objectives: gaining more of some values in exchange for less of others. This section documents the trade-off process and values that Consultative Committee members placed on different water use objectives.

The Consultative Committee used the Performance Measure scores to compare the 13 operating alternatives. Selection of the preferred operating alternatives involved 3 Steps:

1. Identify key Performance Measures
2. Assess trade-offs among operating alternatives and narrow down to better performing alternatives
3. Assess degree of Consultative Committee consensus on remaining alternatives

The outcomes at each step are described next.

6.1 Step 1 Identify Key Performance Measures.

Initially the Consultative Committee developed 28 Performance Measures plus 6 Auxiliary Performance Measures (see Section 4). At the beginning of the trade-off process the Committee agreed to reduce the list to 18 Key Performance Measures to focus on the most important issues. The Committee also retained an additional four second-priority performance measures. The Committee's approach was to use the 18 Key Performance Measures to identify better performing alternatives. Where operating alternatives were not significantly different in their performance, then the second-priority performance measures and auxiliary performance measures would be considered.

18 Key Performance Measures

PM No.	Performance Measures
No. 1	Somass River flood-free days. Number of days that flows in Somass River <650 m^3/s measured at Somass River WSC Gauge
No. 2	Reservoir recreation. Number of days reservoir elevation >329.5 m (24 May to 15 October)
No. 4	Reservoir fishing. Number of days reservoir elevation >329.5 m (April to June)
No. 5	Archaeology no unauthorized collection. Number of days reservoir elevation >328 m
No. 6	Archaeology erosion protection. Number of days reservoir elevation outside range 327 m to 328.5 m
No. 7	First Nation traditional use and study. Number of days reservoir elevation <317.5 m
No. 8	Ash River naturalized flow pattern (1=Yes, 0=No)
No. 11	Reservoir trout spawning habitat (m^2)
No. 12	Reservoir trout rearing habitat (m)
No. 13	Wildlife habitat area in reservoir drawdown zone (ha)
No. 15	Ash River, just downstream of Elsie Dam. Steelhead parr rearing WUW (m)
No. 29	Great Central Lake shoreline incubation M m^3 discharge from Ash River powerhouse
No. 30	Great Central Lake Stamp River migration (M m^3) discharge from Ash River powerhouse
No. 33	Dollar Value of energy (millions)

Second Priority Performance Measures for Fish in the River

PM No.	Performance Measures
No. 22	Ash River at Moran Creek. Steelhead parr rearing WUW (m)
No. 23	Ash River at Moran Creek. Steelhead spawning WUW (m)

No. 24 Ash River at Moran Creek. Coho fry rearing WUW (m)

No. 25 Ash River at Moran Creek. Coho spawning WUW (m)

Performance Measures Not Used in Operating Alternative Selection Process

PM No.	Performance Measures
No. 3	Reservoir recreation days > 327.5 m (24 May to 15 October)
No. 9	Reservoir euphotic volume (Mm^3. days)
No. 10	Reservoir effective littoral zone (ha)
No. 14	Migration pulse flows (1=Yes, 0=No)
No. 16	Ash River just below Elsie Dam. Steelhead spawning WUW (m)
No. 17	Ash River just below Elsie Dam. Coho fry rearing WUW (m)
No. 18	Ash River just below Elsie Dam. Coho spawning WUW (m)
No. 31	Great Central Lake. Total discharge from Ash River powerhouse (M m^3)
No. 32	MW.h generated per acre-feet inflow
No. 34	Plant availability index

6.2 Step 2 Trade-offs Between Operating Alternatives and Identifying Better Performing Alternatives

The Consultative Committee used an interactive colour coded Excel spreadsheet to help interpret the relative scores (Figure 6-1).[1] Each of the 13 columns represents one operating alternative while each of the 18 rows represents one performance measure (and underlying water use objective). The cell at the intersection of a column and a row holds the score for that alternative on that performance measure. Higher scores indicate better performance.

[1] See Appendix K for the annotated table of Performance Measures and water use alternatives.

Alternative No. of Interest: 1

Colour key: Better / Equal / Worse

PM#	PM	Alternative name:	1 WL	2 E	3 B	4 C	5 F	6 D	7 G2	8 H	9 I1	10 I2	11 I3	12 J	13 K
1	Flood Free (days <650 m^3/s at Somass)		12,017	12,017	12,017	12,017	12,017	12,017	12,017	12,017	12,008	12,017	12,017	12,016	11,995
2	Reservoir Rec. days >329.5 m 24 May-15 Oct		82	58	56	57	53	79	63	56	0	0	0	35	0
4	Reservoir Fishing days > 329.5 Apr-Jun		91	79	69	71	66	31	91	69	0	5	5	21	0
5	Arch No Unauthorized Collection days >328 m		302	234	217	221	217	262	264	217	0	79	84	146	45
6	Arch Erosion, days avoid 327 m - 328.5 m		347	336	325	325	325	267	337	339	365	347	346	325	353
7	FN Traditional Use & Study - Reservoir Days		0	0	0	0	0	0	0	0	5	4	4	0	6
8	River naturalized hydrograph 1=Yes 0=No		0	0	0	0	0	0	0	0	0	0	0	1	1
11	Reservoir Trout Spawning m^2		0.0	0.0	0.0	0.0	0.0	50.8	0.0	0	12,934	25	25	10	266
12	Reservoir Trout Rearing m		0.0	0.0	4.4	4.4	4.4	8.8	0.0	4	5,348	5,220	4,002	874	5,630
13	Wildlife habitat Drawdown Zone ha		22	48	52	52	50	39	36	52	216	193	167	73	219
15	Elsie. Steelhead Parr Rearing m		0.8	11.9	11.9	11.9	17.0	2.9	0.8	11.9	11.9	11.9	11.9	11.9	11.9
22	Moran. Steelhead Parr Rearing m		6.1	16.7	17.6	16.7	20.2	6.2	6.1	17.7	17.2	17.2	17.0	17.2	16.7
23	Moran. Steelhead Spawning m		16.2	23.9	26.9	26.9	26.9	16.2	16.2	26.9	23.0	26.5	26.5	28.4	27.9
24	Moran. Coho Fry rearing WUW m		2.3	5.6	5.7	5.6	5.9	2.4	2.3	5.7	5.7	5.7	5.7	5.6	5.6
25	Moran. Coho Spawning m		3.2	4.4	5.1	5.0	5.1	2.8	2.8	5.1	14.5	5.1	5.1	7.1	7.2
29	GCL Shoreline incubation M m^3		29.2	32.8	32.8	32.8	32.8	32.8	32.8	32.8	18.1	32.8	32.8	32.8	32.8
30	GCL Stamp R. migration M m^3		65.4	64.4	64.1	64.4	58.2	33.8	65.5	64.1	15.3	15.3	19.8	59.3	13.9
33	$ Value of energy (millions)		9.6	10.3	10.2	10.2	9.9	9.8	10.9	9.6	6.0	8.1	9.1	9.1	7.1

Figure 6-1: Interactive Colour Coded Excel Spreadsheet to Assist In Comparing Ash River Water Use Plan Operating Alternatives

Using the spreadsheet the Consultative Committee could highlight one operating alternative at a time and compare its Performance Measure scores against the scores of the other alternatives. The spreadsheet used the value of Minimum Significant Incremental Change (MSIC discussed in Section 4) to determine if two Performance Measure scores are the same or significantly different.

As an example of the colour coding, in Figure 6-1 Alternative WL is highlighted as indicated by the blue box at top of Column 1. Choosing Performance Measure No. 6, Archaeology—protect site from erosion—we can see the Performance Measure score for Alternative WL is 347 days. That is, Alternative WL provides 347 days when the reservoir elevation is outside the range 327 m to 328.5 m when the archaeological site is susceptible to potential wave erosion. One column to the right, Alternative E scores 336 but is within ± 15 days MSIC of the score for Alternative WL.[1] To indicate there is no significant difference from Alternative WL, the cell for Performance Measure No. 6 under Alternative E is coloured *yellow*.

In contrast, Performance Measure No. 6 shows Alternative B provides 325 days of erosion protection and the cell is coloured *red*. The red indicates that score of 325 days in Alternative B is significantly less than the 347 day score for Alternative WL.

Finally, when compared to Alternative WL, Alternative I1 scores 365 days on Performance Measure No. 6 and the cell is coloured *blue* indicating Alternative I1 performs better than Alternative WL providing more days of protection from wave erosion.[2]

In summary, the colour coding relative to the highlighted operating alternative is:

Yellow: Not significantly different from the highlighted generating alternative

Red: Significantly worse than the highlighted operating alternative

Blue: Significantly better than the highlighted operating alternative

Note that in the colour coded matrices that follow in this section of the report, the blue, yellow, and red colour coding changes because all comparisons are made against the highlighted operating alternative. As different alternatives are highlighted, the colour coding changes to reflect relative gains, losses, and equalities.

[1] See Section 4 in this report for a description of MSIC.
[2] The more familiar yellow/ red/ green traffic signal colouring was changed to yellow/ red/ blue to accommodate committee members who had difficulty distinguishing between red and green colours.

In making choices, Consultative Committee members sought alternatives that offered more blue cells (gains) and fewer red cells (losses) than the highlighted alternative under consideration. Using the spreadsheet, Committee members could highlight any one of the 13 alternatives and compare its performance to the other 12 alternatives. The colour coding would automatically adjust and show the gains and losses relative to the alternative under scrutiny. Projected onto a screen, the Consultative Committee could collectively review the comparisons and discuss the trade-offs in gains and losses.

The other tool used by the Consultative Committee were box plots (Appendix K) of the Performance Measures which graphically showed the variation in scores for each Performance Measure over 38 years of simulated operations. While the table of Performance Measures showed median values, the box plots showed the range of variation typical over a simulated 38 years of operation through the range of dry to wet inflow years.

Through the trade-off process, the Consultative Committee reduced the number of operating alternatives to four top choices (Alternatives E, C, I2, and J) from the field of 13. Eliminating nine alternatives was not a straightforward process as each alternative had important merits not offered by other alternatives. In order to eliminate an alternative, Committee members had to agree to trading off one water use objective for another. The trade-offs are summarized in the next section.

6.2.1 Eliminate Alternative WL

Many operating alternatives perform better than Alternative WL on river fish and power measures (see blue cells in Figure 6-1). For Performance Measure No. 15 (steelhead parr rearing below Elsie Dam), Alternative WL offers only 0.8 m of wetted stream width while Alternatives E and G2 provide 11.9 m of wetted width, or almost a 15 times improvement. This is because Alternative WL has base flow releases into the Ash River of between 0.29 and 0.71 m^3/s while the other alternatives have a minimum of 3.5 m^3/s release.

Alternative WL also does poorer on power revenue. Alternative WL provides $9.6 million in revenue while the other alternatives offer between $10.2 and $10.9 million, an increase of between $600,000 and $1.3 million. This is because the existing water licence is constrained to 76.5 million m^3 diversion per year to the power plant. This restriction is lifted in the other 12 operating alternatives.

However, Alternative WL does better on Performance Measure No. 5 offering 302 days that the archaeological site is covered by water and the artifacts are protected from unauthorized removal. Cells for Performance Measure No. 5 under the other operating alternatives in Figure 6-1 are red indicating that those alternatives perform significantly poorer in protecting the archaeological site.

The Consultative Committee discussed Alternatives WL, E, and G2 in light of the trade-off between benefits to fish in the Ash River and to power revenues versus possible negative impacts to the archaeological resource. The Committee discussed options for addressing the possible loss of artifacts if WL was eliminated in favour of Alternatives E or G2. The Hupacasath First Nation indicated an interest in a monitoring study to assess the erosion risk to the main archaeological site and a monitoring study to assess the rate of exposure of the scattered lithics in the drawdown zone. They also suggested mitigative salvage of artifacts as it was preferable to have the artifacts in hand rather than on site. The Committee did not have a firm estimate of the cost of such a monitoring program or how it would be funded. However, the Committee agreed to the concept of an archaeology monitoring program.

When Performance Measure No. 5 is omitted, Alternatives G2 and E score better than Alternative WL on all remaining performance measures. The Committee agreed to eliminate Alternative WL subject to archaeology issues be addressed through monitoring or mitigative action.

The Consultative Committee Agreed to Eliminate Alternative WL.

6.2.2 Set Aside Alternative E

Figure 6-2 shows the remaining 12 alternatives and with Alternative E highlighted. The yellow cells show that on most performance measures Alternative E performs similarly to Alternatives B and C. To help differentiate between Alternatives E, B, and C, the Consultative Committee reconsidered two performance measures previously removed: Performance Measure No. 16 (steelhead spawning habitat just below Elsie Dam) and Performance Measure No. 31 (total input to Great Central Lake).

Alternative No. of Interest: 2

Colour key: Better / Equal / Worse

PM#	PM	Alternative name:	2 E	3 B	4 C	5 F	6 D	7 G2	8 H	9 I1	10 I2	11 I3	12 J	13 K
1	Flood Free (days <650 m^3/s at Somass)		12,017	12,017	12,017	12,017	12,017	12,017	12,017	12,008	12,017	12,017	12,016	11,995
2	Reservoir Rec. days >329.5 m 24 May-15 Oct		58	56	57	53	79	63	56	0	0	0	35	0
4	Reservoir Fishing days > 329.5 Apr-Jun		79	69	71	66	31	91	69	0	5	5	21	0
5	Arch No Unauthorized Collection days >328 m		234	217	221	217	262	264	217	0	79	84	146	45
6	Arch Erosion, days avoid 327 m - 328.5 m		336	325	325	325	267	337	339	365	347	346	325	353
7	FN Traditional Use & Study - Reservoir Days		0	0	0	0	0	0	0	5	4	4	0	6
8	River naturalized hydrograph 1=Yes 0=No		0	0	0	0	0	0	0	0	0	0	1	1
11	Reservoir Trout Spawning m^2		0.0	0.0	0.0	0.0	50.8	0.0	0	12,934	25	25	10	266
12	Reservoir Trout Rearing m		0.0	4.4	4.4	4.4	8.8	0.0	4	5,348	5,220	4,002	874	5,630
13	Wildlife habitat Drawdown Zone ha		48	52	52	50	39	36	52	216	193	167	73	219
15	Elsie. Steelhead Parr Rearing m		11.9	11.9	11.9	17.0	2.9	0.8	11.9	11.9	11.9	11.9	11.9	11.9
16	Elsie. Steelhead Spawning m		10.9	17.7	17.7	17.7	4.1	0.0	17.7	17.7	17.7	17.7	26.9	26.9
22	Moran. Steelhead Parr Rearing m		16.7	17.6	16.7	20.2	6.2	6.1	17.7	17.2	17.2	17.0	17.2	16.7
23	Moran. Steelhead Spawning m		23.9	26.9	26.9	26.9	16.2	16.2	26.9	23.0	26.5	26.5	28.4	27.9
24	Moran. Coho Fry rearing WUW m		5.6	5.7	5.6	5.9	2.4	2.3	5.7	5.7	5.7	5.7	5.6	5.6
25	Moran. Coho Spawning m		4.4	5.1	5.0	5.1	2.8	2.8	5.1	14.5	5.1	5.1	7.1	7.2
29	GCL Shoreline incubation M m^3		32.8	32.8	32.8	32.8	32.8	32.8	32.8	18.1	32.8	32.8	32.8	32.8
30	GCL Stamp R. migration M m^3		64.4	64.1	64.4	58.2	33.8	65.5	64.1	15.3	15.3	19.8	59.3	13.9
31	GCL Total input M m^3		377	371	373	358	352	404	371	211	292	333	320	256
33	$ Value of energy (millions)		10.3	10.2	10.2	9.9	9.8	10.9	9.6	6.0	8.1	9.1	9.1	7.1

Figure 6-2: Highlight Alternative E. Alternative WL Removed

The Committee saw merits in Alternative E. First it offers $100,000 more power revenue than Alternatives B or C even though the difference in revenue between the three alternatives is less than the ± $200,000 MSIC. The $200,000 represents about 3.5 days of generation at full load. While the BC Hydro modeller estimated the accuracy around estimating revenue from the Ash River hydroelectric facility to be ± $200,000, some Committee members considered the additional $100,000 in revenue under Alternative E to be significant.

Second, for Committee members concerned about fish habitat in Great Central Lake and the Upper Stamp River, Alternative E delivers 377 million m^3 of water (Performance Measure No. 31) into Great Central Lake compared to 371 million m^3 and 373 million m^3 delivered by Alternatives B and C. Note these figures differ by less than the ±10% MSIC.

As a counter argument, the Fish Technical Subcommittee in earlier meetings recommended Alternatives B and C as the better performing operating alternatives for river fish interests. As a tie-breaker between Alternatives E, B, and C, the Fish Technical Subcommittee considered Performance Measure No. 16 (steelhead spawning below Elsie Dam) Alternatives B and C offered 17.7 m wetted channel width compared to only 10.9 m width under Alternative E.

The gain in steelhead spawning habitat in the Ash River under Alternatives B and C was valued more than gains in water delivered to Great Central Lake and a potential $100,000 increase in revenue under Alternative E. Therefore, the Committee agreed to "set aside" (not eliminate) Alternative E.

6.2.3 Eliminate Alternative B

The Consultative Committee had 11 remaining operating alternatives and next highlighted Alternative B (Figure 6-3). Alternatives B and C score similarly on the key performance measures. In other words, Alternative B and C are expected to deliver the same outcomes with respect to water use planning objectives. However, some Committee members noted that Alternative C maintains releases from Elsie Dam at the lower 3.5 m^3/s for one month longer (6 months at 3.5 m^3/s) compared to Alternative B (only 5 months at 3.5 m^3/s) before increasing base flows to 5 m^3/s.

Alternative No. of Interest: 3

Colour key: Better / Equal / Worse

PM#	PM Alternative name:	3 B	4 C	5 F	6 D	7 G2	8 H	9 I1	10 I2	11 I3	12 J	13 K
1	Flood Free (days <650 m^3/s at Somass)	12,017	12,017	12,017	12,017	12,017	12,017	12,008	12,017	12,017	12,016	11,995
2	Reservoir Rec. days >329.5 m 24 May-15 Oct	56	57	53	79	63	56	0	0	0	35	0
4	Reservoir Fishing days > 329.5 Apr-Jun	69	71	66	31	91	69	0	5	5	21	0
5	Arch No Unauthorized Collection days >328 m	217	221	217	262	264	217	0	79	84	146	45
6	Arch Erosion, days avoid 327 m - 328.5 m	325	325	325	267	337	339	365	347	346	325	353
7	FN Traditional Use & Study - Reservoir Days	0	0	0	0	0	0	5	4	4	0	6
8	River naturalized hydrograph 1=Yes 0=No	0	0	0	0	0	0	0	0	0	1	1
11	Reservoir Trout Spawning m^2	0.0	0.0	0.0	50.8	0.0	0	12,934	25	25	10	266
12	Reservoir Trout Rearing m	4.4	4.4	4.4	8.8	0.0	4	5,348	5,220	4,002	874	5,630
13	Wildlife habitat Drawdown Zone ha	52	52	50	39	36	52	216	193	167	73	219
15	Elsie. Steelhead Parr Rearing m	11.9	11.9	17.0	2.9	0.8	11.9	11.9	11.9	11.9	11.9	11.9
16	Elsie. Steelhead Spawning m	17.7	17.7	17.7	4.1	0.0	17.7	17.7	17.7	17.7	26.9	26.9
22	Moran. Steelhead Parr Rearing m	17.6	16.7	20.2	6.2	6.1	17.7	17.2	17.2	17.0	17.2	16.7
23	Moran. Steelhead Spawning m	26.9	26.9	26.9	16.2	16.2	26.9	23.0	26.5	26.5	28.4	27.9
24	Moran. Coho Fry rearing WUW m	5.7	5.6	5.9	2.4	2.3	5.7	5.7	5.7	5.7	5.6	5.6
25	Moran. Coho Spawning m	5.1	5.0	5.1	2.8	2.8	5.1	14.5	5.1	5.1	7.1	7.2
29	GCL Shoreline incubation M m^3	32.8	32.8	32.8	32.8	32.8	32.8	18.1	32.8	32.8	32.8	32.8
30	GCL Stamp R. migration M m^3	64.1	64.4	58.2	33.8	65.5	64.1	15.3	15.3	19.8	59.3	13.9
31	GCL Total input M m^3	371	373	358	352	404	371	211	292	333	320	256
33	$ Value of energy (millions)	10.2	10.2	9.9	9.8	10.9	9.6	6.0	8.1	9.1	9.1	7.1

Figure 6-3: Highlight Alternative B with Alternative E Removed

Given the performance measures, the expected outcomes relative to the Committee's interests were indistinguishable between Alternatives B and C. Both alternatives would provide the same power revenue, fish and wildlife habitat and protection to archaeology resources. However, Alternative C conserves water in the reservoir by holding releases at 3.5 m^3/s for one month longer than Alternative B. This increases the probability that the system can deliver the minimum flow to maintain fish habitat in low inflow years.

The Consultative Committee agreed to eliminate Alternative B in favour of Alternative C. Alternative C provides the same water use benefits as Alternative B but Alternative C conserves water in the reservoir thereby increasing the probability of maintaining fish habitat in the Ash River during the fall in low flow years. Alternative B offered no gains to any water use objectives by increasing minimum flows to 5 m^3/s one month earlier compared to Alternative C.

6.2.4 Eliminate Alternative H

Next Alternative C is highlighted (Figure 6-4). Relative to Alternative C, Alternative H scored similarly on all key performance measures except for power revenue on which it scored $600,000 less than Alternative C. Alternative H is designed to spill water at 48 m^3/s for two days to draw down Elsie Lake Reservoir quickly through the elevation range 328.5 m down to 327.0 m in order to reduce potential erosion of the archaeological site. When the reservoir is rising because of heavy inflows, it normally passes through the sensitive elevation zone within two days so no special action is required.

Alternative No. of Interest: 4

Colour key: Better / Equal / Worse

PM#	PM	Alternative name:	4 C	5 F	6 D	7 G2	8 H	9 I1	10 I2	11 I3	12 J	13 K
1	Flood Free (days <650 m^3/s at Somass)		12,017	12,017	12,017	12,017	12,017	12,008	12,017	12,017	12,016	11,995
2	Reservoir Rec. days >329.5 m 24 May-15 Oct		57	53	79	63	56	0	0	0	35	0
4	Reservoir Fishing days > 329.5 Apr-Jun		71	66	31	91	69	0	5	5	21	0
5	Arch No Unauthorized Collection days >328 m		221	217	262	264	217	0	79	84	146	45
6	Arch Erosion, days avoid 327 m - 328.5 m		325	325	267	337	339	365	347	346	325	353
7	FN Traditional Use & Study - Reservoir Days		0	0	0	0	0	5	4	4	0	6
8	River naturalized hydrograph 1=Yes 0=No		0	0	0	0	0	0	0	0	1	1
11	Reservoir Trout Spawning m^2		0.0	0.0	50.8	0.0	0	12,934	25	25	10	266
12	Reservoir Trout Rearing m		4.4	4.4	8.8	0.0	4	5,348	5,220	4,002	874	5,630
13	Wildlife habitat Drawdown Zone ha		52	50	39	36	52	216	193	167	73	219
15	Elsie. Steelhead Parr Rearing m		11.9	17.0	2.9	0.8	11.9	11.9	11.9	11.9	11.9	11.9
16	Elsie. Steelhead Spawning m		17.7	17.7	4.1	0.0	17.7	17.7	17.7	17.7	26.9	26.9
22	Moran. Steelhead Parr Rearing m		16.7	20.2	6.2	6.1	17.7	17.2	17.2	17.0	17.2	16.7
23	Moran. Steelhead Spawning m		26.9	26.9	16.2	16.2	26.9	23.0	26.5	26.5	28.4	27.9
24	Moran. Coho Fry rearing WUW m		5.6	5.9	2.4	2.3	5.7	5.7	5.7	5.7	5.6	5.6
25	Moran. Coho Spawning m		5.0	5.1	2.8	2.8	5.1	14.5	5.1	5.1	7.1	7.2
29	GCL Shoreline incubation M m^3		32.8	32.8	32.8	32.8	32.8	18.1	32.8	32.8	32.8	32.8
30	GCL Stamp R. migration M m^3		64.4	58.2	33.8	65.5	64.1	15.3	15.3	19.8	59.3	13.9
31	GCL Total input M m^3		373	358	352	404	371	211	292	333	320	256
33	$ Value of energy (millions)		10.2	9.9	9.8	10.9	9.6	6.0	8.1	9.1	9.1	7.1

Figure 6-4: Highlight Alternative C with Alternative B Removed

Both Alternatives C and H provide the same outcomes relative to water use objectives including avoiding the sensitive elevation range 327 to 328.5 m for archaeological resources. The action of spilling to avoid being in the 327 to 328.5 days has no measurable effect on the performance measure No. 6. However, Alternative H incurs a $600,000 loss in revenue compared to Alternative C.

The Consultative Committee agreed to eliminate Alternative H in favour of Alternative C which provides a gain of $600,000 more in power revenue with no trade-offs on other water use interests.

6.2.5 Eliminate Alternative F

Of the remaining operating alternatives, Alternative F provides the most steelhead parr rearing habitat, at 17 m weighted usable width, in the Ash River just below Elsie Dam. In comparison, the next best alternatives increased weighted usable steelhead rearing parr habitat to 11.9 m width. However, the trade-off is that Alternative F provides $300,000 less power revenues (Figure 6-5).

Alternative No. of Interest: 4

Colour key: Better / Equal / Worse

PM#	PM Alternative name:	4 C	5 F	6 D	7 G2	9 I1	10 I2	11 I3	12 J	13 K
1	Flood Free (days <650 m^3/s at Somass)	12,017	12,017	12,017	12,017	12,008	12,017	12,017	12,016	11,995
2	Reservoir Rec. days >329.5 m 24 May-15 Oct	57	53	79	63	0	0	0	35	0
4	Reservoir Fishing days > 329.5 Apr-Jun	71	66	31	91	0	5	5	21	0
5	Arch No Unauthorized Collection days >328 m	221	217	262	264	0	79	84	146	45
6	Arch Erosion, days avoid 327 m - 328.5 m	325	325	267	337	365	347	346	325	353
7	FN Traditional Use & Study - Reservoir Days	0	0	0	0	5	4	4	0	6
8	River naturalized hydrograph 1=Yes 0=No	0	0	0	0	0	0	0	1	1
11	Reservoir Trout Spawning m^2	0.0	0.0	50.8	0.0	12,934	25	25	10	266
12	Reservoir Trout Rearing m	4.4	4.4	8.8	0.0	5,348	5,220	4,002	874	5,630
13	Wildlife habitat Drawdown Zone ha	52	50	39	36	216	193	167	73	219
15	Elsie. Steelhead Parr Rearing m	11.9	17.0	2.9	0.8	11.9	11.9	11.9	11.9	11.9
16	Elsie. Steelhead Spawning m	17.7	17.7	4.1	0.0	17.7	17.7	17.7	26.9	26.9
22	Moran. Steelhead Parr Rearing m	16.7	20.2	6.2	6.1	17.2	17.2	17.0	17.2	16.7
23	Moran. Steelhead Spawning m	26.9	26.9	16.2	16.2	23.0	26.5	26.5	28.4	27.9
24	Moran. Coho Fry rearing WUW m	5.6	5.9	2.4	2.3	5.7	5.7	5.7	5.6	5.6
25	Moran. Coho Spawning m	5.0	5.1	2.8	2.8	14.5	5.1	5.1	7.1	7.2
29	GCL Shoreline incubation M m^3	32.8	32.8	32.8	32.8	18.1	32.8	32.8	32.8	32.8
30	GCL Stamp R. migration M m^3	64.4	58.2	33.8	65.5	15.3	15.3	19.8	59.3	13.9
31	GCL Total input M m^3	373	358	352	404	211	292	333	320	256
33	$ Value of energy (millions)	10.2	9.9	9.8	10.9	6.0	8.1	9.1	9.1	7.1

Figure 6-5: Highlight Alternative C with Alternative H Removed

Alternative F performed the best at achieving the objective "Maximize fish production in the Ash River". Yet, the Consultative Committee had reservations about this alternative.

- Members of the Fish Technical Subcommittee had ranked Alternative F either third or fourth choice after Alternatives B and C. Many members of the Fish Technical Subcommittee considered that the 5 m^3/s year round release under Alternative F would be a much higher flow than the system has ever experienced particularly during the summer. One Consultative Committee member considered Alternative F as being "too rich" with water and had uncertainties about whether the increased minimum flows would have negative effects on river ecology. The Committee did not develop a performance measure to indicate if an operating alternative deviated significantly from a "normal" ecological condition.

- Alternative F causes the reservoir to "run out of water" 3 years out of the 38 simulated years. The 5 m^3/s release into the Ash River could not be sustained during the October to November spawner migration period in dry inflow years. Note Alternative C also drains the reservoir 2 years out of the 38 simulated years of operation. Without releases from Elsie Dam, flows in the Ash River would depend only on inflows from tributaries to the river.

- For Consultative Committee members interested in sockeye in Great Central Lake and the Upper Stamp River, releasing 5 m^3/s into the Ash River reduces the volume of water available for generation and discharge into Great Central Lake. Alternative F diverts 358 million m^3 into Great Central Lake while Alternative C diverts 373 million m^3. Note these two figures are similar and are within the ±10% MSIC, however,

the Committee determined the 15 million m^3 difference was meaningful as having to curtail generation would increase the risk of reduced flows in the Upper Stamp River.

The Consultative Committee agreed to eliminate Alternative F. In eliminating Alternative F, the Committee gave up a 43% increase in steelhead rearing habitat (to 17 m channel width from 11.9 m) relative to the next best alternatives (Alternatives C, I-series, J, and K).

The Committee valued

(1) **more certainty in water supply (under Alternative F, releases from Elsie Lake Reservoir were unsustainable 3 years in 38 years in model simulations),**

(2) **providing 15 million m^3 more water into Great Central Lake for the benefit migrating sockeye in the Upper Stamp River (this would also benefit lake spawners), and**

(3) **not disturbing the ecology of the Ash River (by introducing a new 5 m^3/s minimum flow year round).**

6.2.6 Eliminate Alternative D

With Alternative D highlighted Figure 6-6 shows other operating alternatives offered more benefits than Alternative D for protection of the archaeological site and for fish in the river (there are many blue cells under other alternatives). Alternative D was designed to keep the reservoir high to provide lake recreation opportunities. However, the trade-off is reduced flows in the Ash River and the modelling results show Alternative D provides less rearing habitat (2.9 m wetted width) than most of the remaining alternatives (11.9 m) for steelhead parr.

Alternative No. of Interest: 6

Colour key: Better / Equal / Worse

M#	PM	Alternative name:	4 C	6 D	7 G2	9 I1	10 I2	11 I3	12 J	13 K
1		Flood Free (days <650 m^3/s at Somass)	12,017	12,017	12,017	12,008	12,017	12,017	12,016	11,995
2		Reservoir Rec. days >329.5 m 24 May-15 Oct	57	79	63	0	0	0	35	0
4		Reservoir Fishing days > 329.5 Apr-Jun	71	31	91	0	5	5	21	0
5		Arch No Unauthorized Collection days >328 m	221	262	264	0	79	84	146	45
6		Arch Erosion, days avoid 327 m - 328.5 m	325	267	337	365	347	346	325	353
7		FN Traditional Use & Study - Reservoir Days	0	0	0	5	4	4	0	6
8		River naturalized hydrograph 1=Yes 0=No	0	0	0	0	0	0	1	1
11		Reservoir Trout Spawning m^2	0.0	50.8	0.0	12,934	25	25	10	266
12		Reservoir Trout Rearing m	4.4	8.8	0.0	5,348	5,220	4,002	874	5,630
13		Wildlife habitat Drawdown Zone ha	52	39	36	216	193	167	73	219
15		Elsie. Steelhead Parr Rearing m	11.9	2.9	0.8	11.9	11.9	11.9	11.9	11.9
16		Elsie. Steelhead Spawning m	17.7	4.1	0.0	17.7	17.7	17.7	26.9	26.9
22		Moran. Steelhead Parr Rearing m	16.7	6.2	6.1	17.2	17.2	17.0	17.2	16.7
23		Moran. Steelhead Spawning m	26.9	16.2	16.2	23.0	26.5	26.5	28.4	27.9
24		Moran. Coho Fry rearing WUW m	5.6	2.4	2.3	5.7	5.7	5.7	5.6	5.6
25		Moran. Coho Spawning m	5.0	2.8	2.8	14.5	5.1	5.1	7.1	7.2
29		GCL Shoreline incubation M m^3	32.8	32.8	32.8	18.1	32.8	32.8	32.8	32.8
30		GCL Stamp R. migration M m^3	64.4	33.8	65.5	15.3	15.3	19.8	59.3	13.9
31		GCL Total input M m^3	373	352	404	211	292	333	320	256
33		$ Value of energy (millions)	10.2	9.8	10.9	6.0	8.1	9.1	9.1	7.1

Figure 6-6: Highlight Alternative D with Alternative F Removed

The Consultative Committee agreed to remove Alternative D. The Committee valued the gain in steelhead rearing habitat more than a gain in recreation days at Elsie Lake Reservoir.

6.2.7 Eliminate Alternative G2

Figure 6-7 shows the remaining seven operating alternatives with Alternative G2 highlighted. Alternative G2 was designed to maximize power generation and provide fish flow releases into the Ash River of 0.29 m^3/s in the fall, winter, and spring and 0.71 m^3/s in the summer. The Consultative Committee debated the trade-offs between Alternative G2 and the other alternatives:

- Alternative G2 did not offer as much benefit to fish in the Ash River as other operating alternatives because releases for fish are the same as the current water licence (between 0.29 m^3/s and 0.71 m^3/s). Alternative G2 provides 0.8 m wetted width for steelhead rearing habitat versus 11.9 m under other alternatives.

- In practice, Alternative G2 would cause less water to be released from Elsie Lake Reservoir for fish habitat than current operations. While the existing water licence is still in effect BC Hydro has typically maintained base flow releases at about 3 m^3/s for the past few years. Alternative G2 would reduce releases to the regime of 0.29 m^3/s and 0.71 m^3/s.

- Alternative G2 provides a gain of between $700,000 and $3.9 million in power revenue than the other alternatives.

- Alternative G2 is best at protecting archaeological sites by covering the sites with water for 264 days versus 221 days or less under other operating alternatives. The Committee discussed addressing protecting the archaeological sites through monitoring. The monitoring would include collecting any artifacts found.

One Consultative Committee member commented that the choice of 3.5 m^3/s release was rather arbitrary as the relationship between flow release and fish habitat is linear. We could have chosen any point along the line between zero and approximately 7 m^3/s minimum discharge.

Alternative No. of Interest: 7

Colour key: Better / Equal / Worse

PM#	PM	Alternative name:	4 C	7 G2	9 I1	10 I2	11 I3	12 J	13 K
1	Flood Free (days <650 m^3/s at Somass)		12,017	12,017	12,008	12,017	12,017	12,016	11,995
2	Reservoir Rec. days >329.5 m 24 May-15 Oct		57	63	0	0	0	35	0
4	Reservoir Fishing days > 329.5 Apr-Jun		71	91	0	5	5	21	0
5	Arch No Unauthorized Collection days >328 m		221	264	0	79	84	146	45
6	Arch Erosion, days avoid 327 m - 328.5 m		325	337	365	347	346	325	353
7	FN Traditional Use & Study - Reservoir Days		0	0	5	4	4	0	6
8	River naturalized hydrograph 1=Yes 0=No		0	0	0	0	0	1	1
11	Reservoir Trout Spawning m^2		0.0	0.0	12,934	25	25	10	266
12	Reservoir Trout Rearing m		4.4	0.0	5,348	5,220	4,002	874	5,630
13	Wildlife habitat Drawdown Zone ha		52	36	216	193	167	73	219
15	Elsie. Steelhead Parr Rearing m		11.9	0.8	11.9	11.9	11.9	11.9	11.9
16	Elsie. Steelhead Spawning m		17.7	0.0	17.7	17.7	17.7	26.9	26.9
22	Moran. Steelhead Parr Rearing m		16.7	6.1	17.2	17.2	17.0	17.2	16.7
23	Moran. Steelhead Spawning m		26.9	16.2	23.0	26.5	26.5	28.4	27.9
24	Moran. Coho Fry rearing WUW m		5.6	2.3	5.7	5.7	5.7	5.6	5.6
25	Moran. Coho Spawning m		5.0	2.8	14.5	5.1	5.1	7.1	7.2
29	GCL Shoreline incubation M m^3		32.8	32.8	18.1	32.8	32.8	32.8	32.8
30	GCL Stamp R. migration M m^3		64.4	65.5	15.3	15.3	19.8	59.3	13.9
31	GCL Total input M m^3		373	404	211	292	333	320	256
33	$ Value of energy (millions)		10.2	10.9	6.0	8.1	9.1	9.1	7.1

Figure 6-7: Highlight Alternative G2 with Alternative D Removed

The Consultative Committee agreed to eliminate Alternative G2. The Committee valued a gain in fish habitat in the Ash River under other alternatives more than a gain of $700,000+ in power generation under Alternative G2.

6.2.8 Eliminate Alternative K

Alternative K was designed to provide fish habitat and a more naturally shaped hydrograph in the Ash River. Alternative K (Figure 6-8) performs equally well as other operating alternatives on river fish Performance Measures (yellow cells) and improves on steelhead spawning habitat (Performance Measure No. 16) over other alternatives. Alternative K (and Alternative J) provides more spawning habitat by releasing higher volumes of water in order to create a more naturalized hydrograph in the Ash River.

Alternative No. of Interest: 13

Colour key Better / Equal / Worse

PM#	PM	Alternative name:	4 C	9 I1	10 I2	11 I3	12 J	13 K
1	Flood Free (days <650 m^3/s at Somass)		12,017	12,008	12,017	12,017	12,016	11,995
2	Reservoir Rec. days >329.5 m 24 May-15 Oct		57	0	0	0	35	0
4	Reservoir Fishing days > 329.5 Apr-Jun		71	0	5	5	21	0
5	Arch No Unauthorized Collection days >328 m		221	0	79	84	146	45
6	Arch Erosion, days avoid 327 m - 328.5 m		325	365	347	346	325	353
7	FN Traditional Use & Study - Reservoir Days		0	5	4	4	0	6
8	River naturalized hydrograph 1=Yes 0=No		0	0	0	0	1	1
11	Reservoir Trout Spawning m^2		0.0	12,934	25	25	10	266
12	Reservoir Trout Rearing m		4.4	5,348	5,220	4,002	874	5,630
13	Wildlife habitat Drawdown Zone ha		52	216	193	167	73	219
15	Elsie. Steelhead Parr Rearing m		11.9	11.9	11.9	11.9	11.9	11.9
16	Elsie. Steelhead Spawning m		17.7	17.7	17.7	17.7	26.9	26.9
22	Moran. Steelhead Parr Rearing m		16.7	17.2	17.2	17.0	17.2	16.7
23	Moran. Steelhead Spawning m		26.9	23.0	26.5	26.5	28.4	27.9
24	Moran. Coho Fry rearing WUW m		5.6	5.7	5.7	5.7	5.6	5.6
25	Moran. Coho Spawning m		5.0	14.5	5.1	5.1	7.1	7.2
29	GCL Shoreline incubation M m^3		32.8	18.1	32.8	32.8	32.8	32.8
30	GCL Stamp R. migration M m^3		64.4	15.3	15.3	19.8	59.3	13.9
31	GCL Total input M m^3		373	211	292	333	320	256
33	$ Value of energy (millions)		10.2	6.0	8.1	9.1	9.1	7.1

Figure 6-8: Highlight Alternative K with Alternative G2 Removed

Some of the trade-offs between Alternative K and the other operating alternatives:

- Alternative K performs better on reservoir trout measures (Performance Measures No. 11 and No. 12) providing 10 times as much trout spawning habitat.
- Alternative K is one of two alternatives that restores a more naturalized hydrograph in the Ash River for First Nation traditional use.
- Alternative K addresses many of the Hupacasath First Nation's interests including protecting the main archaeological site from potential wave erosion.
- Alternative K exposes the upper part of the drawdown zone allowing it to be revegetated for part of the year.
- Alternative K diverts less water (256 million m^3) into Great Central Lake for sockeye habitat than other alternatives (292 million m^3 to 373 million m^3).
- Alternative K generates less power revenue than other alternatives, up to $3.1 million less relative to Alternative C.
- Alternative K reduces the number of flood-free days for residents along the Somass River by between 13 days to 22 days over a 38 year period.

The Hupacasath First Nation representatives offered to eliminate Alternative K if the archaeology interests could be addressed in some way.

The Consultative Committee agreed to address the archaeology interests through monitoring. The Committee agreed to eliminate Alternative K. The Committee valued diverting 36 million m^3 more water to Great Central Lake and the Upper Stamp River to support sockeye over more than a 10 times gain in Elsie Reservoir trout spawning habitat.

6.2.9 Eliminate Alternatives I1 and I3

At this point the Consultative Committee brought back Alternative E (it was only set aside) into the mix (Figure 6-9). With Alternative I1 highlighted, the discussions turned to the merits of Alternatives I1, I2, and I3.

Alternative No. of Interest: 9

Color key: Better / Equal / Worse

PM#	PM	Alternative name:	2 E	4 C	9 I1	10 I2	11 I3	12 J
1	Flood Free (days <650 m^3/s at Somass)		12,017	12,017	12,008	12,017	12,017	12,016
2	Reservoir Rec. days >329.5 m 24 May-15 Oct		58	57	0	0	0	35
4	Reservoir Fishing days > 329.5 Apr-Jun		79	71	0	5	5	21
5	Arch No Unauthorized Collection days >328 m		234	221	0	79	84	146
6	Arch Erosion, days avoid 327 m - 328.5 m		336	325	365	347	346	325
7	FN Traditional Use & Study - Reservoir Days		0	0	5	4	4	0
8	River naturalized hydrograph 1=Yes 0=No		0	0	0	0	0	1
11	Reservoir Trout Spawning m^2		0.0	0.0	12,934	25	25	10
12	Reservoir Trout Rearing m		0.0	4.4	5,348	5,220	4,002	874
13	Wildlife habitat Drawdown Zone ha		48	52	216	193	167	73
15	Elsie. Steelhead Parr Rearing m		11.9	11.9	11.9	11.9	11.9	11.9
16	Elsie. Steelhead Spawning m		10.9	17.7	17.7	17.7	17.7	26.9
22	Moran. Steelhead Parr Rearing m		16.7	16.7	17.2	17.2	17.0	17.2
23	Moran. Steelhead Spawning m		23.9	26.9	23.0	26.5	26.5	28.4
24	Moran. Coho Fry rearing WUW m		5.6	5.6	5.7	5.7	5.7	5.6
25	Moran. Coho Spawning m		4.4	5.0	14.5	5.1	5.1	7.1
29	GCL Shoreline incubation M m^3		32.8	32.8	18.1	32.8	32.8	32.8
30	GCL Stamp R. migration M m^3		64.4	64.4	15.3	15.3	19.8	59.3
31	GCL Total input M m^3		377	373	211	292	333	320
33	$ Value of energy (millions)		10.3	10.2	6.0	8.1	9.1	9.1

Figure 6-9: Highlight Alternative I1 with Alternative E Returned and Alternative K Removed

The design of the "I" series of operating alternatives exposes the upper drawdown zone for all or part of the year allowing vegetation to re-establish. The value is in restoring opportunities for traditional use by First Nations and restoring habitat inundated by current operations. The benefits and trade-offs are:

- Alternative I1 provides 365 days of protection from potential wave erosion for the main archaeological site. This occurs as the reservoir is permanently kept at a maximum of 320 m, well below the key archaeological site. Also Alternative I1 reduces exposure of scattered artifacts to potential wave erosion. However, the 320 m elevation does not protect archaeological resources from unauthorized collection.

- The "I" series of operating alternatives provide significantly more trout habitat in the reservoir by not raising the reservoir at key times thereby avoiding inundating spawning and rearing habitat in tributaries to the reservoir. Trout pairs utilize about 0.5 m^2 each for spawning so an increase in even 25 m^2 spawning area provides habitat for 50 more trout pairs.

- However, the "I" series of operating alternatives diverts only 25% of the volume to Great Central Lake compared to other alternatives during the sockeye migration period in the Upper Stamp River (Performance Measure No. 30). Committee members were concerned about the negative impact to sockeye production in Great Central Lake with low inflows during the migration period.

- Alternative I1 provides between $2.1 million and $4.2 million less revenue per year than other alternatives.

- Alternative I1 decreases the number of flood free days along the Somass River by an estimated 8 to 9 days over 38 years.

- The six remaining operating alternatives score similarly on performance measures for fish in the Ash River.

The trade-offs in the remaining operating alternatives were between reservoir trout values, archaeology resources, power revenue and flood control.

Protecting the archaeological values in the reservoir was important to Hupacasath First Nation representatives. Trout in the reservoir was also important and during the summer of 2002 the Hupacasath First Nation conducted a study to evaluate barriers to trout access to tributaries. This study was funded by the BC Hydro Bridge Coastal Fish and Wildlife Restoration Program. Based on existing information there were about six sites with barriers. The estimated cost for crews to manually remove the debris blocking passage was $50,000.

Hupacasath First Nation representatives were willing to eliminate Performance Measure No. 5 (protect artifacts from unauthorized removal) and Performance Measure No. 6 (protect archaeology site from wave erosion) if these archaeology issues could be addressed through the monitoring program. Also, the Hupacasath First Nation sought Consultative Committee support in their applications to the Bridge Coastal Fish and Wildlife Restoration Program to investigate means of improving trout habitat in the reservoir and to restore some vegetation to the upper parts of the drawdown zone. On this basis, the Hupacasath First Nation representatives were also willing to remove Alternatives I1 and I3, leaving Alternative I2.

The Consultative Committee agreed to remove Performance Measure No. 5, Performance Measure No. 6, and Alternatives I1 and I3 and support the Hupacasath First Nation in their applications for funding for monitoring studies to address archaeological, trout, and drawdown revegetation interests. The Consultative Committee also acknowledged that the assessment of trout barriers in reservoir tributaries and the proposed revegetation of drawdown zones were good candidate projects for funding under the Bridge Coastal Fish and Wildlife Restoration Program.

The recommended monitoring studies are described in Section 7.1.

6.2.10 Remove Performance Measures that Score Similarly Across Alternatives

Scores on Performance Measures No. 1, 7, 15, 22, 23, 24, and 29 were now similar (cells were yellow) across the four remaining operating alternatives. These seven performance measures were removed as they no longer provided any distinction between the operating alternatives. Figure 6-10 shows the resulting table of 4 operating alternatives and simplified set of 10 Performance Measures. Performance Measure No. 8 was also eliminated as the naturalized flow pattern was already a feature of the Alternative J and did not need to be represented by a Performance Measure.

Alternative No. of Interest: 4

Color key: Better / Equal / Worse

PM#	PM	Alternative name:	2 **E**	**4** **C**	10 **I2**	12 **J**
2	Reservoir Recreation days >329.5 m 24 May-15 Oct		58	57	0	35
4	Reservoir Fishing days >329.5 April-June		79	71	5	21
11	Reservoir Trout Spawning m^2		0.0	0.0	25	10
12	Reservoir Trout Rearing m		0.0	4.4	5,220	874
13	Wildlife habitat Drawdown Zone ha		48	52	193	73
16	Elsie. Steelhead Spawning m		10.9	17.7	17.7	26.9
25	Moran. Coho Spawning m		4.4	5.0	5.1	7.1
30	GCL Stamp R. migration M m^3		64.4	64.4	15.3	59.3
31	GCL Total input M m^3		377	373	292	320
33	$ Value of energy (millions)		10.3	10.2	8.1	9.1

Figure 6-10: Four Remaining Alternatives and Simplified Set of 10 Performance Measures

At this point the remaining four operating alternatives each had merit. The Committee could not eliminate any more alternatives. The merits of the four alternatives were:

- Alternatives E and C provide the most power revenue. Conversely Alternatives I2 and J reduce revenues by between $1.1 million and $2.1 million per year, respectively, from Alternative C.

- Some Committee members deemed the $100,000 benefit in power revenue of Alternative E to be a significant gain over Alternative C. Note that the $100,000 difference was less than the Minimum Significant Incremental Change of ±2% (or ±$200,000) suggested by the BC Hydro modeller as the accuracy of the Power and Value of Energy models. In relative terms, the $100,000 represented a difference of about 42 hours or 1.75 days of generation at full load.

- Alternatives I2 and J perform better for reservoir interests including trout spawning and rearing habitat and for providing more exposed drawdown zone for restoring vegetation.

6.3 Step 3 - Check Degree of Consensus on Alternatives E, C, I2, and J

The facilitator requested that each Consultative Committee member verbally state their degree of support for **Alternatives E, C, I2 and J**. Possible declarations were:

- I fully **Support** the alternative

- I **Accept** the alternative (I can live with it) with conditions for a monitoring program as described in Section 7 below.

- I **Block** the alternative, I cannot live with it

The results (Table 6-1**) show that Alternative C received unanimous acceptance by the Consultative Committee on condition of the specified monitoring programs.**

Alternatives E, I2, and J were also acceptable to some Consultative Committee members. NorskeCanada accepted Alternatives E and J as viable alternatives with conditions. BC Hydro also accepted Alternative E. The Hupacasath First Nation[1] and Tseshaht First Nation found Alternatives I2, J, and C equally acceptable, on condition of the monitoring program, in satisfying their interests.

The Hupacasath First Nation stated a number of times during the Ash River water use planning process that they were uncomfortable, and in fact, would not trade-off an aboriginal right such as wildlife harvesting against fish harvesting. The Hupacasath First Nation participated in the trade-off process to narrow down the operating alternatives to three acceptable alternatives that would take into account most of their aboriginal rights.

[1] On 8 May 2003 Hupacasath First Nation sent a letter to BC Hydro providing comments on the final Ash River Water Use Plan Consultative Committee Report. In the letter, they declared that they were withdrawing acceptance of Alternatives C, J and I2 and fully support Alternative K (See Appendix Q).

Table 6-1: Preference for Ash River Water Use Plan Operating Alternatives: A=Accept with Conditions, B=Block

Consultative Committee Representative	Operating Alternative			
	Alt E	Alt C	Alt I2	Alt J
Alberni Valley Environmental Association	B	**A**	B	B
Alberni-Clayoquot Regional District	B	**A**	B	B
Alberni-Clayoquot Regional District - Sproat Lake Area Director	B	**A**	B	B
BC Hydro 1	**A**	**A**	B	B
BC Hydro 2	**A**	**A**	B	B
Fisheries and Oceans Canada	B	**A**	B	B
Hupacasath First Nation 1	B	**A**	**A**	**A**
Hupacasath First Nation 2	B	**A**	**A**	**A**
Ministry of Sustainable Resource Management	B	**A**	B	B
Ministry of Water, Land and Air Protection	B	**A**	B	B
NorskeCanada	**A**	**A**	B	**A**
Regional Aquatic Management Society	B	**A**	B	B
Tseshaht First Nation	B	**A**	**A**	**A**
Total Accepting out of 13	**3**	**13**	**3**	**4**

Consultative Committee members also provided written supporting rationale for why they accepted or blocked each alternative (see Appendix L).

6.3.1 Summary of Consultative Committee Values

By the time the Ash River water use planning process reached the trade-off stage, Consultative Committee members had already narrowed down to the most important issues to be addressed. Modelling the operating alternatives showed that the finite supply of water in the Ash River system could not satisfy all the water use objectives. Generally, gains in resources in the reservoir conflicted with gains in the Ash River. Furthermore, while Great Central Lake and the Upper Stamp River were outside the scope of the Ash River Water Use Plan process, Committee members were aware of impacts of their choices on sockeye in the adjacent system. In providing benefits to fish in the Ash River, the Committee did not want to increase risks to fish resources in the Great Central Lake/Upper Stamp River system.

Ultimately the Consultative Committee had to decide which of the competing benefits were more important. The Ash River water use planning process showed:

- The Consultative Committee valued gains in fish production in the Ash River, particularly of steelhead, over gains in trout production or gains in recreation opportunities at the reservoir.

- While not within the scope of the Ash River Water Use Plan, the Committee valued protecting sockeye in the Upper Stamp River over extraordinary gains in steelhead rearing habitat in the Ash River or increased trout production in the reservoir.

- The Hupacasath First Nation valued gains in reservoir resources and gains in the Ash River fish production equally. The Hupacasath First Nation was not prepared to trade-off resource values between the reservoir and the river.

- The Committee valued gains in fish production in the Ash River over maximizing gains in power revenue when eliminating Alternative G2.

6.3.2 Recommended Operation of the Ash River Hydroelectric Facility

The Ash River Water Use Consultative Committee recommends that the Ash River hydroelectric facility be operated as designed subject to the following operating constraints (Table 6-2).

Table 6-2: Recommended Operating Constraints for the Ash River Hydroelectric Facility

Facility	Operating Variable	Target	When	Comments
Elsie Dam	Minimum discharge into Ash River from Elsie Dam	3.5 m^3/s	1 May to 31 October	Discharge measured at hollow cone valve and/or sluice gate
		5.0 m^3/s	1 November to 30 April	
		10 m^3/s	Two 48 hour periods between 1 August and 30 September[1]	Migration pulse flow measured at Moran Creek gauge
	Maximum discharge into Ash River	No constraint	Year Round	
	Maximum Ramping Rate	As per BC Hydro Ramping Strategy	Year Round	
Elsie Reservoir	Maximum Reservoir Level	No constraint	Year Round	No constraint on reservoir elevations
	Minimum Reservoir Level	No constraint	Year Round	
Power Intake	Diversion flow	No constraint	Year Round	No constraint on power diversion
	Maximum annual diversion volume	No constraint	Year Round	

1. Migration pulse flows: ramp discharge from Elsie Dam to increase flow in the Ash River up to 10 m^3/s, measured at Moran Creek gauge, then back down to 3.5 m^3/s over a 48 hour period. Induce two pulses during the summer steelhead migration period (1 August to 30 September) with each pulse coinciding with natural increases inflows from precipitation.

6.3.3 Expected Consequences of Recommended Operating Alternative

Alternative C is expected to provide numerous benefits over the current water licence (Table 6-3).

Table 6-3: Expected Consequences of the Ash River Water Use Alternative C relative to Current Water Licence

Water Use Interest	Consequences
Power generation	+ Increased power revenue of +$600,000 per year on average (approximately 6% increase) over current water licence.
First Nation Archaeology and Heritage	+ Opportunity to address archaeology and heritage issues through the monitoring program
Fish in Elsie Lake Reservoir	+ Increased trout rearing habitat in tributaries to the reservoir
Fish in Ash River	+ Increased rearing and spawning habitat for fish in the Ash River including a nearly 14-fold increase in steelhead parr rearing habitat just below Elsie Dam relative to flows under the existing water licence.[1]
	+ Increased opportunities for fish to migrate past Lanterman Falls and Dickson Falls
	+ Increased minimum flows in the Ash River
Wildlife	+ Increase in riparian habitat around Elsie Lake Reservoir
Flood control	o Neutral – No increase in expected number of flooding-days for property along the Somass River compared to expected number of flooding-days under current water licence (i.e., Alternative C does not make flooding worse)
Reservoir recreation	- Potential loss. The recommended operating alternative is expected to hold the reservoir at lower elevations during 24 May to 15 October than under the current water licence. This may change the type of or reduce the quality of the recreation experience at the reservoir.

6.3.4 Other Consequences from the Recommended Operating Alternative

BC Hydro and NorskeCanada Communications Protocol

The Consultative Committee had an interest in minimizing impacts to fish resources in Great Central Lake and the Upper Stamp River resulting from changes to water use in the Ash River system. An additional benefit of the Ash River water use planning process is agreement to develop a communications protocol between BC Hydro and NorskeCanada. Under the protocol BC Hydro will provide advance notice to NorskeCanada of planned changes to operations that will affect water delivered into Great Central Lake.

The communications protocol will also lead to a definition of *threshold of critical low flow* which will trigger discussions between BC Hydro, NorskeCanada, Fisheries and Oceans Canada and the Ministry of Water, Land and Air

[1] The actual flows released for fish at present and over the past 5 years (1996 - 2000) are substantially higher than the licenced flows and are similar to flows under Alternative C.

Protection. The four organizations, in consultation with the Comptroller of Water Rights, will make recommendations on how to adjust operations on both the Ash River and Great Central Lake systems to protect fish resources in both systems in times of very low flows. In the event that changes are required to BC Hydro's licensed operations, Hydro would have to apply to the provincial Comptroller for authorization. When the Ash River Water Use Plan concluded, the Great Central Lake Committee still needed to conduct further study and analysis to define this threshold of critical low flow.

BC Hydro and Hupacasath First Nation Communications Protocol

During the trade-off process, Hupacasath First Nation requested that BC Hydro provide notice when the reservoir is expected to drop below 318.5 m. The Hupacasath First Nation are interested in opportunities for traditional use and archaeological study in the drawdown zone.

6.3.5 Hydrograph and Reservoir Elevations under the Recommended Operating Alternative

The recommended operating alternative will impose a modified hydrograph onto the Ash River and a modified regime of reservoir elevations onto Elsie Lake Reservoir compared to operations under the current water licence. See Appendix M.

7 MONITORING PROGRAMS

In addition to recommending a preferred operating alternative for the Ash River hydroelectric facility (Section 6.3), the Consultative Committee recommended an associated monitoring program designed to address key uncertainties and answer specific questions that may change future decisions on operations. This section describes the Ash River Water Use Plan monitoring program initially discussed, and the criteria used to evaluate them for eligibility under the Water Use Plan Program.

7.1 Ash River Water Use Plan Monitoring Programs

At the final Consultative Committee meeting on 24 and 25 June 2002, the Committee discussed six potential monitoring programs.

- Archaeological Artifacts in Elsie Lake Reservoir Drawdown Zone Monitoring Program
- Adult Steelhead Migration Monitoring Program, which shall also assess migration of other species (i.e., coho and chinook).
- Steelhead Parr Monitoring Program
- Elsie Lake Reservoir Trout Rearing Habitat Monitoring Program
- Elsie Lake Reservoir Riparian Wildlife Habitat Monitoring Program
- Ash River Riparian Wildlife Habitat Monitoring Program

The Consultative Committee evaluated the monitoring programs listed above for eligibility under the Ash River Water Use Plan using the Eligibility Criteria for Water Use Monitoring Studies (Appendix N). (See Appendix O for more detailed discussion of the following program elements.)

7.2 Purpose of Eligibility Criteria for Water Use Monitoring Studies

The Water Use Plan Management Committee developed principles and criteria for screening monitoring programs and the component studies. In the face of uncertainty about the relationship between changes in operation and biological response in the Ash River system, a monitoring program is intended to:

1. assess the effectiveness of the operational changes for the Ash River hydroelectric facility relative to water use objectives

2. assess compliance of BC Hydro with the authorized Water Use Plan for the Ash River hydroelectric facility

In the Ash River water use planning process, the expected biological response in Elsie Lake Reservoir and in the Ash River under the preferred operating alternative represents the best judgement of Consultative Committee members based on the available information. For instance, Alternative C provides a pulse flow in the Middle Ash River averaging 10 m^3s over a two-day period between 1 August to 30 September to stimulate adult steelhead migration. This in turn is expected to maximize the rate of adult steelhead migration in the Ash River. A monitoring program provides the opportunity to assess how well the preferred operating alternative, Alternative C, achieves the desired fundamental objective of increasing steelhead abundance. Therefore, a monitoring program can provide better data for future decision making and reduce the uncertainty around the biological response to changes in operations.

7.2.1 Water Use Plan Monitoring and Adaptive Management

Adaptive management is a technique of learning in the face of uncertainty by imposing change and learning from the outcome. In the **active** form of adaptive management, a reservoir/river system is subjected to a planned series of different operating alternatives. For instance, in the case of the Ash River hydroelectric facility, an active adaptive management monitoring program might see several different minimum flow releases, with each flow regime lasting 5 to 10 years. The monitoring program might then study the effect of different flow regimes on fish populations. The operating alternative yielding the highest fish abundance would be assessed at the end of the experimental period.

In contrast, in the **passive** form of adaptive management there would be imposition of one operating alternative. This is the case for the Ash River hydroelectric facility with implementation of Alternative C. With a passive adaptive management strategy, the monitoring studies will assess how well the operating alternative performs relative to the performance measures and water use objectives developed by the Consultative Committee (e.g., does Alternative C provide greater Weighted Usable Width of stream rearing habitat for steelhead parr than the current water licence?).

Typically, a monitoring program is designed to provide a before-and-after comparison of alternative operating regimes. There would be a period of data collection to establish a baseline condition. Then the new operating regime is adopted and the effects are monitored for a period. The before-and-after comparison would indicate if the new operating regime performed better than the old.

There are two complicating factors for a monitoring program for the Ash River hydroelectric facility. First, the Consultative Committee recommended that Alternative C be implemented immediately with no period for baseline data

collection. Second, current operations and operations under Alternative C are quite similar with little contrast between them. That is the flows observed in the Ash River below Elsie Dam and the operation of Elsie Lake Reservoir will be quite similar before and after the implementation of Alternative C.

An analysis of fish flow releases from Elsie Dam showed that for each year between 1996 and 1999 median flows during the critical stream flow period for anadromous fish (September to October) ranged from 4.27 m^3s to 9.43 m^3/s. In fact, in recent years because of the dam safety upgrade BC Hydro has released water at rates in excess of both the existing water licence and Alternative C (3.5 m^3/s) during the Critical Stream Flow Period. It is necessary to distinguish here between the existing water licence and current operations. The existing water licence requires a minimum release of 0.29 m^3/s during the Critical Stream Flow Period.[1] Meanwhile under current operations, records for 1996 to 1999 show median values of 4.27 m^3/s to 9.43 m^3/s having been released during the Critical Stream Flow Period. Flow releases under current operations in recent years have been higher than required by the existing water licence.

Given the similarity between current operations (4.27 m^3/s to 9.43 m^3/s median release) and Alternative C (3.5 m^3/s median release) during the Critical Stream Flow Period, it will be difficult to detect a significant change in the biological response of fish and wildlife once Alternative C is implemented. The implication is that many of the monitoring programs discussed by the Consultative Committee cannot assess the effectiveness of Alternative C relative to the Ash River Water Use Plan objectives (see Point 1 in Section 7.2). Furthermore, by implementing Alternative C immediately following issuance of a new water licence, there is no opportunity to collect baseline information.

7.3 Eligibility of Ash River Water Use Monitoring Programs

Given the realities discussed above, the six potential monitoring programs were tested against the Eligibility Criteria for Water Use Monitoring Studies. The eligibility criteria state that a monitoring program should:

1. provide information that will help in deciding the best use of water;
2. have sufficient statistical power to distinguish between operating alternatives (current operations versus Alternative C) in achieving Ash River Water Use Plan objectives;
3. provide results in a timely manner; and
4. be cost effective.

[1] The other requirement of the current water licence is that flows measured in the Ash River at the Moran Creek gauge be a minimum of 3.5 m^3/s. Releases from Elsie Dam are augmented by local stream inflows to make up 3.5 m^3/s. As local tributary inflows increase, releases from Elsie Dam can be curtailed.

These criteria can be summed up as *efficacy*, *sensitivity*, *timeliness*, and *cost effectiveness*. Monitoring programs satisfying these criteria are eligible under the Ash River Water Use Plan. On point two above, the similarity of Alternative C to current operations will make it statistically difficult to distinguish whether Alternative C or current operations is better for fish or wildlife abundance.

Table 7-1 summarizes the information for the five Ash River Water Use Plan monitoring programs which was analyzed to evaluate whether the programs met the eligibility criteria.

As per Table 7-2, when the six potential monitoring programs were evaluated, two programs satisfied the eligibility criteria: Archaeological Artifacts in Elsie Lake Reservoir Drawdown Zone Monitoring Program and Adult Steelhead Migration Monitoring Program.

The remaining four proposed monitoring programs fail one or more of the eligibility criteria (Section 7.1). Three proposed monitoring programs fail to satisfy the sensitivity criteria (No. 2) as there will be little detectable change given. Alternative C is very similar to current operations. The fourth program is not linked to any performance measure. Nonetheless, the Consultative Committee recognized these four monitoring programs would provide useful baseline information for the next water use planning process.

The Consultative Committee discussed other funding sources such as the Bridge Coastal Restoration Program for those monitoring programs that did not meet the eligibility criteria. As per the mandate of the Monitoring Advisory Committee, (Section 1.1) the Committee may seek additional resources to contribute to the monitoring program. Descriptions and budget are provided for the six monitoring programs (Appendix O).

Table 7-1: Information matrix for WUP monitoring requests. (Responses follow guidelines in draft WUP Monitoring Principles and Criteria Document, WUP Management Committee, 2002)

I **Study** (WUP, Title of Study, Interest Area)	II **Description**	III **Data Gap Addressed** (list the issue, the competing hypotheses, and the estimates of the probability of these competing hypotheses being true.)	IV **Amount of learning expected through monitoring** (high, medium or low)	V **Estimated Duration of Study Program**	VI **Time frame in which this information will be used:** (before the next WUP, during the next WUP, after the next WUP)	VII **Estimated Cost** (including lost power values)	VIII **Willingness of Consultative Committee to change water allocation** (high, medium, or low)	IX **Rating of Study**
Archaeological Artifacts in Elsie Lake Reservoir Drawdown Zone Monitoring Program and Mitigative Measures								
Monitoring Large Lithic Site Erosion	Monitor rate of erosion/ aggradation of drawdown zone substrate	Issue: reservoir operation may be a factor in erosion/aggradation of substrates at large lithic site. **Hypotheses** H_0: Rate of erosion-exposure of lithic artifacts at the large lithic site at Elsie Lake Reservoir is the same or less under Alternative C compared to current operations. H_1: Rate of erosion-exposure of lithic artifacts at the large lithic site at Elsie Lake Reservoir is greater under Alternative C compared to current operations. If H_0 cannot be rejected then one of the other competing alternatives besides Alternative C may offer more protection to lithic artifacts. Probability of H_0 being true: 40/60.	Low. Monitoring will only allow qualitative comparison between competing alternatives. Monitoring will not quantitatively show benefits/ impacts of competing alternatives.	Until WUP review period (5 years), or until site is protected, or until site has been salvaged.	Information will assist in decision-making during WUP implementation as well as during the next WUP.	$2000 to establish baseline data and transects on site + $2600/year x 5 years = $15,000	Low to Medium: If Alternative C is a factor in erosion of the main archaeological site and mitigative activities are not effective or cannot be done, there is a chance that the Consultative Committee may shift away from Alternative C.	Medium
Monitoring Artifact Exposure at Large Lithic Site	Monitor the rate at which artifacts may be exposed	Issue: reservoir operation may be causing artifacts at large lithic site to be exposed. **Hypotheses** H_0: Rate of exposure of artifacts at the large lithic site at Elsie Lake Reservoir is the same or less under Alternative C compared to current operations. H_1: Rate of exposure of artifacts at the large lithic site at Elsie Lake Reservoir is greater under Alternative C compared to current operations. If H_0 cannot be rejected then one of the other competing alternatives besides Alternative C may offer more protection to lithic artifacts. Probability of H_0 being true: 40/60.	Moderate. Monitoring will quantify number and type of artifacts potentially exposed to show benefits/impacts of competing alternatives.	Until WUP review period (5 years), or until site is protected, or until site has been salvaged.	Information will assist in decision-making during WUP implementation as well as during the next WUP.	$6000/year x 5 years = $30,000 Monitoring may be deferred, adjusted or annual cycle modified if few or no artifacts are found or if site is protected or salvaged. Therefore, the total cost could be <$30,000	Low to Medium: If Alternative C is a factor in erosion of the main archaeological site and mitigative activities are not effective or cannot be done, there is a chance that the Consultative Committee may shift away from Alternative C.	Medium
Monitoring Artifact Exposure at Scattered Lithic Sites	Monitor the rate at which artifacts may be exposed	Issue: reservoir operation may be causing artifacts at scattered lithic sites to be exposed. **Hypotheses** H_0: Rate of exposure of scattered artifacts at Elsie Lake Reservoir is the same or less under Alternative C compared to current operations. H_1: Rate of exposure of scattered artifacts at Elsie Lake Reservoir is greater under Alternative C compared to current operations. If H_0 cannot be rejected then one of the other competing alternatives besides Alternative C may offer more protection to lithic artifacts. Probability of H_0 being true: 40/60.	Moderate. Monitoring will quantify number and type of artifacts potentially exposed to show benefits/impacts of competing alternatives.	Until WUP review period (5 years), or until no further exposure is occurring.	Information will assist in decision-making during WUP implementation as well as during the next WUP.	$20,000/year x 2 years = $40,000^{+-} Monitoring may be deferred, adjusted or cycle modified if few or no artifacts are found. Therefore, the total cost could be <$40,000	Low: If Alternative C contributes to a large number of artifacts being exposed, or a substantial site is exposed, there is some chance that the Consultative Committee may shift away from Alternative C.	Low
Assessment of Options to Protect Large Lithic Site	Develop and assess options to protect large lithic site from reservoir operation impacts.	Issue: reservoir operation may be a factor in erosion/aggradation of substrates at large lithic site. Various approaches to protecting the site, other than changing reservoir operation, need to be assessed to assist in making a decision on how to address the interests associated with the large lithic site. **Hypotheses** n/a	Moderate. A number of options to protect the site will be presented along with an assessment of their feasibility, effectiveness and cost. A preliminary design and cost estimate will be provided for two of the possible options.	This assessment has been completed – October 2002.	Information will assist in decision-making during WUP development and implementation.	$5,000	Medium to High: This study would yield information on the costs and benefits of various protection options, these options could then be considered in an assessment of mitigative options to determine the best course of action.	Medium

I **Study** (WUP, Title of Study, Interest Area)	II **Description**	III **Data Gap Addressed** (list the issue, the competing hypotheses, and the estimates of the probability of these competing hypotheses being true.)	IV **Amount of learning expected through monitoring** (high, medium or low)	V **Estimated Duration of Study Program**	VI **Time frame in which this information will be used:** (before the next WUP, during the next WUP, after the next WUP)	VII **Estimated Cost** (including lost power values)	VIII **Willingness of Consultative Committee to change water allocation** (high, medium, or low)	IX **Rating of Study**
Archaeological Artifacts in Elsie Lake Reservoir Drawdown Zone Monitoring Program and Mitigative Measures								
Mitigative Salvage Excavation – Large Lithic Site	Recover artifacts from large lithic site, assess extent and significance of site, determine if additional effort is needed.	Mitigative activity in lieu of monitoring. Whether to salvage or monitor depends on outcome of assessment of protection options and monitoring of potential rate of substrate erosion/aggradation. **Hypotheses** n/a	n/a	To be determined	n/a	To be determined	Medium to High: Mitigative salvage is an option that could be used to mitigate impacts to the large lithic site. As such, it needs to be considered in an assessment of mitigative options, including protection options, to determine the best course of action.	n/a
Environmental Monitoring Programs								
Adult Steelhead Migration Monitoring Program	Monitoring migration success of adult steelhead past Dickson Falls	Hypotheses: H_0: The rate of adult steelhead migration past Dickson Falls is equal or less under Alternative C (pulse flows) compared to current operations (no pulse flow). H_1: The rate of adult steelhead migration past Dickson Falls is higher under Alternative C compared to current operations.	Learning: High Monitoring study will lead to quantitative discrimination between competing hypotheses.	5 years	Before the next WUP	$15,000 each year for 5 years. Power revenue loss = To be determined	High. Study will aid decision to adopt or not adopt pulse flows	
Steelhead Parr Abundance Monitoring Program	Monitoring abundance of steelhead parr in middle Ash River	Hypotheses: H_0: Abundance of steelhead parr is equal or less under Alternative C compared to current operations. H_1: Abundance of steelhead parr is greater under Alternative C compared to current operations.	Learning: Low. Lack of effect size (contrast) between Alternative C and current operations makes detecting a significant difference in parr abundance difficult. However, rationale for providing base-line information to next WUP	5 years	During the next WUP	$50,000 each year for 5 years. No loss in power revenue Total: $250,000	Low. Steelhead abundance primary consideration in WUP. If Alternative C provides no benefit then other interests may become more important with decision to select another alternative.	
Elsie Lake Reservoir Riparian Wildlife Habitat Monitoring Program	Monitor wildlife use of reservoir drawdown zone and rate of re-vegetation	Issue: Exposing more drawdown zone may offer more wildlife habitat around Elsie Lake Reservoir Hypotheses:H_0: Wildlife use in the drawdown zone is the same or less under Alternative C compared to current operations. H_1: Wildlife use in the drawdown zone is greater under Alternative C compared to current operations.	Low Similar gross hydrographs under Alternative C and under current operations. Will likely create similar riparian habitat conditions and rate of revegetation. Will be difficult to detect significant difference.	4 years wildlife habitat 3 years of study over 11 year period for revegetation study	During next WUP	Annual budgets: $26.300 $13.800 $13,800 $13,800 $0 $12,500 $0 $0 $0 $0 $12,500 Total: $92,700	Low-High Consultative Committee members had varying opinions (important to not important) on contribution of draw-down zone to wildlife habitat in watershed	
Ash River Riparian Wildlife Habitat Monitoring Program	Monitor wildlife use of riparian area along middle Ash River	Issue: The hydrograph of the middle Ash River may affect the quality and quantity of riparian habitat along the River. Hypotheses: H_0: Alternative C provides riparian habitat along the middle Ash River of the same quantity and quality as current operations. H_1: Alternative C provides riparian habitat along the middle Ash River of better quantity and quality as current operations.	Low to Medium Similarity of hydrographs between Alternative C and current operations make detecting differences in the response of riparian habitat difficult.	5 years	During next WUP	$10,000 each year for 5 years Total: $50,000	Low Low probability that Consultative Committee would change decision on preferred alternative. Riparian habitat along middle Ash River was not an issue.	

Table 7-2: Eligibility of Ash River Water Use Plan Monitoring Programs

Monitoring Program	Satisfies Monitoring Program Principles and Criteria?
Archaeological Artifacts in Elsie Lake Reservoir Drawdown Zone	Yes. Hupacasath First Nation agreed to drop Performance Measure 5 (unauthorized collection of artifacts) during trade-off process if exposed artifacts could be addressed through monitoring and if appropriate, salvage excavation. (Section 6.2.9). Monitoring results could affect the decision of preferred operating alternative among available alternatives.
Steelhead Parr Monitoring	No, fails on *sensitivity* and *usefulness in future decisions on water use* criteria. Quantity of steelhead parr rearing habitat expected to be similar under Alternative C and current operations.
Adult Steelhead Migration Monitoring	Yes, satisfies all 4 criteria
Elsie Lake Reservoir Trout Rearing Habitat Monitoring	No. While linked to Performance Measure 12 (trout rearing in Elsie Lake Reservoir), program fails on *sensitivity* criteria. Reservoir operations under Alternative C and current operations are similar.
Elsie Lake Reservoir Riparian Wildlife Habitat Monitoring	No, fails on *sensitivity*, *usefulness in future decisions on water use*, and *cost effectiveness* criteria.
Ash River Riparian Wildlife Habitat Monitoring	No, not linked to any Performance Measures developed in the Ash River Water Use Plan. Would not change decision on preferred operating alternative among available alternatives.

7.3.1 Archaeological Artifacts in Elsie Lake Reservoir Drawdown Zone Monitoring Program

During Step 5 of the Ash River water use planning process, a thorough archaeological inventory and impact assessment was completed for Elsie Lake Reservoir. The report titled Elsie Lake Reservoir Archaeological Inventory and Impact Assessment – Permit 2001-266, recommended monitoring of artifact exposure at recorded and unrecorded lithic sites, exploration of protection options for the large lithic scatter DiSh-17, mitigative salvage excavation of large lithic scatter DiSh-17 and an archaeological survey of newly exposed parts of the inundation zone during future low water events. Copies of the report were submitted to the Hupacasath First Nation, BC Hydro, and the provincial Archaeology Planning and Assessment Branch.

At the June 2002 Consultative Committee meeting, First Nation representatives accepted operating alternative C, among others, provided that archaeological and traditional use issues were addressed through monitoring. See Table 7-1.

During the meeting, the Consultative Committee agreed in principal to this monitoring program although no terms of reference or detailed estimates were available at that time. The Committee expected that there would be several components to the Archaeological Artifacts in Elsie Lake Reservoir Drawdown Zone Monitoring Program including: monitoring large lithic site erosion,

monitoring artifact exposure at large lithic scatter site, monitoring artifact exposure at scattered lithic sites, assessment of options to protect large lithic scatter site, and mitigative salvage excavation - large lithic scatter site.

At the June 2002 Consultative Committee meeting, the Hupacasath First Nation requested that BC Hydro make funding available during the summer of 2002 in order to initiate the archaeological artifacts monitoring and mitigative salvage programs prior to the reservoir refilling in the fall. At the Committee meeting, BC Hydro representatives confirmed that there was no identified funding source for immediate mitigation activities or monitoring studies identified through the Ash River water use planning process.

Activities Completed

Subsequent to the June 2002 Consultative Committee meeting, BC Hydro and the Hupacasath First Nation completed a number of archaeology-related activities that had been proposed under the Archaeological Artifacts in Elsie Lake Reservoir Drawdown Zone Monitoring Program.

In September 2002, the Hupacasath First Nation completed a surface collection of artifacts at the large lithic scatter site in the Elsie Reservoir drawdown zone that was to serve as a baseline for potential future monitoring of the site. In October 2002, BC Hydro initiated a geotechnical assessment of the erosion processes and rates that may be affecting the large lithic scatter in the Elsie Lake Reservoir drawdown zone. The baseline information has been collected and transects for the erosion monitoring have been installed.

Status

In summary, at the June 2002 Consultative Committee meeting, an Archaeological Artifacts in Elsie Lake Reservoir Monitoring Program was proposed. A number of activities have been undertaken, during and following the Ash River Water Use Plan consultative process, to address these archaeological and traditional use issues, including:

- an archaeological inventory and impact assessment,
- an assessment of options to protect the large lithic scatter that was identified in Elsie Lake Reservoir,
- collection of surface artifacts from the large lithic scatter site,
- installation of an erosion monitoring system for the large lithic scatter site,
- a mitigative salvage of the large lithic scatter site, and
- cataloguing of artifacts from the large lithic scatter site.

BC Hydro, First Nations and the provincial Archaeology Planning and Assessment Branch are currently reviewing the results of these activities completed to date. It is expected that the review of the results of the archaeological management work completed to date will help the Archaeology Planning and Assessment Branch, BC Hydro and First Nations establish what steps remain to be taken to complete the post-Ash River Water Use Plan monitoring activities.

7.4 Adult Steelhead Migration Monitoring Program

The middle Ash River provides habitat for steelhead spawning and rearing. However, steelhead and other fish migrating up the Ash River are blocked first by Lanterman Falls then Dickson Falls. During the Ash River water use planning process, the Fish Technical Subcommittee undertook an expert judgement process (Wong, 2001) to estimate the ideal flows conditions such that fish could surmount the barriers. Through observations of the falls, a review of existing literature and a professional knowledge of fish behaviour, the Fish Technical Subcommittee hypothesized that a rising-falling discharge over 48 hours and peaking at 10 m^3/s, measured at the Moran Creek gauge, would allow some steelhead to successfully migrate past the falls. This hypothesis and the appropriate discharge rate remain untested.

The Adult Steelhead Migration Monitoring Program will assess the success of the pulse flow approach in stimulating migration of steelhead. Direct field observations will also provide information on the most appropriate seasonal timing for pulsed flows and the required magnitude and duration of pulse flow releases. The suggested duration of the migration monitoring program is five years.

7.5 Ash River Water Use Plan Monitoring Advisory Committee Mandate

The Consultative Committee recommends that a Monitoring Advisory Committee be established.

Membership on the Committee should include:

- BC Hydro
- Fisheries and Oceans Canada
- Hupacasath First Nation
- Tseshaht First Nation
- Ministry of Water, Land and Air Protection
- Ministry of Sustainable Resource Management
- Community representatives (from existing Committee, if possible)

- Representative of local government (from existing Committee, if possible)

7.6 Ash River Water Use Plan Monitoring Advisory Committee Mandate

The Consultative Committee recommends that the mandate of the Ash River Water Use Plan Monitoring Committee is to:

- Review and agree to study terms of reference.
- Review annual study results and assess need to recommend an early Ash River Water Use Plan review (in Year 5).
- Recommend improvements to monitoring programs within existing water use planning budgets. The Monitoring Advisory Committee may seek additional resources to contribute to the monitoring program.
- Determine annually whether there are recommendations to BC Hydro on operational changes within the constraints of the water licence.
- Support periodic communication with the public (e.g., newsletter, annual reports).
- Ensure publication of monitoring reports.
- Nurture co-operation and collaboration to improve the environmental database and to build common understanding (ongoing).

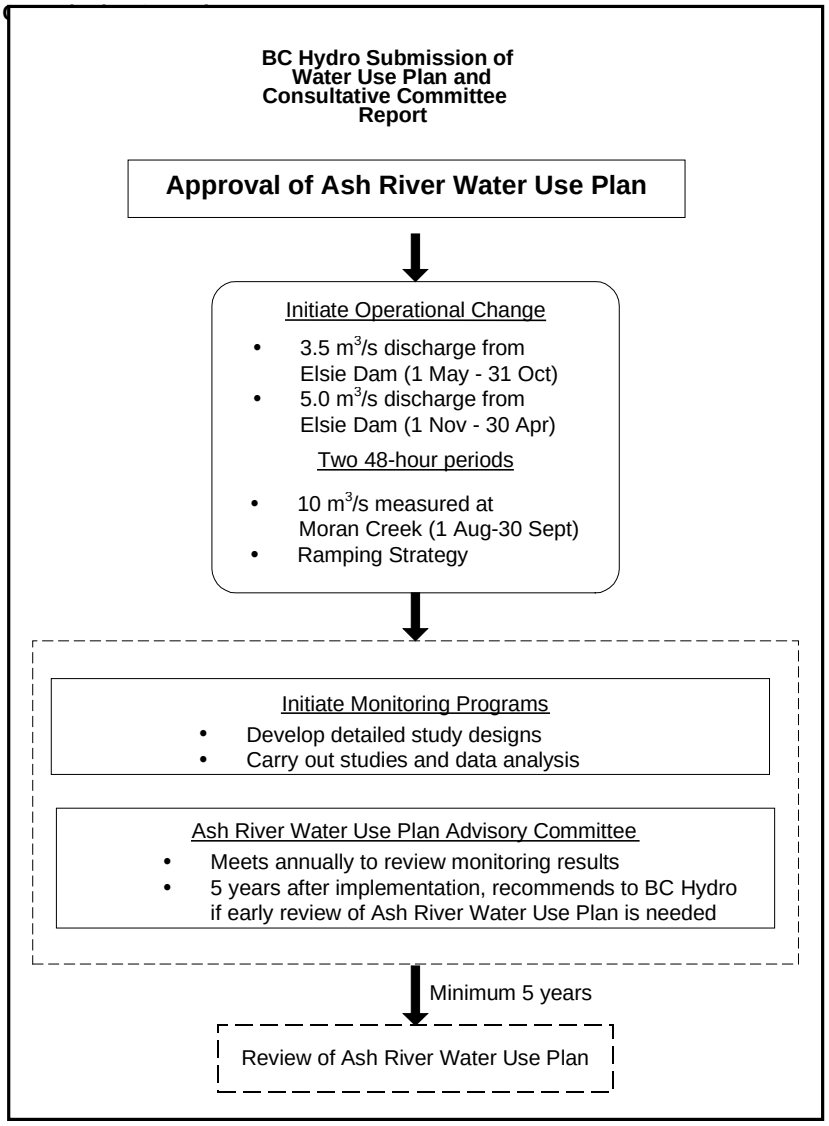
The Consultative Committee recommends that the Monitoring Advisory Committee:

- Meet within six months of implementation of the Ash River Water Use Plan
- That the first meeting of the Ash River Water Use Plan Monitoring Advisory Committee be held in Port Alberni.

8 IMPLEMENTATION OF RECOMMENDATIONS

The operational changes and monitoring program recommended by the Ash River Consultative Committee will be implemented once the Comptroller of Water Rights and government approve the Ash River Water Use Plan (Figure 8-1).

Figure 8-1: Next steps



1. Under the Initiate Operational Change section in Figure 8-1 the figures are minimum discharges into the Ash River from Elsie Dam. It should also be noted that the current water licence constraint on water diversion for generation is removed.

8.1 Approval of the Water Use Plan

The Comptroller of Water Rights will review the Ash River Water Use Plan under provisions of the *Water Act* and will involve Fisheries and Oceans Canada, other provincial agencies, First Nations, and holders of water licences who might be affected by the changes.

8.2 Initiate Monitoring Program

The monitoring program requires implementation of the recommended operational changes. Once the Ash River Water Use Plan is approved by the Comptroller of Water Rights, the following activities will be undertaken:

- Develop detailed terms of reference for the monitoring program
- Implement the specified flow releases from Elsie Dam into the Ash River
- Commence monitoring program study, data collection, analysis, and reporting

9 REVIEW PERIOD

Five years after the implementation of the Ash River Water Use Plan, the Ash River Water Use Plan Monitoring Advisory Committee will review the results of the monitoring program and assess the need to recommend to BC Hydro an early review of the Ash River Water Use Plan. Alternatively, if the studies suggest that a review of the Ash River Water Use Plan is not needed, the Advisory Committee can recommend when a review should be assessed.

At the earliest, the next review of the Ash Water Use Plan will be five years after implementing the Ash River Water Use Plan.

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Wong T. (2002). *Domestic water withdrawals from the Somass River and BC Hydro Water Use Planning.* Memo to Beaver Creek Improvement District. May 2, 2002. Prepared by Quintry Management Consulting Inc. for BC Hydro. Digital Adobe Acrobat PDF.

Woo, K. 2001. Response from Kim Hyatt with respect to water temperature concerns/issues. Memo. 2 pp.

APPENDIX A: ELSIE DAM SAFETY UPGRADE

ELSIE DAM SAFETY UPGRADE (2000-2003)

As part of its ongoing dam safety program, BC Hydro conducts regular dam safety reviews of all its dams. The condition of Elsie Dam has not changed since it was built in 1958 and it has operated without incident. However, a 1999 review identified a need for a dam upgrade to meet current, more stringent earthquake design standards.

Analysis of horizontal layers of loose material found in the Main Dam and Saddle Dam 1 during the review in October 1999 indicated there was a risk the dams could deform and fail if a large earthquake occurred when the reservoir was filled above the level of these loose layers. Other recommended planned upgrades included work on the outlet tower and the low-level outlet.

The four-year upgrade project included the following activities:

- Excavate a channel or slot within the overflow spillway during the summer of 2000 to keep the reservoir level below elevation 326 m.
- Remove and replace the loose soil layers in the Main Dam and Saddle Dam 1 in the summer of 2001. Return the crest of the dam to the original height.
- Install a sluice gate in the new spillway channel as an alternate to the low level outlet for releasing water, and if necessary for augmenting the low level outlet to bring the reservoir level down.
- In the summer of 2002, remove and rebuild the low level intake tower.
- In 2003, refurbish and extend the low level outlet valve in Saddle Dam 1. Build up berm on the downstream side of Saddle Dam 1. Install instrumentation.

Note that the dam safety upgrade will not change the storage capacity of Elsie Lake Reservoir. The crests of the dams will be reconstructed to the original height.

APPENDIX B: ASH RIVER WATER USE PLAN CONSULTATIVE COMMITTEE, OBSERVERS AND SUB-COMMITTEES

Table B-1: Ash River Water Use Plan Consultative Committee

Member	Affiliation	Notes
Derek Appleton	Sproat Lake Area Director – Alberni Clayoquot Regional District	
Martin Byrne	Beaver Creek Improvement District	(Changed to Observer status in 2001)
Mike Carter	Alberni Valley Sport Fishing Association and Ferguson Road Residents	
Barry Chilibeck	Fisheries and Oceans	(Replaced by Ken Woo in 2002)
Dave Chitty	Alberni Valley Environmental Association	
Kevin Conlin	Ministry of Sustainable Resource Management	
Larry Cross	NorskeCanada	
Phil Edgell	Regional Aquatic Management Society (RAMS)	
Harry Brownlow	BC Hydro	
Michael Irg	Alberni-Clayoquot Regional District	
Trevor Jones	Hupacasath First Nation	
Susan Lauder	Hupacasath First Nation	(Replaced by Trevor Jones in 2002)
Doug Lowe	Ministry of Water, Land and Air Protection	
Anita Mathur	Ministry of Water, Land and Air Protection	(Changed to observer status in 2001)
Glen Rasmussen	Robertson Creek Hatchery – DFO	
Al Ross	Tseshaht First Nation	(Alternative for Dave Watts)
Ron Ross	Alberni Valley Environmental Association	(Changed to alternate for Dave Chitty in 2002)
Judith Sayers	Hupacasath First Nation	
Tom Veary	BC Hydro	
Ken Watson	City of Port Alberni	(Changed to Observer status in 2001)
Dave Watts	Tseshaht First Nation	
Craig Wightman	Ministry of Water, Land and Air Protection	(Became alternate for Doug Lowe in 2002)
Ken Woo	Fisheries and Oceans Canada	

Table B-2: Ash River Water Use Plan Water Use Plan Observers

Observer	Affiliation
Elverna Baker	Alberni Valley Chamber of Commerce
Dan Biggs	Ministry of Forests – South Island Forest District
Darlene Clark	Alberni District Sportsman's Association
Wayne Crowley	Dickson Lake Owner
Dave Dick	Ministry of Transportation and Highways
Jim Lane	Nuu-Chah-Nulth Tribal Council
Lori Macleod	Sproat Lake Stewardship Society
Neil Malbon	Weyerhaeuser
Anita Mathur	Water and Land BC Inc (Consultative Committee member until becoming Observer in 2001)
Sandy McRuer	Alberni Valley Naturalists
Craig Orr	Watershed Watch Salmon Society
Paul Pashnik	Coulson Forest Products
Ron Ptolemy	Ministry of Water, Land and Air Protection
Maureen Sager	Alberni Environmental Coalition
Dan Shannon	Shannon Dairy Ltd.
Rik Simmons	Ministry of Water, Land and Air Protection - Parks
Bill Thomson	Farmers Institute
Ken Watson	(Consultative Committee member until becoming observer in 2001)

Table B-3: Ash River Water Use Plan Subcommittees

Member	Affiliation	Fish Technical Committee	First Nation Archaeology and Heritage	Wildlife Technical Committee	Flood Control	Recreation
Harry Brownlow	BC Hydro	✓				
Mike Carter	Alberni Valley Sport Fishing Assoc. and Ferguson Road Resident				✓	✓
Dave Chitty	Alberni Valley Environmental Association					
Kevin Conlin	Ministry Sustainable Resource Management	✓				
Wayne Crawley	Resident, landowner					✓
Phil Edgell	Regional Aquatic Management Society	✓				
Michael Irg	Alberni-Clayoquot Regional District					✓
Trevor Jones	Hupacasath First Nation	✓	✓	✓		
Jim Lane	Nuu-Chah-Nulth, Fisheries Advisor	✓				
Doug Lowe	Min. of Water, Air and Land Protection	✓		✓		
Al Mclean	BC Hydro	✓				
Ron Ptolemy	Min. Water, Land and Air Protection	✓				
Glen Rasmussen	Robertson Creek Hatchery – DFO	✓				
Lisa Gallic	Tseshaht First Nation	✓				
Al Ross	Tseshaht First Nation	✓				
Judith Sayers	Hupacasath First Nation	✓	✓	✓		
Mel Sheng	Fisheries and Oceans	✓				
Steve Tatoosh	Hupacasath First Nation	✓				
Tom Veary	BC Hydro	✓				
Dave Watts	Tseshaht First Nation	✓				
Bob Westcott	BC Hydro	✓				
Craig Wightman	Min. Water, Land and Air Protection	✓				
Michael Wright	Consultant	✓				
Ken Woo	Fisheries and Oceans	✓				

APPENDIX C: SCHEDULE OF CONSULTATIVE COMMITTEE MEETINGS AND ACTIVITIES

Step 1: Initiate Water Use Plan	**11 September 2000** ▪ Public announcement
Step 2: Issues Scoping	**26 September 2000** ▪ Open House **18 October 2000** ▪ Overview of the water use planning process ▪ Introduce terms of reference and workplan ▪ Presentation of Ash River project operations **08 November 2000** ▪ Site tour to reservoir and powerhouse
Step 3: Determine the Consultative Process	**09-10 January 2001** ▪ Confirmed Consultative Committee members, terms of reference, and workplan ▪ Presentation on Structured Decision Making (process steps)
Step 4: Develop Objectives and Performance Measures	▪ Cross cultural training ▪ Started objective setting **14 February 2001** ▪ Review objectives and introduce performance measures ▪ Presentation of interest heading overviews **13-14 March 2001** ▪ Continue presentations on interest heading overviews ▪ Review objectives and performance measures ▪ Develop trial operating alternatives
Step 5: Additional Information Gathering	**15-16 May 2001** ▪ Presentation on value of electricity ▪ Study review and selection process ▪ Review of four trial operating alternatives. Discussion of alternatives and impacts ▪ Studies selected and begin
Step 6: Creating Alternatives	**19 September 2001** ▪ Discussion of study findings ▪ Alternative worksheet handed out **20-21 October 2001** ▪ Presentation on traditional ecological knowledge ▪ Ash River system overview and physical limitations ▪ Water use planning monitoring principles ▪ Review and confirmation of objectives and performance measures ▪ Developed new operating alternatives

Step 7: Assess Trade-Offs	**12-13 February 2002** ▪ Reviewed work to date ▪ Review of modelling alternatives ▪ Archaeology presentation **24-25 June 2002** ▪ Final Consultative Committee meeting. Between the February and June Consultative Committee meetings, BC Hydro met one-on-one with community and agency members. ▪ Review of operating alternatives ▪ Trade-off discussion and documentation of agreement and disagreement
Step 8: Document Areas of Agreement and Disagreement	▪ Refine existing alternatives and develop new alternatives ▪ Continue trade-off discussion and documentation ▪ Review of recommended monitoring program and specific wording of recommendations Final review of recommendations and wording of the Consultative Committee Report

APPENDIX D: LIST OF DOCUMENTS GENERATED BY THE ASH RIVER WATER USE PLANNING PROCESS

This appendix summarizes the documents prepared or used in the 2000-2002 Ash River water use planning process. The format of the documents is as indicated, either bound paper or as digital files.

A. Meeting Notes

Meeting notes summarizing presentations, discussions, and agreements at Ash River Water Use Plan Consultative Committee and Subcommittee Meetings. In most cases draft notes were circulated for review followed by notes marked "final". Meeting notes were distributed as digital files.

Committee or Subcommittee	Meeting Notes	
Ash Consultative Committee	18 October 2000	15-16 May 2001
	8 November 2000	19 September 2001
	9-10 January 2001	20- 21 October 2001
	14 February 2001	12-13 February 2002
	13-14 March 2001	24-25 June 2002
Recreation Subcommittee	No formal meeting notes	
Flood and Erosion Control Subcommittee	No formal meeting notes	
Wildlife Subcommittee	5 October 2001	5 June 2002
	13 February 2002	
First Nation Heritage and Archaeology Subcommittee	13 February 2002	
Fish Technical Subcommittee	5 March 2001	7 December 2001
	29 March 2001	8 February 2002
	10 May 2001	3 April 2002
	1 October 2001	6 June 2002
	14 November 2001	

B. BC Hydro Ash River Water Use Plan - Interim Reports

These reports are in bound and digital formats

BC Hydro. (2001). *Issues Identification Report: Ash River Water Use Plan*. 24 January 2001

BC Hydro. (2002). *Proposed Consultation Process Report: Ash River Water Use Plan*. 24 January 2001

C. Reports, literature reviews, and memos generated by the Ash River water use planning process. These reports exist in various forms, either as bound publications or in digital MS-Word or Adobe Acrobat PDF form.

BC Conservation Foundation (2002). *An Assessment of Dickson and Lanterman Falls as Obstructions to Fish Migration in the Ash River System*. Prepared by Corey Hryhorczuk and Scott Sylvestri. Nanaimo B.C., 16 pp bound.

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Woo, K. 2001. *Response from Kim Hyatt with respect to water temperature concerns/issues*. Prepared by Fisheries and Oceans Canada. 3 October 2001. Memo. 2 pp. Digital MS-Word "KenHyatt Temp 3Oct2001.doc"

APPENDIX E: EVALUATING THE ELIGIBILITY OF STUDIES IN WATER USE PLANNING

STUDY PROPOSALS

Studies may include field data collection, analysis and/or model building. The costs and benefits of each study proposed will be described using the "Study Proposal Template". These will be summarized in a summary matrix (Table E-1:).

Evaluation Criteria (See Figure E-1 for Flowchart Summary)

Step 1

Will the study provide information related to the calculation of a performance measure?

- If not, the study is not eligible for Step 5 studies.

Step 2

Is the data gap or uncertainty that this study addresses significant enough to affect the ranking of alternatives?

- A "no" answer should normally disqualify a study from further consideration. For some studies, the answer will be clearly "yes". For others, it may be unclear. Judgement will have to be used.
- In some cases, there may be data gaps that we could fill that would improve a performance measure, but that are unlikely to affect the ranking of alternatives. Examples of cases where an uncertainty exists but is not likely to affect ranking of alternatives include:
    - We may not know a parameter value exactly, but we can with reasonable confidence establish a range of plausible values for it. If, within that range, the performance measure value does not change significantly, then it is not essential to address the uncertainty.
    - If all alternatives are equally affected by an uncertainty (all biased up or all biased down), the absolute value of the performance measure may be wrong, but the relative ranking of the alternatives is not affected.

Step 3

Can the study provide meaningful, reliable data within the time frame available in the Water Use Plan project schedule?

- If not, the study is not eligible for Step 5 studies.

- In many cases, especially for studies involving fisheries and wildlife, year-to-year variability is significant and it is not possible to draw scientifically defensible conclusions from a single field season. If a study cannot provide data that provides useful information after a single field season, it is not a candidate for Step 5 studies. It may however be a candidate for longer term monitoring programs that are conducted as part of *Water Use Plan* implementation. If it turns out that participants feel that a particular uncertainty significantly affects the ability to make responsible decisions at Step 7, then a monitoring program may be designed to address the uncertainty and ensure that better information is available for the next *Water Use Plan* review. Participants may link their recommendations about the timing of the next *Water Use Plan* review to the expected timing of results from long term monitoring programs.

Step 4

Do the benefits outweigh the costs?

- If Steps 1 through 3 are yes, then it is necessary to look at the cost of a proposed study. There may be a range of study designs that will provide a range of data quality, and these should be evaluated. If the costs for studies in support of a performance measure are very high, then it may be important to consider alternative performance measures. In some cases, a simpler measure may provide better value.

STUDY PRIORITIZATION

After evaluating each study against the above criteria, it will be assigned one of five priorities:

Priority 1	The information provided by this study is essential for *Water Use Plan*. Responsible decisions cannot be made without it.
Priority 2	This study will provide information that is likely to affect the ranking of alternatives. The benefits clearly outweigh the costs.
Priority 3	This study has benefits, but is of lower priority. Some reasons for lower priority include: ▪ costs may outweigh benefits; ▪ the benefits may not be significant enough to affect ranking of alternatives; ▪ the performance measure this study addresses has less likelihood of being the "limiting factor" (relative to other performance measures).
Priority 4	This study is not necessary or desirable for *Water Use Plan*.
Priority 5	This study may be important, but cannot be completed within the *Water Use Plan* timeline.

STUDY APPROVAL

The Consultative Committee will prioritize studies as above, and will make recommendations to BC Hydro about which studies should be approved. However, BC Hydro retains the final decision-making responsibility for study approval, and will make this decision based on the recommendations of the Consultative Committee, the costs and benefits outlined as above (and in the study proposal template), and the availability of resources.

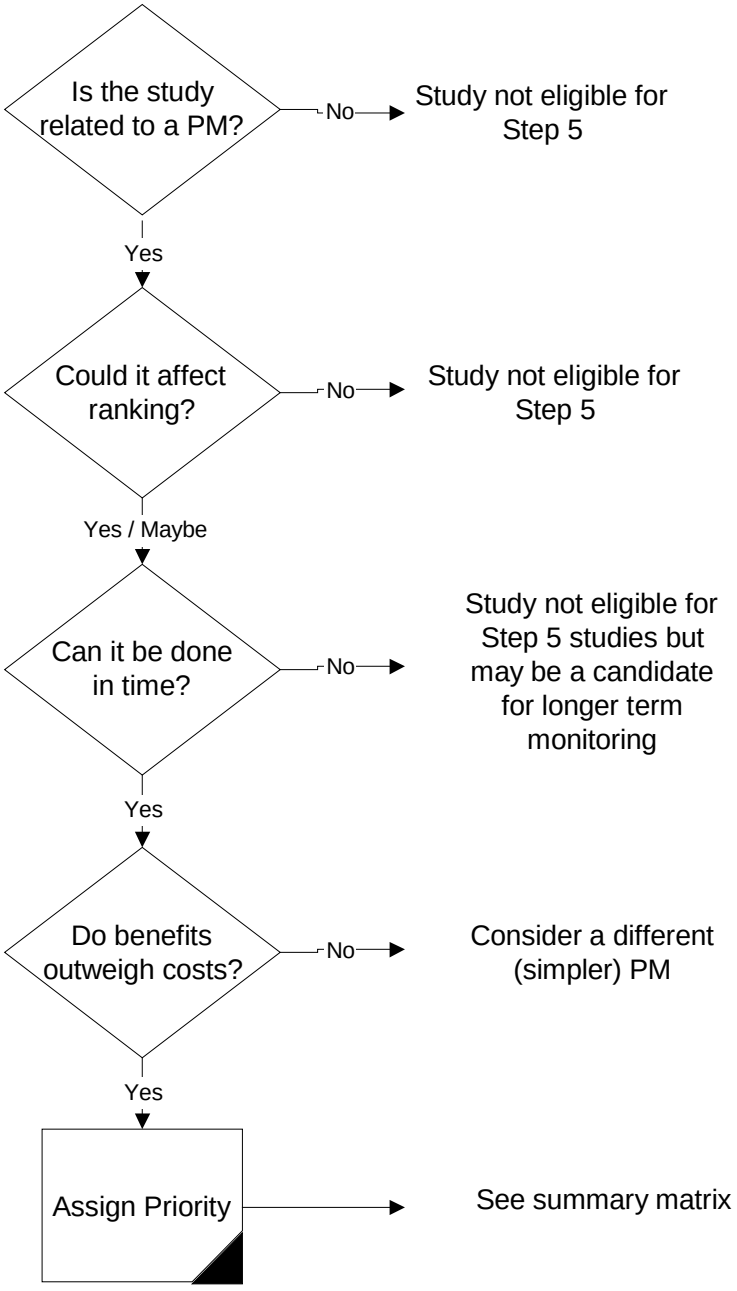


Figure E-1 Guidelines for Prioritizing Step 5 Studies

Table E-1: Summary Matrix for Priority Setting

Study	Cost	Completion Date	Uncertainty or Data Gap Affected	Affects	Benefits Ranking?	Risks	Priority Assigned

Based on the information contained in the Study Proposal Template, the summary table will be completed and used to assign a priority to each study.

APPENDIX F: RAMP RATES FOR THE ASH RIVER HYDROELECTRIC FACILITY

The Ash River Consultative Committee recommends that the following ramp rates be adopted in the Ash River Water Use Plan. The releases from Elsie Lake Reservoir are measured at the Low Level Outlet (LLO, also know as the hollow cone valve) located in the base of the main saddle dam of Elsie Dam.

Table F-1: Rate of Change in Release from Elsie Dam Low Level Outlet into Ash River

	Ramp Up Rate (Pertains to LLO, not spillway)	**Ramp Down Rate** (Pertains to LLO, not spillway)
Ramp Rate [1]	Discharge — Rate of Change	Discharge — Rate of Change
Imperial	0-100 cfs = **40 cfs/hr** 101-200 cfs = **80 cfs/hr** 201-300 cfs = **100 cfs/hr** 301-500 cfs = **120 cfs/hr** 501-700 cfs = **140 cfs/hr** 701-950 cfs = **160 cfs/hr** >950 cfs = **180 cfs/hr**	>950 cfs[2] = **88 cfs/hr** 950-701 cfs = **80 cfs/hr** (3.1 hrs) 700-601 cfs = **72 cfs/hr** (1.4 hrs) 600-501 cfs = **64 cfs/hr** (1.6 hrs) 500-301 cfs = **36 cfs/hr** (5.6 hrs) 300-201 cfs = **32 cfs/hr** (3.1 hrs) 200-125 cfs = **12 cfs/hr** (6.3 hrs) 125-0 cfs[3] = **8 cfs/hr**
Ramp Rate **Metric**	0-2.8 cms = **1.1 cms/hr** 2.8-5.7 cms = **2.3 cms/hr** 5.7-8.5 cms = **2.8 cms/hr** 8.5-14.2 cms = **3.4 cms/hr** 14.2-19.8 cms = **4.0 cms/hr** 19.8-26.9 cms = **4.5 cms/hr** >27 cms = **5.1 cms/hr**	>27 cms* = **2.5 cms/hr** 27.0-19.8 cms = **2.3 cms/hr** (3.1hrs) 19.8-17.0 cms = **2.0 cms/hr** (1.4hrs) 17.0-14.2 cms = **1.8 cms/hr** (1.6hrs) 14.2-8.5 cms = **1.0 cms/hr** (5.6hrs) 8.5-5.7 cms = **0.9 cms/hr** (3.1hrs) 5.7-3.5 cms = **0.3 cms/hr** (6.3hrs) 3.5-0 cms** = **0.2 cms/hr**
Justification	Based on natural ramp rates at Elsie Dam	It is estimated that these rates should produce a stage drop of <2.5 cm/hr in the Ash River
Source	Based on Elsie Lake Reservoir data generated for Goff Longworth (BCH) by Pentti Sjoman (BCH), August 2000	Modified natural ramp rates based on field data collected during October 2000 ramping event
Comments	-Ramping should occur every 15 minutes -LLO not operated at flows greater than 1050 cfs.	

[1] cfs = cubic feet per second = 0.0283 m^3/s
[2] Extrapolated from natural ramp rates for Elsie Lake Reservoir
[3] Derived from natural ramp rates for Elsie Lake Reservoir. Eight cfs/hr or .2 cms/hr is the minimum stage drop per hour in the data set analyzed (Nov-Dec-Jan 1995-1999)

APPENDIX G: FISH RELATED STUDIES IN THE ASH RIVER WATER USE PLANNING PROCESS

The Consultative Committee undertook several studies to better understand impacts of operations on fish habitat in the Ash River. The studies also provided data on how available habitat varied with flows for calculating performance measures. Where appropriate, data were collected according to provincial resource inventory standards.

HYDRAULIC REVIEW

A hydrologic review of the Ash River hydroelectric system (Lewis, 2001a) provided a better understanding of annual inflow patterns, the diversion of water from Elsie Lake Reservoir between the Ash River and Great Central Lake, and when periods of critical low flows for fish occurred.

PLACE NAMES IN ASH RIVER WATER USE PLANNING AREA

Fisheries and Oceans Canada prepared a map (Figure 2-1in body of report) of place names in the Ash system. The map helped standardize references to geographic locations (i.e. Upper Ash, Lower Ash River). Hupacasath First Nation provided aboriginal names to places as well (Table G-1).

Table G-1: Hupacasath First Nation Place Names

a-tu-min (place of beaver)	Elsie Lake (original, pre-impoundment)
o-ii-ni-mat	Ash Lake (near Dickson Lake)
Ts-axla	Ash River

FISH LIFE STAGES AND TIMING (PERIODICITY CHART)

The Fish Technical Subcommittee compiled information on the timing of key life stages for fish in the Ash River. The Ministry of Water, Land and Air Protection provided periodicity charts for steelhead, coho, and chinook showing the timing of migration, spawning, and emergence from eggs (summarized in Lewis, 2001b). Using the life history information, the Fish Technical Subcommittee focussed on migration, rearing and spawning of steelhead and coho as being the key fish issues for the river. A Traditional Ecological Knowledge (TEK) study conducted by the Hupacasath First Nation provided information on fish species present in the system.

MIGRATION FLOWS AT LANTERMAN AND DICKSON FALLS

The Fish Technical Subcommittee had very little information on the flows that would permit fish, primarily steelhead, to overcome barriers at Dickson and Lanterman Falls. The Fish Technical Subcommittee undertook a structured expert opinion exercise that combined existing information, professional experience, and a site visit to estimate the flows that would provide the best opportunities for fish passage. D. Burt and Associates

provided additional information on the condition of the barriers and steelhead passage in July 2001 (Burt, 2001).

The expert opinion process led to the specifications for the "migration pulse flows" built into the operating alternatives, that is a pulse increasing background flows to 10 m^3/s then back to background over a 48 hour period. The concept was that individual fish would surmount the falls at the appropriate flows either as flows increased to, or decreased from, the 10 m^3/s peak over 48 hours. Note that the suitability of the pulse flow remains to be evaluated.

INSTREAM FLOW STUDIES

The Fish Technical Subcommittee conducted instream flow studies in the Ash River to establish the relationship between available spawning and rearing habitat over a range of flows (Lewis, 2001d). Crews established 17 transects between Elsie Dam and the confluence of the Ash and Stamp Rivers representing glide, riffle, and run habitats. Crews sampled habitat characteristics at each transect at two flow levels, 3.5 m^3/s and 7 m^3/s released from Elsie Dam. Tributary inflows increased those flows with distance from the dam.

The results showed how width of suitable steelhead parr rearing habitat increased linearly as flows increased. Habitat response at flows above 7 m^3/s discharge (Figure G-1) are an extrapolation based on the morphology of the stream channel increasing discharge above 7 m^3/s in a confined channel is not expected to yield increased width of habitat. At high flows in Figure G-1, the width of suitable habitat may decrease as water depth and velocity increase beyond what the fish and aquatic biota can tolerate. The study results were used to calculate scores for rearing and spawning habitat performance measures under different operating alternatives.

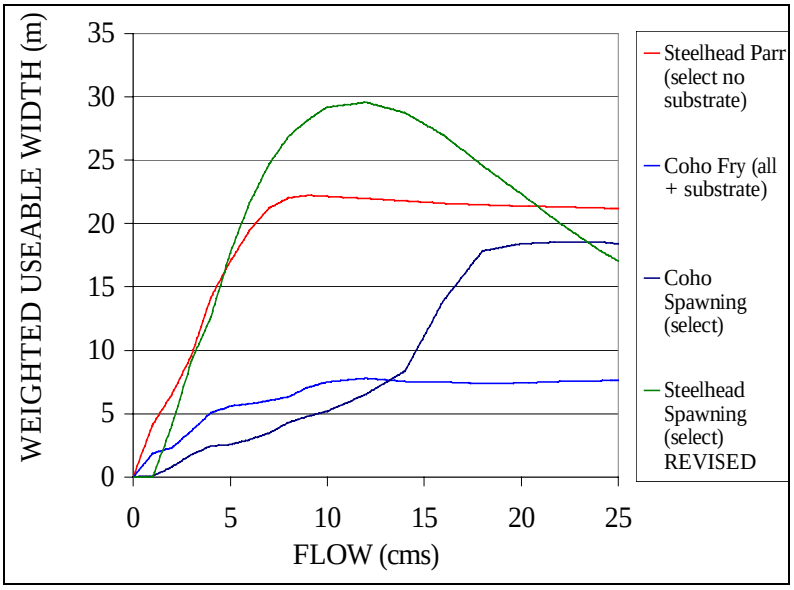


Figure G-1: Relationship between flow and fish habitat for steelhead and coho in the Ash River. (Some curves based on selected transects with or without substrate as a factor)

RAMP RATES

When changes are made to the rate of discharge from the hollow cone valve, excessive ramping rates can strand or displace fish. Particularly, ramping down can leave fish stranded as the water rapidly recedes. The Fish Technical Subcommittee assessed current ramping rates and compared them to natural ramping rates and rates at other facilities. The Fish Technical Subcommittee found the BC Hydro draft ramping strategy to be conservative. The Consultative Committee did not specify ramping rates as a constraint when developing water use operating alternatives. Ramping rates are specified on an hourly basis while the minimum resolution of the water use modelling was one day. The Consultative Committee will recommend adopting the BC Hydro ramping strategy for the Ash River (Appendix F).

APPENDIX H: ANALYSIS OF AVAILABLE DISCHARGE IN THE SOMASS RIVER FOR DOMESTIC WATER WITHDRAWAL

The representative from the Beaver Creek Improvement District identified domestic water withdrawals from the Somass River as a potential Ash River Water Use Plan issue. The concern was that BC Hydro operations may limit the water available for domestic use. As summarized below, an analysis of water licences and river discharge data showed that domestic water withdrawals represented less than 2% of river discharge during the lowest flows observed over 43 years of data.

There are 43 years of discharge data (1958 to 2000) from the Water Survey of Canada gauge on the Somass River located near Ferguson Road (Figure H-1). The upper red line in Figure H-1 shows the daily flows averaged over 43 years and the lower, blue line shows the lowest flows observed for each calendar day.

In comparison, when the Beaver Creek Improvement District water licence is combined with other licence holders, the total allowable withdrawal is of approximately 0.30 m^3/s (Table H-1). Given a worst case scenario in which discharge in the Somass River is at a 43 year low and at the same time all water licence holders on the Somass are withdrawing the maximum permitted by their water licences, the combined withdrawals represent approximately 1.7% of the flow in the river. In average conditions, during summer low flows, the ratio of withdrawals to flow (0.30 $m^3/s \div 37.3$ m^3/s) is 0.008 or less than 1% of the water available in the Somass River.

Withdrawals from the Somass River for domestic use are small relative to the available discharge even in low flow periods. The purpose of the Ash River water use planning process is to develop a preferred operating regime for the Ash River hydroelectric system. Any changes relative to status quo are not expected to have a significant effect on water available for licensed domestic water use. Elsie Lake Reservoir has a small storage capacity relative to annual inflows. Any water in storage diverted to the generation plant on Great Central Lake eventually flows back into the Somass River by way of Great Central Lake and the Stamp River. Given that there was little that potential changes to operations could do to impact or benefit domestic water supply in the Somass River, the Ash River Water Use Plan Consultative Committee decided not to pursue domestic water withdrawals as a water use planning issue.

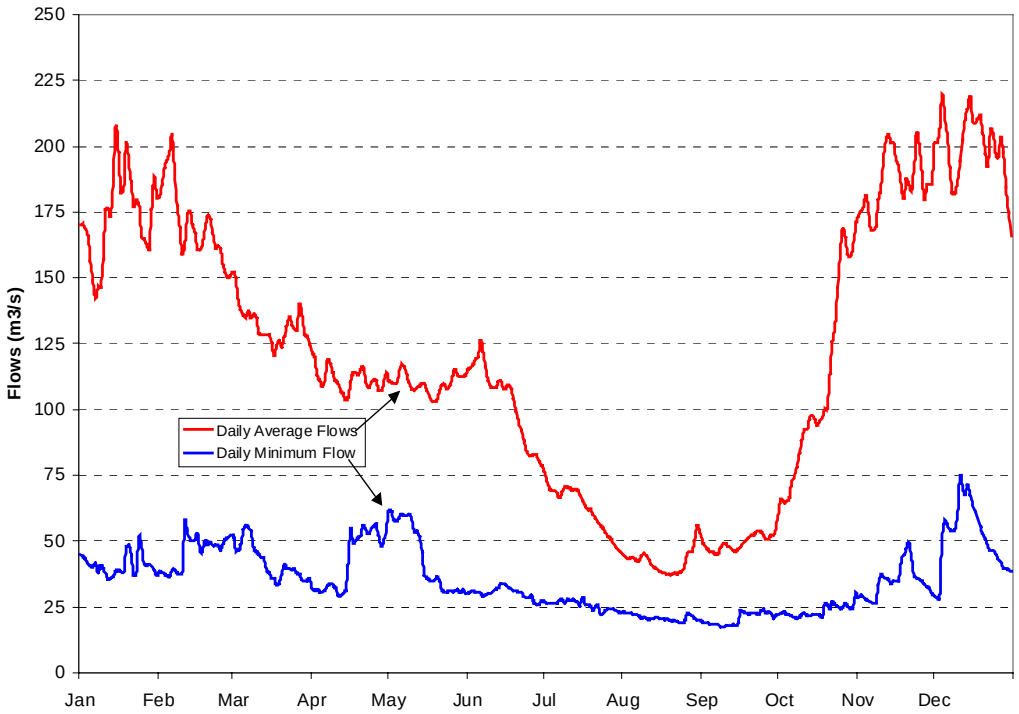


Figure H-1: Somass River - Daily average flows and daily minimum flows - 1958 to 2000

Table H-1: Summary of current water licences on the Somass River and low flows observed at the WSC Somass gauge (near Ferguson Road). Flows expressed both in litres/second and m^3/second

Water Licences Limits and Somass River Discharge History	Litres per second[1]	m^3 per second
Beaver Creek Improvement District – Licence maximum	100	0.10
Sum of other licensed withdrawals on Somass River	~200	~0.20
Total maximum withdrawal rate of all water licences on Somass River	300	0.30
Somass discharge observed 1958 to 2000		
Minimum average daily discharge[2]	37 300	37.3
Minimum observed discharge[3]	17 500	17.5
Ratio of total licensed withdrawals to lowest observed discharge at Somass Water Survey of Canada gauge (0.30 m^3/s ÷ 17.5 m^3/s)	0.017 or 1.7% of minimum discharge	

1. 1 m^3 = 1 000 litres
2. The summer low flow averages 37.3 m^3/s. See lowest point on red (upper) line in Figure H-1.
3. Lowest observed discharge over a 24 hour period was 17.5 m^3/s. See lowest point on blue (lower) line in Figure H-1.

APPENDIX I: MINIMUM RELEASES FROM ELSIE DAM TO PROVIDE A NATURALIZED FLOW PATTERN IN ASH RIVER

A **Period beginning**	B **Proposed Natural Flow Pattern Alternative[1] (m^3)**	C **Estimated Naturalized Median Daily Flow[2] (m^3)**
1 January	8.0	18.2
15 January	8.0	18.2
1 February	8.0	15.4
15 February	8.0	15.4
1 March	8.0	16.6
15 March	8.0	16.6
1 April	10.0	21.9
15 April	15.0	21.9
1 May	15.0	21.9
15 May	10.0	21.9
1 June	10.0	16.5
15 June	6.0	16.5
1 July	6.0	6.5
15 July	6.0	6.5
1 August	3.5	2.9
15 August	3.5	2.9
1 September	3.5	1.9
15 September	3.5	1.9
1 October	3.5	5.5
15 October	8.0	5.5
1 November	8.0	19.8
15 November	8.0	19.8
1 December	8.0	15.8
15 December	8.0	15.8

1. Column B is the proposed natural flow alternative hydrograph
2. Column C is the estimated seasonal natural flows in the Ash River in the absence of the dam and reservoir

APPENDIX J: ASH RIVER ROUND 3 OPERATING ALTERNATIVES AND 34 PERFORMANCE MEASURES AND AUXILIARY PERFORMANCE MEASURES

		WL	E	B	C	F	D	G2	H	I1	I2	I3	J	K
	Alternatives/Performance Measures	**Water Licence**	**Fish 3.5 m^3/s year round**	**Fish 3.5 m3/s May-Sept then 5 m3/s Oct-Apr**	**Fish 3.5 m^3/s May-Oct then 5 m^3/s Nov-Apr**	**Fish 5.0 m^3/s year round**	**Reservoir Recreation**	**Power WL Fish No diversion limit**	**Archaeology avoid 327-328.5 m**	**Restore Drawdown Zone Variant 1 <320 m year round**	**Restore Drawdown Zone Variant 2 <320 m May-Oct**	**Restore Drawdown Zone Variant 3 <323 m May-Oct**	**Natural Flow Pattern Hydrograph**	**Restore Drawdown Zone + Natural Flow Pattern Hydrograph**
PM#.	**FLOOD CONTROL**													
1	No. days discharge at Somass gauge <650 m^3/s over a 34 year period. (Max=12 045 days)	12 017	12 017	12 017	12 017	12 017	12 017	12 017	12 017	12 008	12 017	12 017	12 016	11 995
	RECREATION-RESERVOIR													
2	No. days elevation >329.5 m 24 May - Thanksgiving (Max=144 days/year)	82	57.5	56	57	52.5	78.5	63	56	0	0	0	34.5	0
3	No. days elevation >327.5 m May 24 - Thanksgiving (Max=144 days/year)	112	83	83	83	83	142	82.5	76.5	0	0	0	75.5	0
4	No. days elevation > 329.5 1 April - 30 June (Max=91 days/year)	91	79	69	70.5	65.5	31	91	69	0	5	5	21	0
	FIRST NATION CULTURE AND HERITAGE-RESERVOIR													
5	Unauthorized collection protection: No. days elevation >328 m (Max=365 days/year)	302	233.5	216.5	220.5	216.5	261.5	263.5	216.5	0	78.5	84	145.5	45
6	Erosion protection: No. days elevation outside range of 327 m to 328.5 m (Max 365 days/year)	347	335.5	325	325	324.5	266.5	336.5	338.5	365	347	345.5	325	353
7	Traditional use and study opportunities: No. days elevation <317.5 m	0	0	0	0	0	0	0	0	4.5	4	4	0	6

		WL	E	B	C	F	D	G2	H	I1	I2	I3	J	K
	Alternatives/Performance Measures	**Water Licence**	**Fish 3.5 m^3/s year round**	**Fish 3.5 m3/s May-Sept then 5 m3/s Oct-Apr**	**Fish 3.5 m^3/s May-Oct then 5 m^3/s Nov-Apr**	**Fish 5.0 m^3/s year round**	**Reservoir Recreation**	**Power WL Fish No diversion limit**	**Archaeology avoid 327-328.5 m**	**Restore Drawdown Zone Variant 1 <320 m year round**	**Restore Drawdown Zone Variant 2 <320 m May-Oct**	**Restore Drawdown Zone Variant 3 <323 m May-Oct**	**Natural Flow Pattern Hydrograph**	**Restore Drawdown Zone + Natural Flow Pattern Hydrograph**
	FIRST NATIONS TRADITIONAL USE-RIVER													
8	Natural flow hydrograph for traditional use in river (1=Yes, 0=No)	0	0	0	0	0	0	0	0	0	0	0	1	1
	FISH HABITAT-RESERVOIR													
9	Sum of Euphotic Volume (M m^3 days)	21 436	19 134	18 596	18 742	18 295	20 863	20 066	18 447	5 992	11 454	12 480	16 182	10 000
10	Sum of Effective Littoral Area (ha)	202	204	205	205	206	218	203	205	247	226	225	212	237
	Rainbow Trout													
11	Sum Elsie Tributary Effective Spawning Habitat (m^2)	0	0	0	0	0	50.7	0	0	12 934	25	25	10	266
12	Sum Elsie Effective Tributary Rearing Habitat (m)	0	0	4.4	4.4	4.4	8.8	0	4.4	5 348	5 220	4 002	874	5 630
	WILDLIFE HABITAT-RESERVOIR													
13	Hectares of riparian habitat (Apr-Sept)	22	48	52	52	50	39	36	52	216	193	167	73	219
	FISH-MIGRATION PULSE FLOW													
14	Pulsed flows of desired magnitude, shape, and duration to assist Steelhead passage at Lanterman and Dickson Falls (1=Yes 0=No)	0	1	1	1	1	1	0	1	1	1	1	1	1
	FISH HABITAT-JUST BELOW ELSIE DAM													
	Steelhead													
15	Sum of Steelhead Parr Rearing WUW (m)	0.8	11.9	11.9	11.9	17.0	2.9	0.8	11.9	11.9	11.9	11.9	11.9	11.9
16	Sum of Steelhead Spawning WUW (m)	13.7	10.9	17.7	17.7	17.7	4.1	0.0	17.7	17.7	17.7	17.7	26.9	26.9

	Alternatives/Performance Measures	WL Water Licence	E Fish 3.5 m^3/s year round	B Fish 3.5 m3/s May-Sept then 5 m3/s Oct-Apr	C Fish 3.5 m^3/s May-Oct then 5 m^3/s Nov-Apr	F Fish 5.0 m^3/s year round	D Reservoir Recreation	G2 Power WL Fish No diversion limit	H Archaeology avoid 327-328.5 m	I1 Restore Drawdown Zone Variant 1 <320 m year round	I2 Restore Drawdown Zone Variant 2 <320 m May-Oct	I3 Restore Drawdown Zone Variant 3 <323 m May-Oct	J Natural Flow Pattern Hydrograph	K Restore Drawdown Zone + Natural Flow Pattern Hydrograph
	Coho													
17	Sum Coho Fry Rearing Weighted Useable Width (m)	0.4	4.3	4.3	4.3	5.6	1.3	0.4	4.3	4.3	4.3	4.3	4.3	4.3
18	Sum Coho Spawning Weighted Useable Width (m)	0.0	2.1	2.6	2.6	2.6	0.0	0.0	2.6	5.8	2.6	2.6	4.3	4.3
	Auxiliary Performance Measures													
19	Elsie: Fish flow needs met (Max=365)	153	365	365	365	365	121.5	116.5	365	362	362.5	363	365	358.5
20	Elsie: Min daily flow (m^3/s) Year round	0.3	3.5	3.5	3.5	5.0	0.3	0.3	3.5	0.0	0.0	0.0	3.5	0.0
21	Elsie: Mean daily flow during CSFP (m^3/s). Aug-Sept	0.5	3.9	3.9	3.9	5.3	1.0	0.5	5.4	3.9	3.9	3.9	3.9	3.9
	FISH HABITAT - BELOW MORAN CREEK													
	Steelhead													
22	Sum of Steelhead Parr Rearing WUW (m)	6.1	16.7	17.6	16.7	20.2	6.2	6.1	17.7	17.2	17.2	17.0	17.2	16.7
23	Sum of Steelhead Spawning WUW (m)	16.2	23.9	26.9	26.9	26.9	16.2	16.2	26.9	23.0	26.5	26.5	28.4	27.9
	Coho													
24	Sum Coho Fry Rearing Weighted Useable Width (m)	2.3	5.6	5.7	5.6	5.9	2.4	2.3	5.7	5.7	5.7	5.7	5.6	5.6
25	Sum Coho Spawning Weighted Useable Width (m)	3.2	4.4	5.1	5.0	5.1	2.8	2.8	5.1	14.5	5.1	5.1	7.1	7.2
	Auxiliary Performance Measures													
26	Moran: Fish flow needs met (Max=365 days)	230	365	365	365	365	232	227	365	362	363	364	365	359
27	Moran. Min. daily flow (m^3/s) (Year round).	0.6	3.7	3.9	3.8	5.2	0.6	0.6	3.9	0.7	0.7	0.8	3.8	0.8

		WL	E	B	C	F	D	G2	H	I1	I2	I3	J	K
	Alternatives/Performance Measures	**Water Licence**	**Fish 3.5 m^3/s year round**	**Fish 3.5 m3/s May-Sept then 5 m3/s Oct-Apr**	**Fish 3.5 m^3/s May-Oct then 5 m^3/s Nov-Apr**	**Fish 5.0 m^3/s year round**	**Reservoir Recreation**	**Power WL Fish No diversion limit**	**Archaeology avoid 327-328.5 m**	**Restore Drawdown Zone Variant 1 <320 m year round**	**Restore Drawdown Zone Variant 2 <320 m May-Oct**	**Restore Drawdown Zone Variant 3 <323 m May-Oct**	**Natural Flow Pattern Hydrograph**	**Restore Drawdown Zone + Natural Flow Pattern Hydrograph**
28	Moran: Mean daily flow during CSFP (m^3/s). Aug-Sept	2.2	5.6	5.6	5.6	7.0	2.7	2.2	7.1	5.7	5.7	5.7	5.6	5.6
	GREAT CENTRAL LAKE													
29	Shoreline egg incubation (M m^3 diversion in Feb)	29.2	32.8	32.8	32.8	32.8	32.8	32.8	32.8	18.1	32.8	32.8	32.8	32.8
30	Spawner migration-Stamp River: (M m^3 diversion Aug-15 Oct)	65.4	64.4	64.1	64.4	58.2	33.8	65.5	64.1	15.3	15.3	19.8	59.3	13.9
31	Total inflow to GCL	339	377	371	373	358	352	404	371	211	292	333	320	256
	POWER													
32	MW.h generated per acre-foot of water inflow	0.35	0.38	0.37	0.37	0.36	0.35	0.40	0.37	0.21	0.29	0.33	0.33	0.25
33	$ value of energy (millions)	9.6	10.3	10.2	10.2	9.9	9.8	10.9	9.6	6.0	8.1	9.1	9.1	7.1
34	Plant availability with no restrictions	471	471	471	471	471	471	471	471	462	466	468	471	465

APPENDIX K: BOX PLOTS SHOWING VARIABILITY OF PERFORMANCE MEASURE SCORES OVER 38 YEARS OF SIMULATED OPERATIONS OF THE ASH RIVER HYDROELECTRIC FACILITY

Interpreting Box Plots

The performance measures are based on median values observed over 38 years of simulated operation of the Ash River hydroelectric facility. We are also interested in the variation of the performance measure scores from year-to-year. Box plots graphically show this variation as well as visually show how the alternatives compare to each other.

For example Table K-1 shows the performance measure for reservoir recreation for each of the 38 years of simulated operation. This performance measure counts the number of days the reservoir is above 329.5 m each year between 24 May and Thanksgiving (arbitrarily set at 15 October). For instance in 1963 there were 24 days during the summer that the reservoir was in the preferred elevation range above 329.5 m.

We see based on 38 years (Figure K-1) that there is year to year variation in the number of days the reservoir is above 329.5 m. The range is from a low of 0 days in 1965, 91 and 92 to a high of 128 days in 1971. The median value is 53 days. In 50% of the years, there will be more than 53 days when the reservoir is above 329.5 m. And in the other 50% of the years, there will be less than 53 days.

We can specify other percentile points. The 25th percentile value is 35 days. That is, 25% of the observations fall below 35 days and 75% of the observations are above 35 days. Similarly, we can calculate the 75th percentile (74 days). So 75% of the years, there will be less than 74 days and in 25% of the years, there will be more than 74 days when the reservoir is above 329.5 m.

The box plots in this appendix compare the range of scores for each Performance measure across the 13 operating alternatives considered in Ash River Water Use Plan (e.g., Figure K-2).

Table K-1

Year	No. Days > 329.5 m
1963	24
1964	70
1965	0
1966	71
1967	60
1968	47
1969	79
1970	35
1971	128
1972	71
1973	40
1974	88
1975	62
1976	77
1977	36
1978	84
1979	76
1980	6
1981	13
1982	75
1983	72
1984	74
1985	7
1986	36
1987	54
1988	70
1989	45
1990	45
1991	0
1992	0
1993	44
1994	26
1995	51
1996	7
1997	86
1998	57
1999	120
2000	46

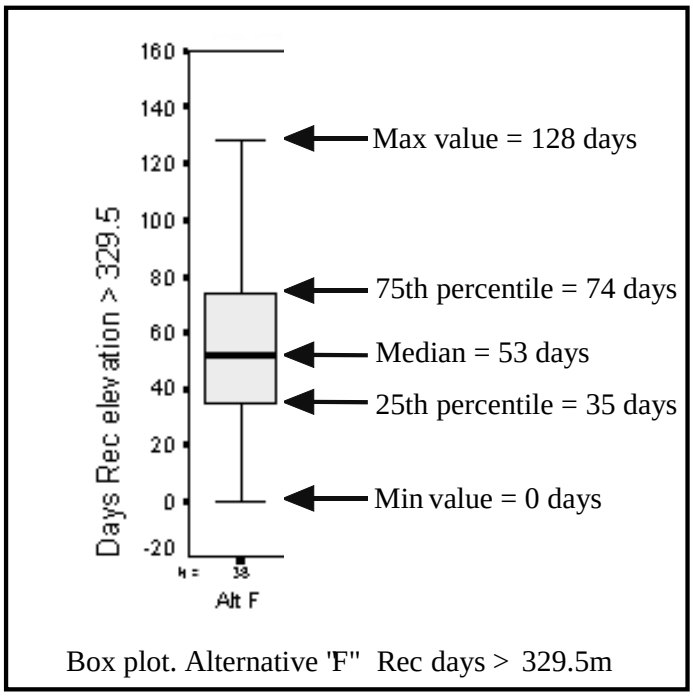


Figure K-1 Blue rectangle shows median (dark line) and range of observations, 25% above and 25% below the median (i.e., 50% of the time, there will be between 35 and 74 days the reservoir is 329.5 m or higher). The "whiskers" show the minimum (0 days) and maximum (128 days) values. Extreme outliers show as circles (Alternatives E, B, and C in Figure 2 have outliers)

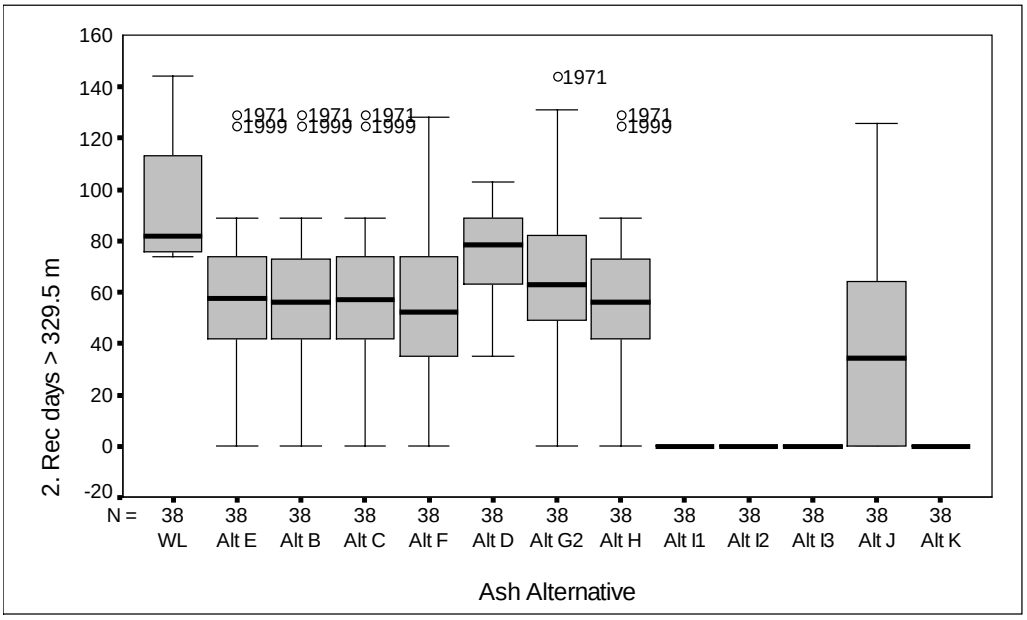
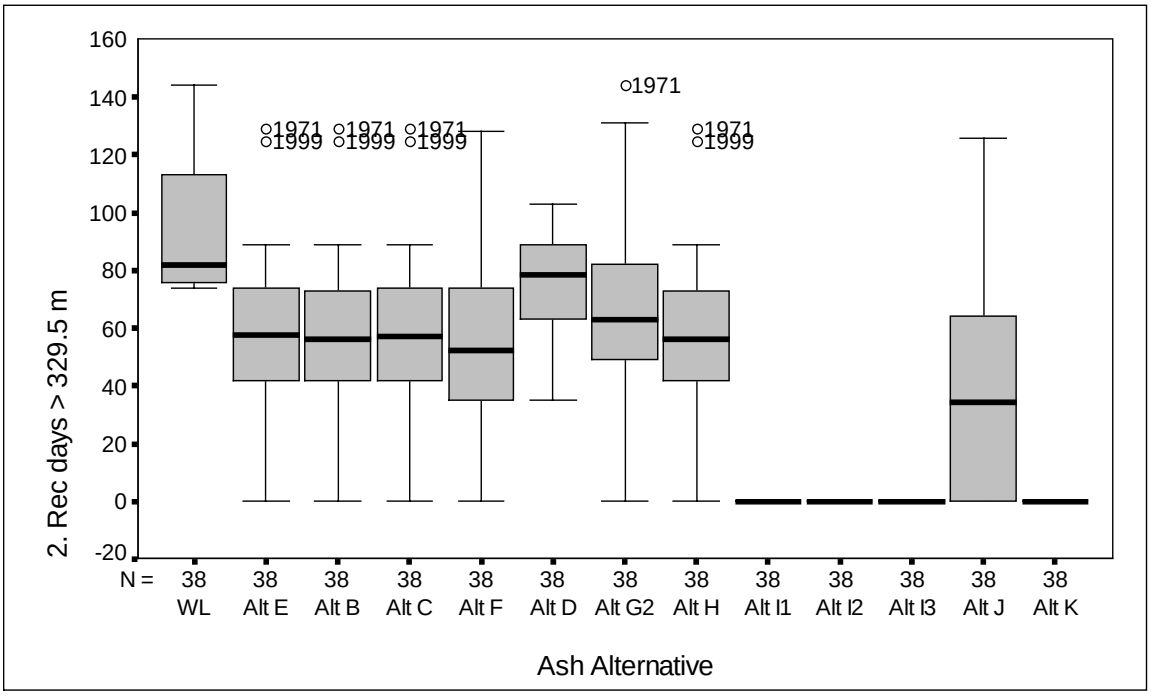
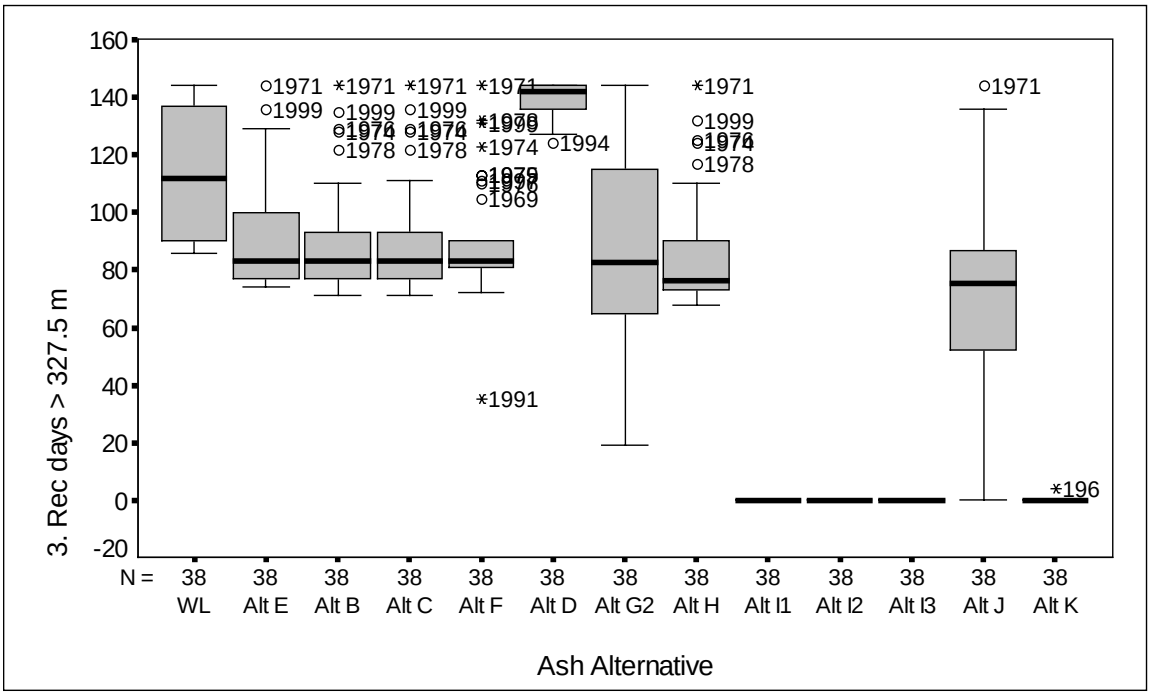


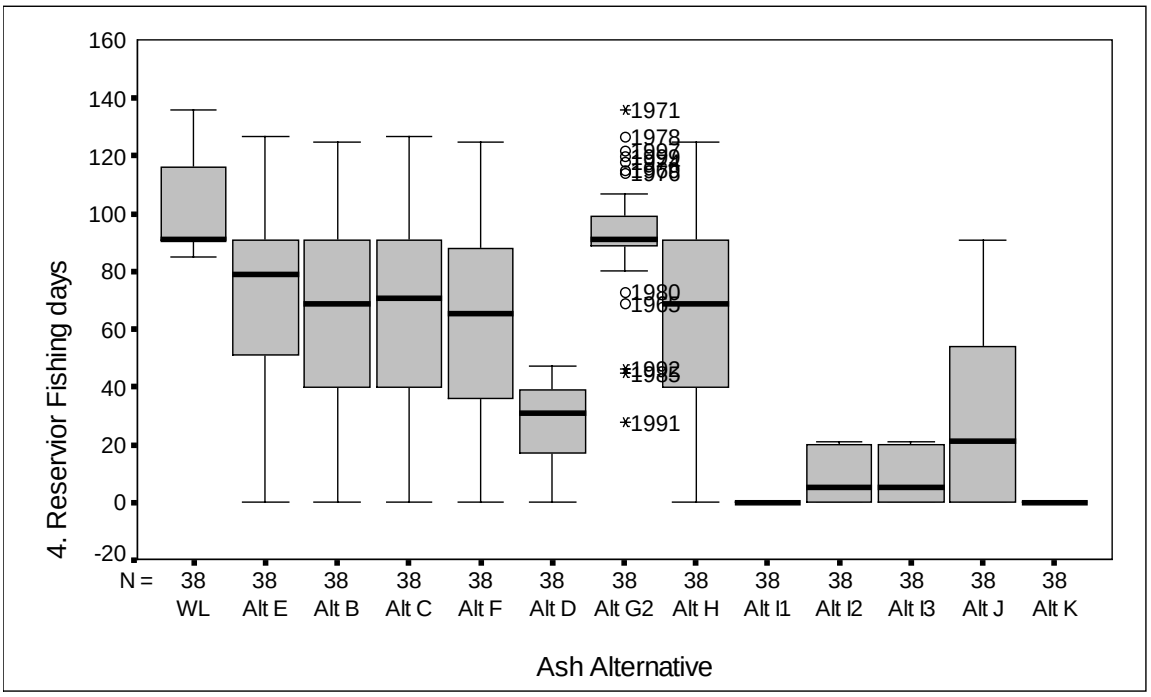
Figure K-2 Comparing 13 alternatives on the performance measure Reservoir Recreation days >329.5 m. Alternatives E, B and C have similar medians scores. Alternative F has a slightly lower median score but given the similar overlapping range of the performance measure scores, Alternatives E, B, C and F effectively perform similarly on this performance measure.



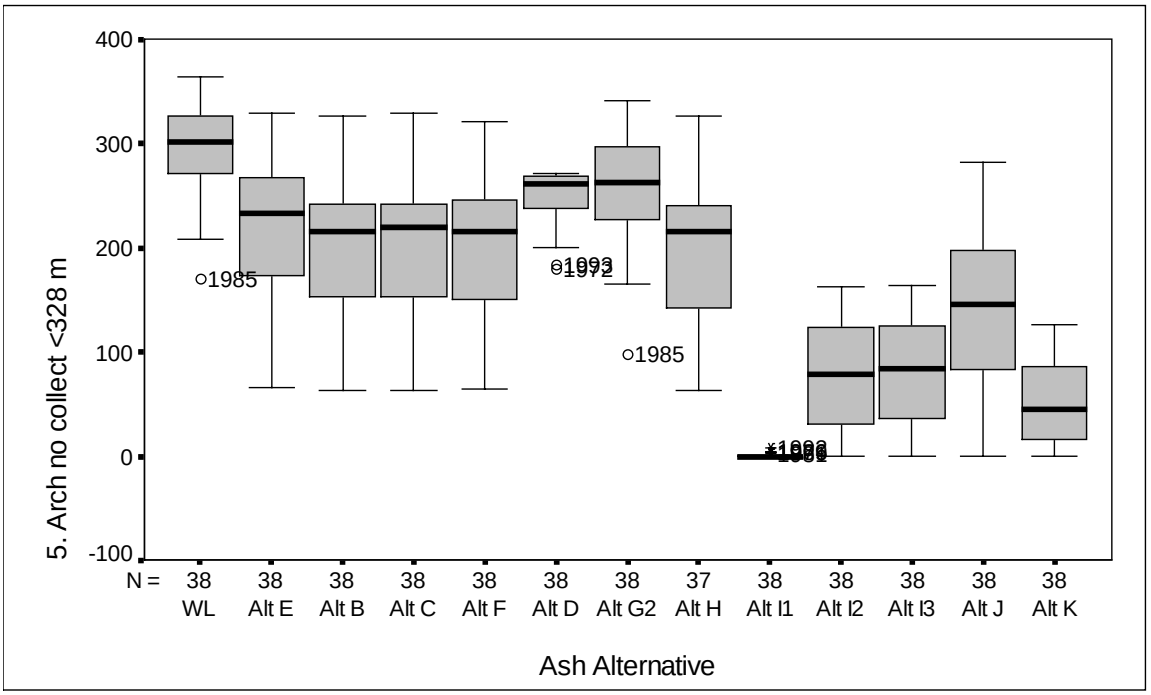
PM No. 2 No. of Days Elevation >329.5 m, 24 May – Thanksgiving (max = 144 days/year)



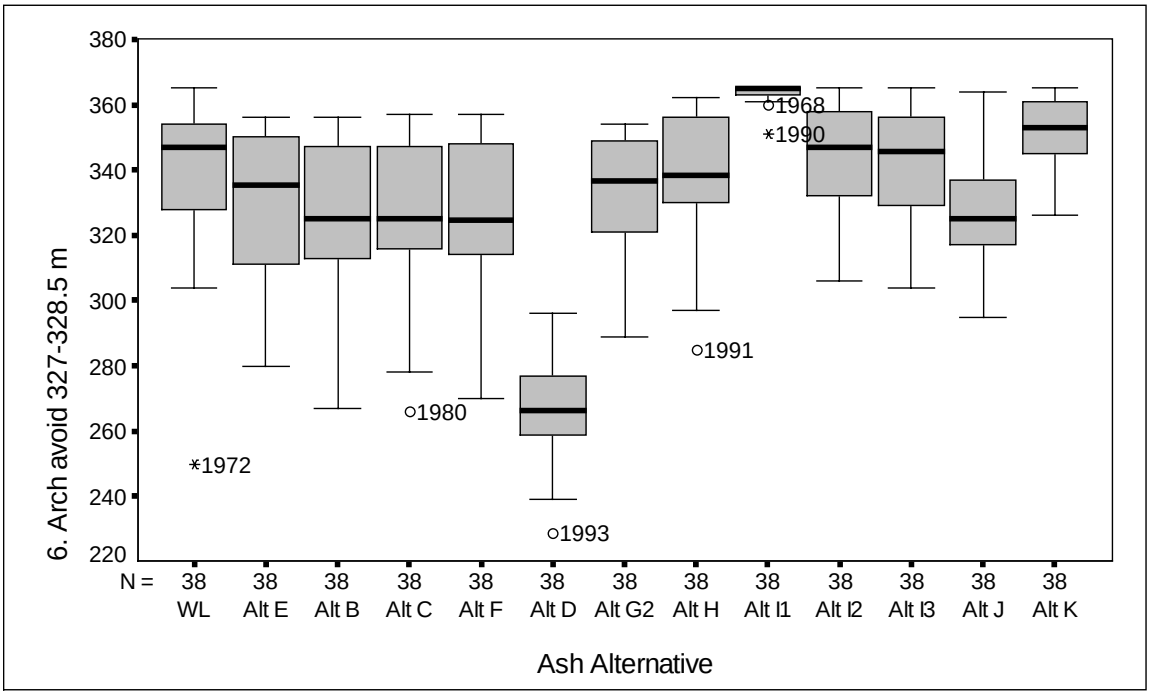
PM No. 3 No. of Days Elevation >327.5 m, 24 May – Thanksgiving (max = 144 days/year)



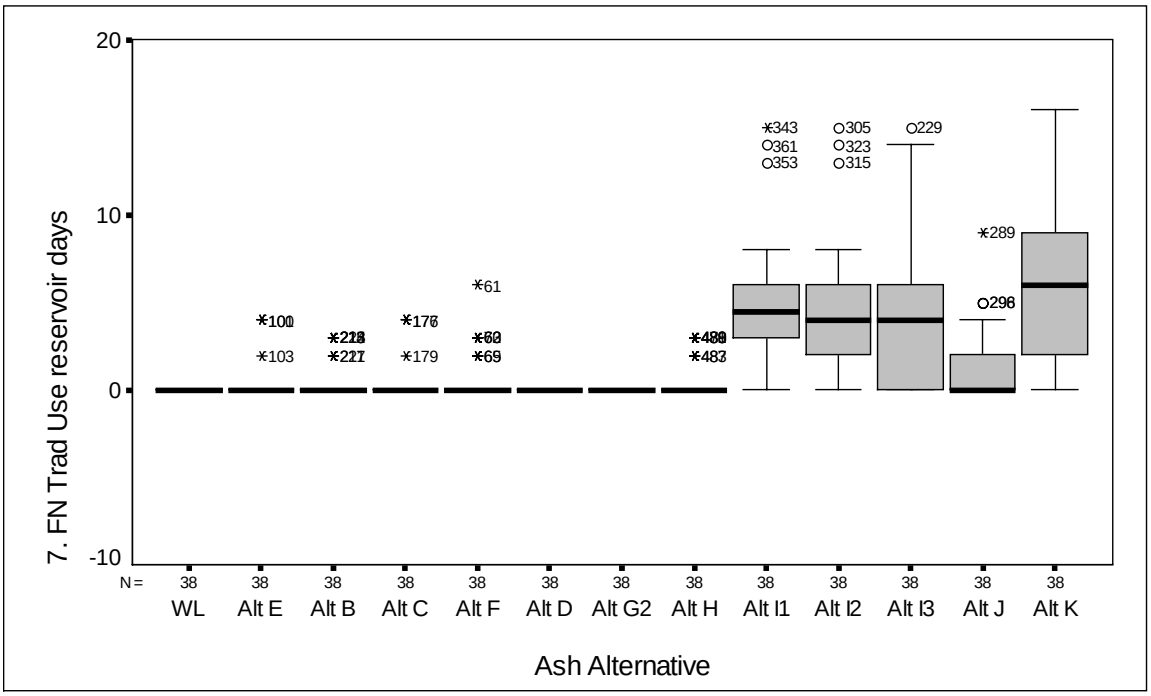
PM No. 4 No. of Days Elevation = 329.5, 1 April – 30 June (max = 91 days/year)



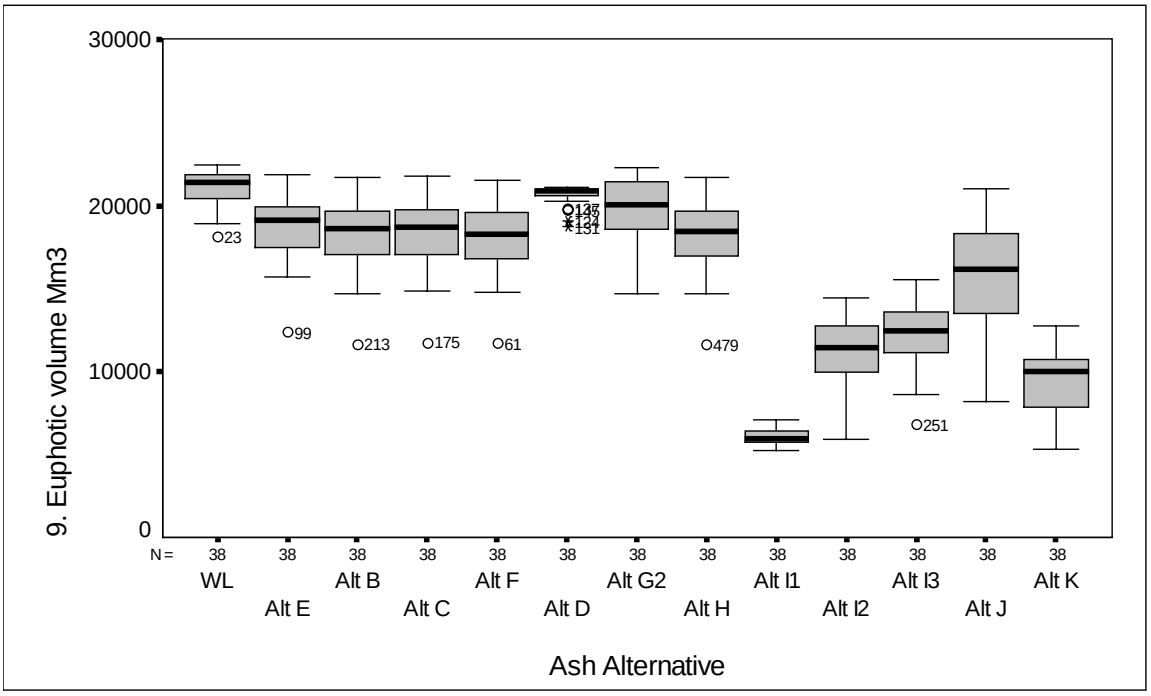
PM No. 5 Unauthorized Collection Protection: No. of Days Elevation ≥328 m (max = 365 days/year)



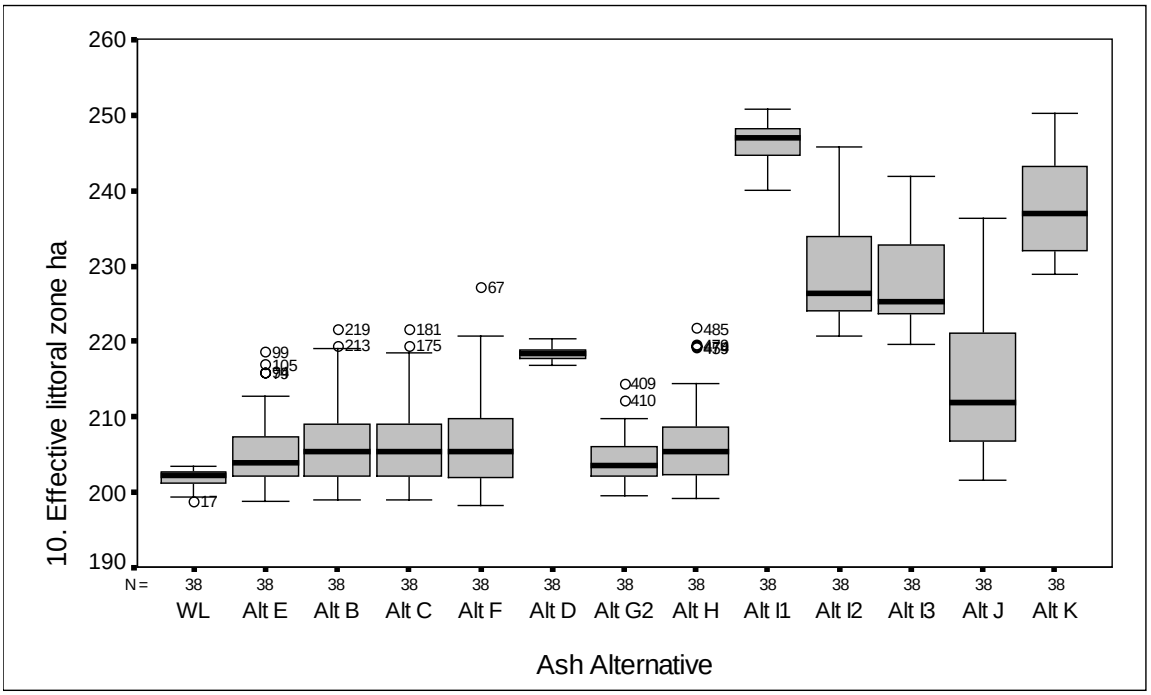
PM No. 6 Erosion Protection: No. of Days Elevation Outside Range of 327 m to 328.5 m (max 365 days/year)



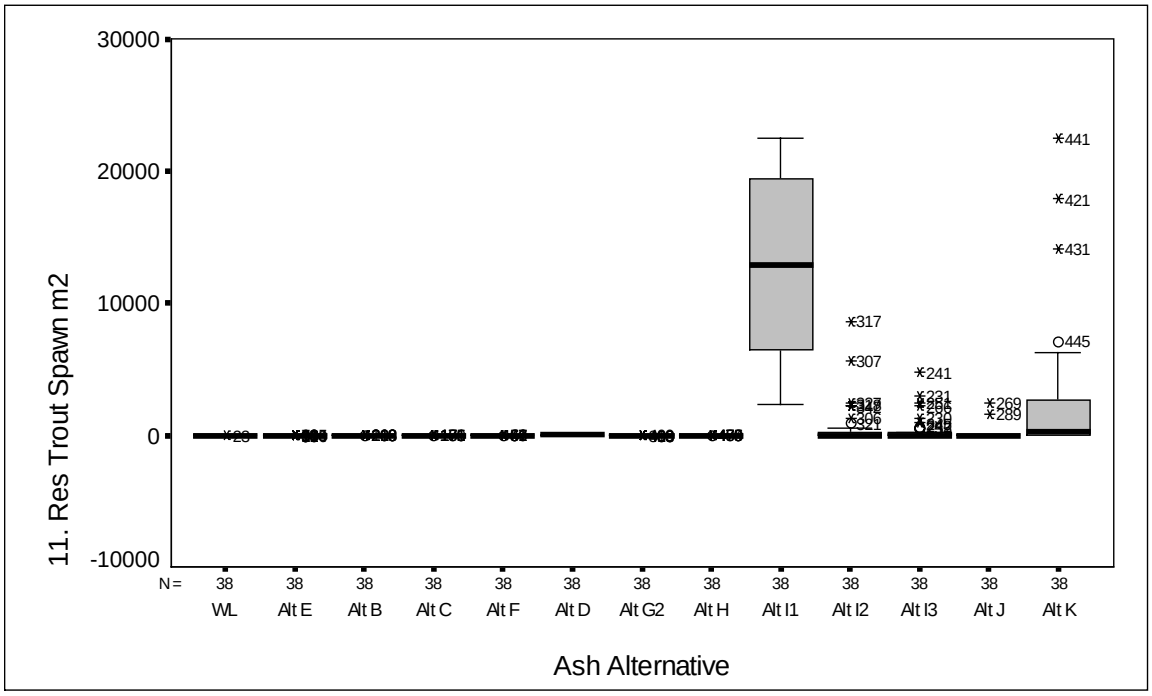
PM No. 7 Traditional Use and Study Opportunities: No. of Days Elevation <317.5 m



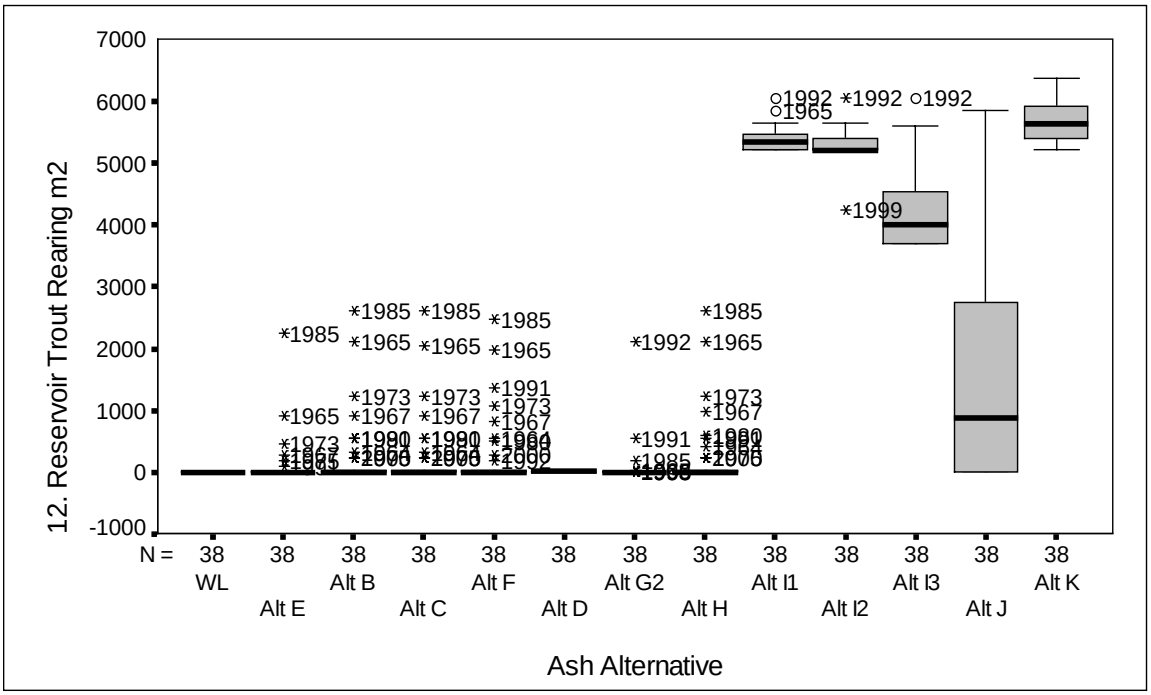
PM No. 9 Sum of Euphotic Volume (M m^3 days)



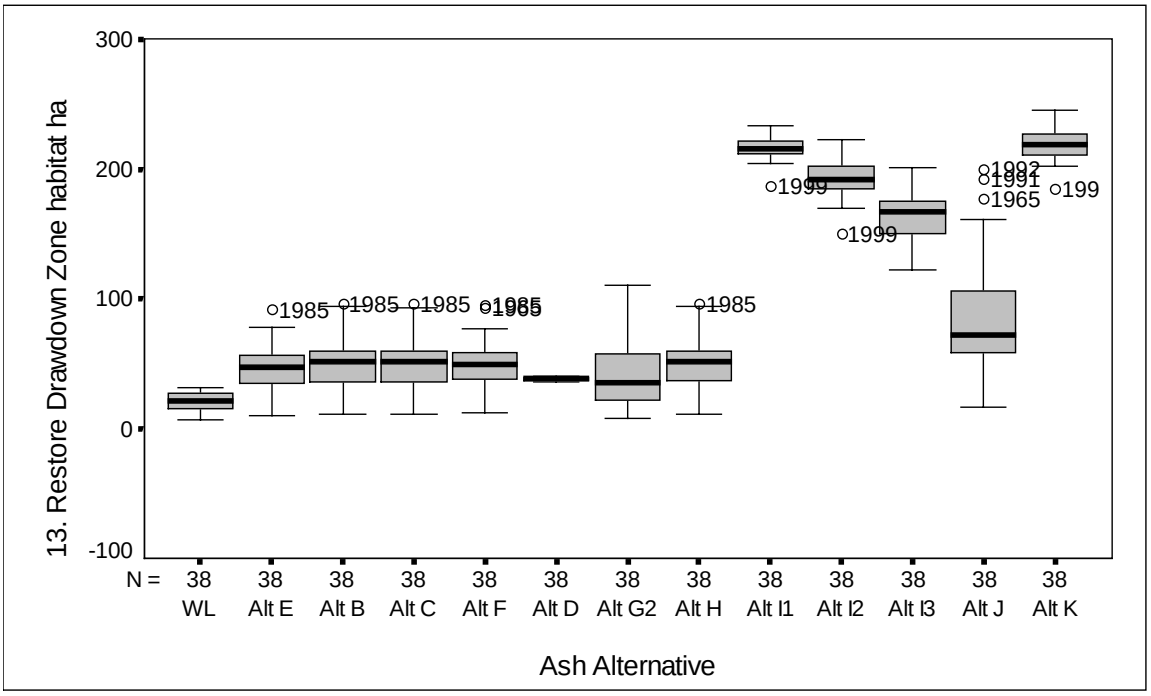
PM No. 10 Sum of Effective Littoral Area (ha)



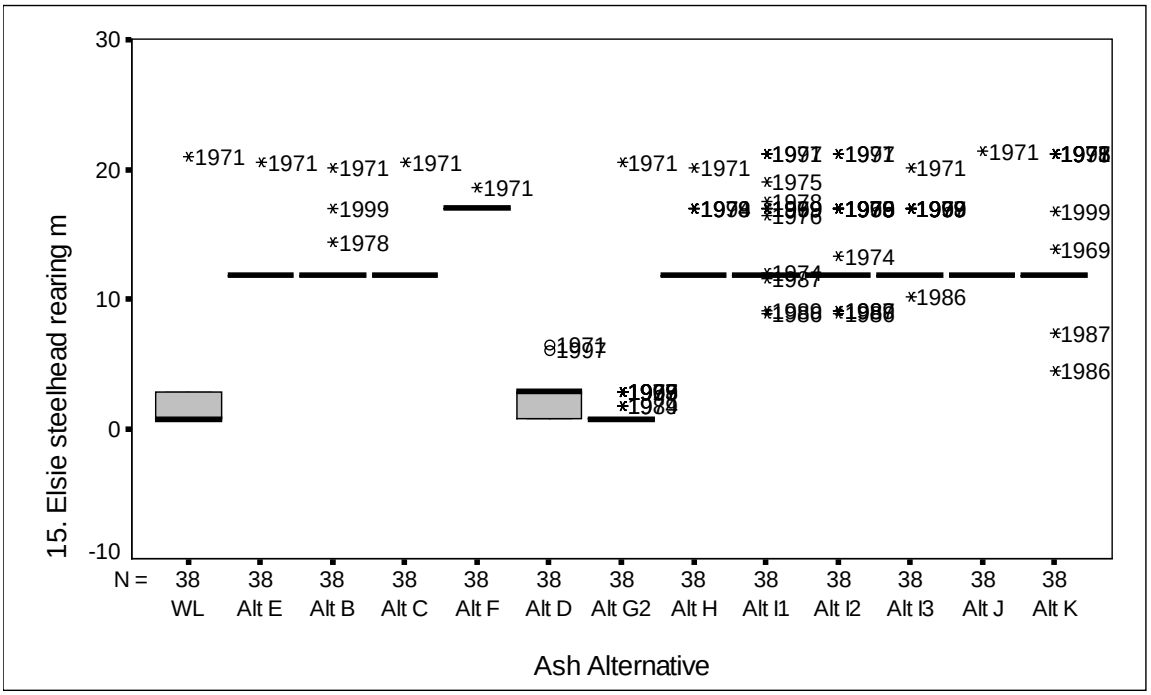
PM No. 11 Sum Elsie Tributary Effective Spawning Habitat (m^2)



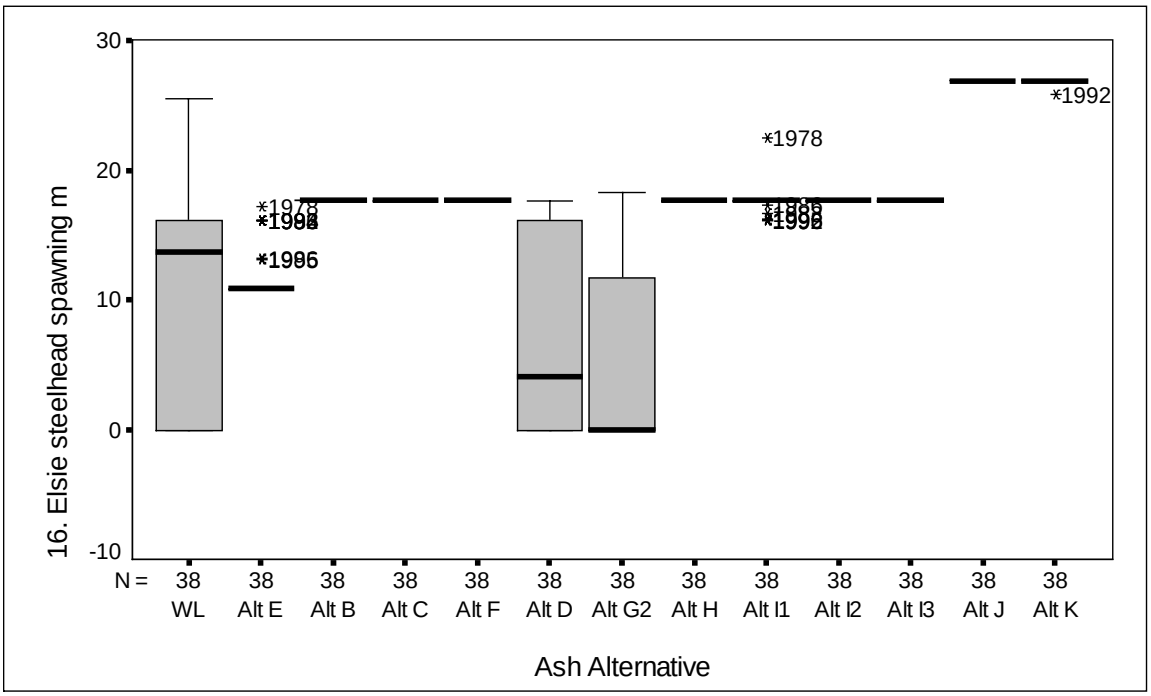
PM No. 12 Sum Elsie Effective Tributary Rearing Habitat (m)



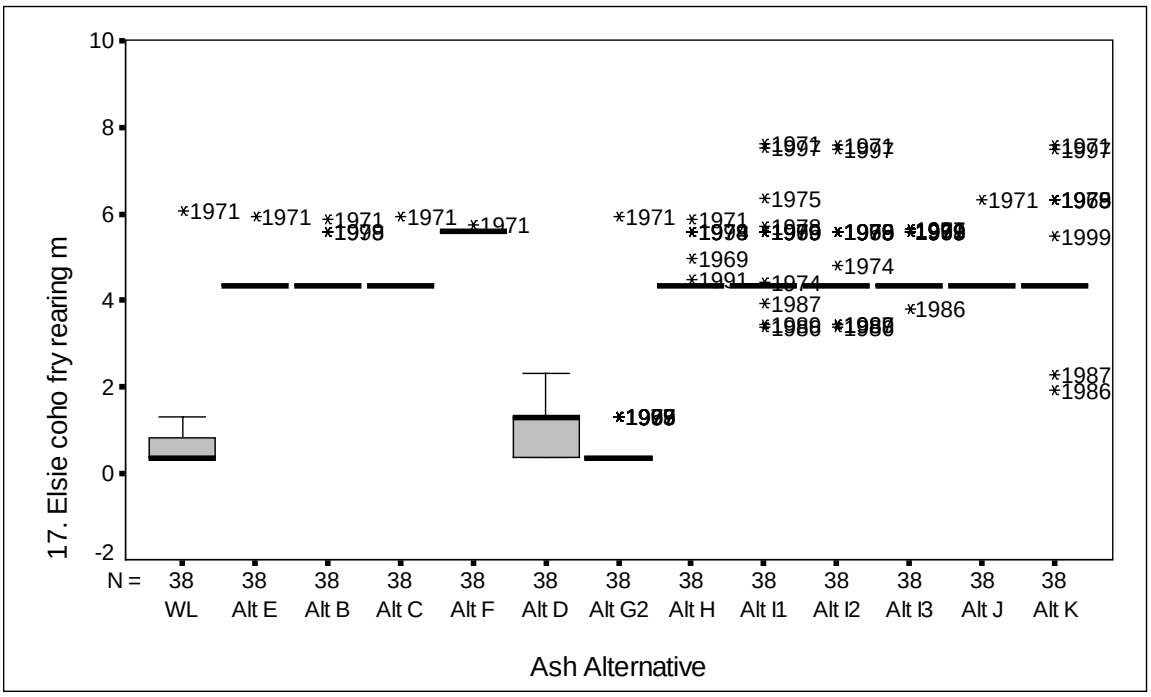
PM No. 13 Hectares of Riparian Habitat (Apr - Sept)



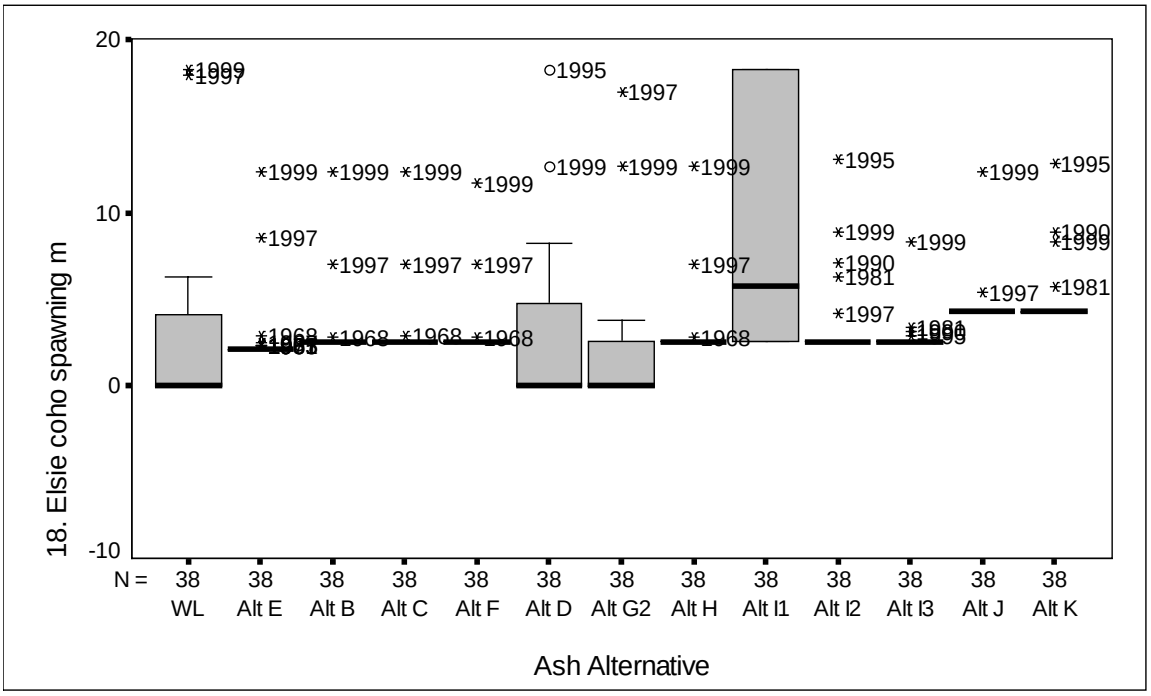
PM No. 15 Sum of Steelhead Parr Rearing WUW (m)



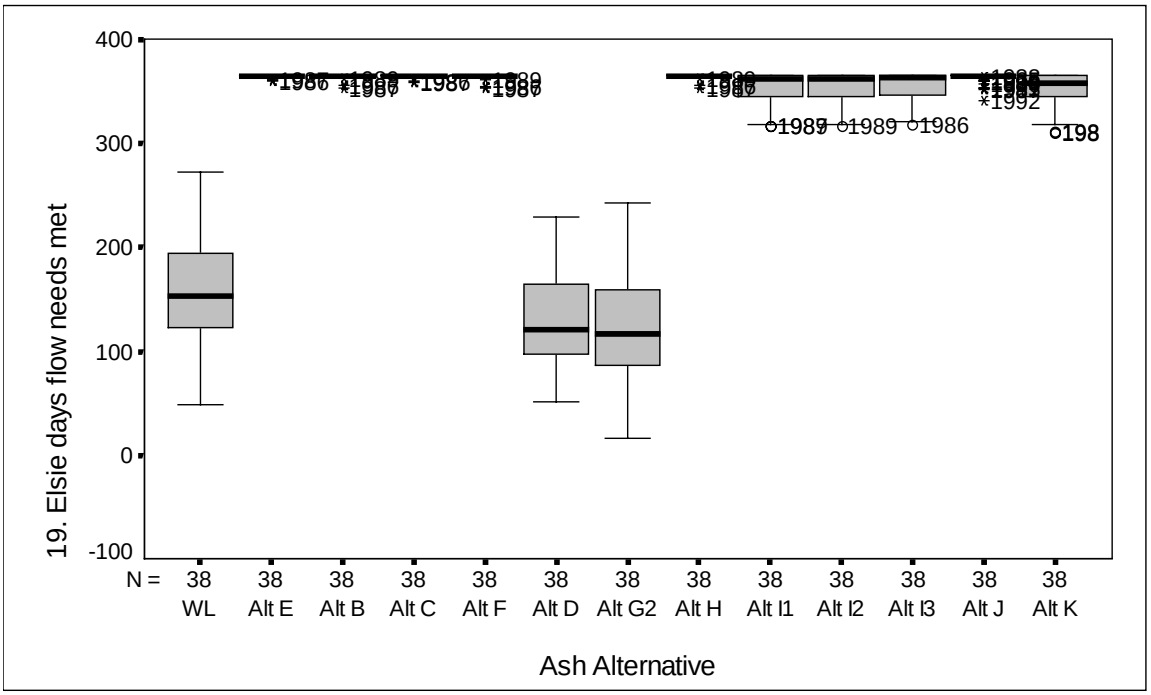
PM No. 16 Sum of Steelhead Spawning WUW (m)



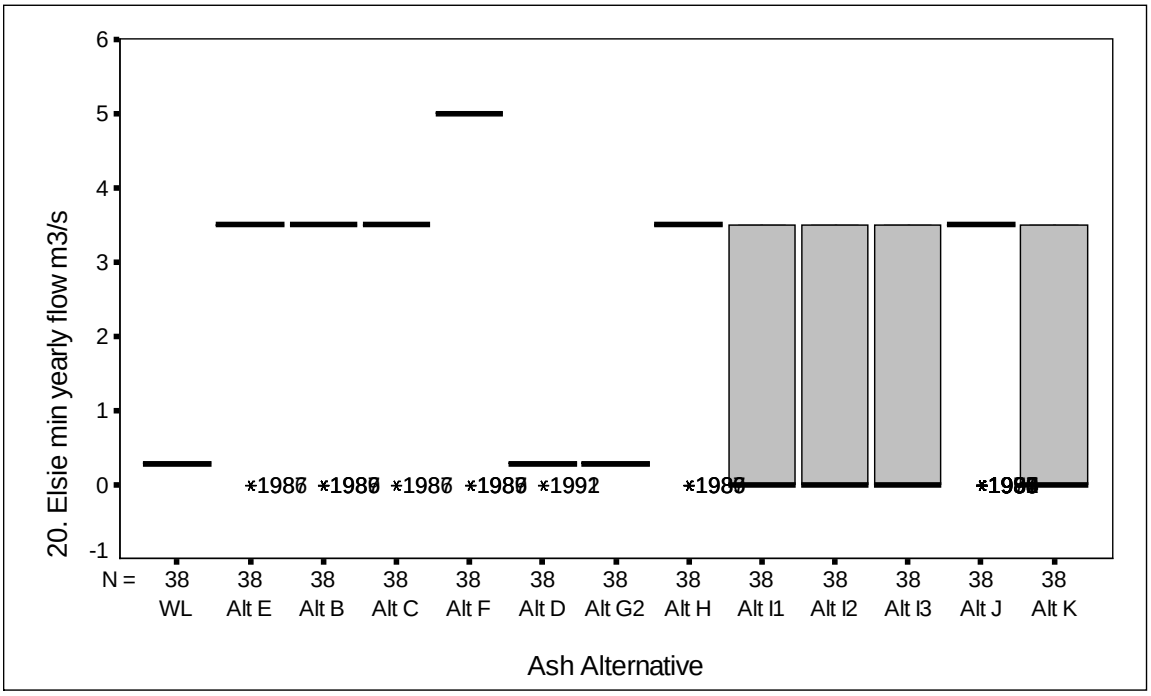
PM No. 17 Sum Coho Fry Rearing Weighted Usable Width (m)



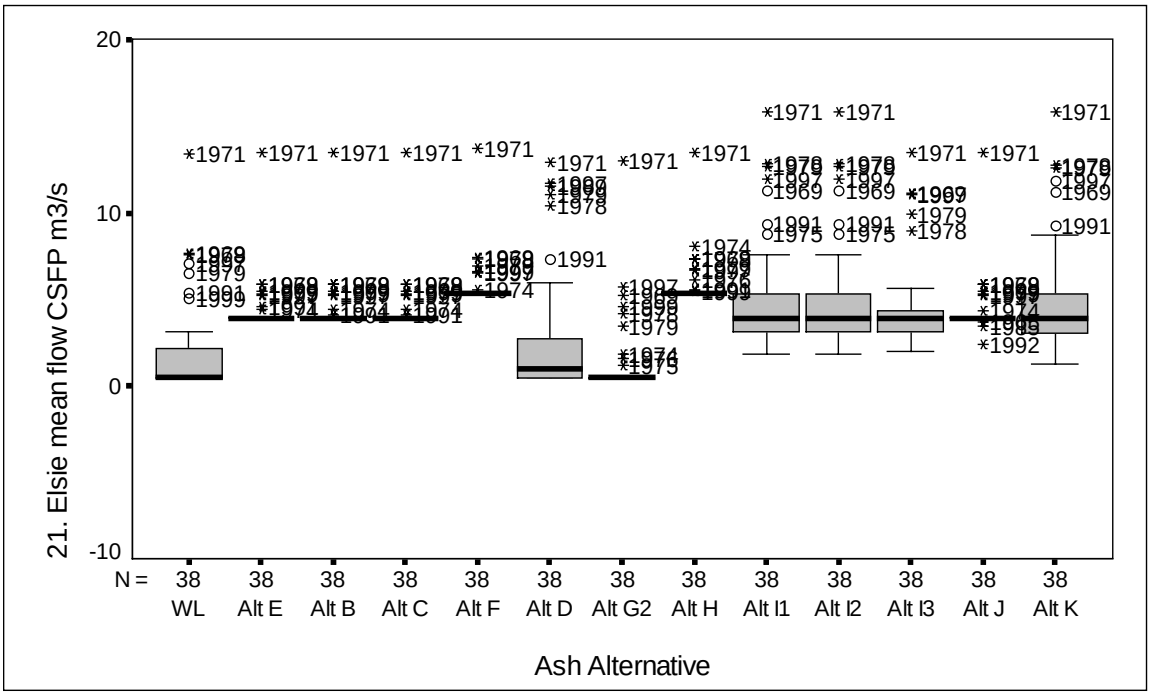
PM No. 18 Sum Coho Spawning Weighted Usable Width (m)



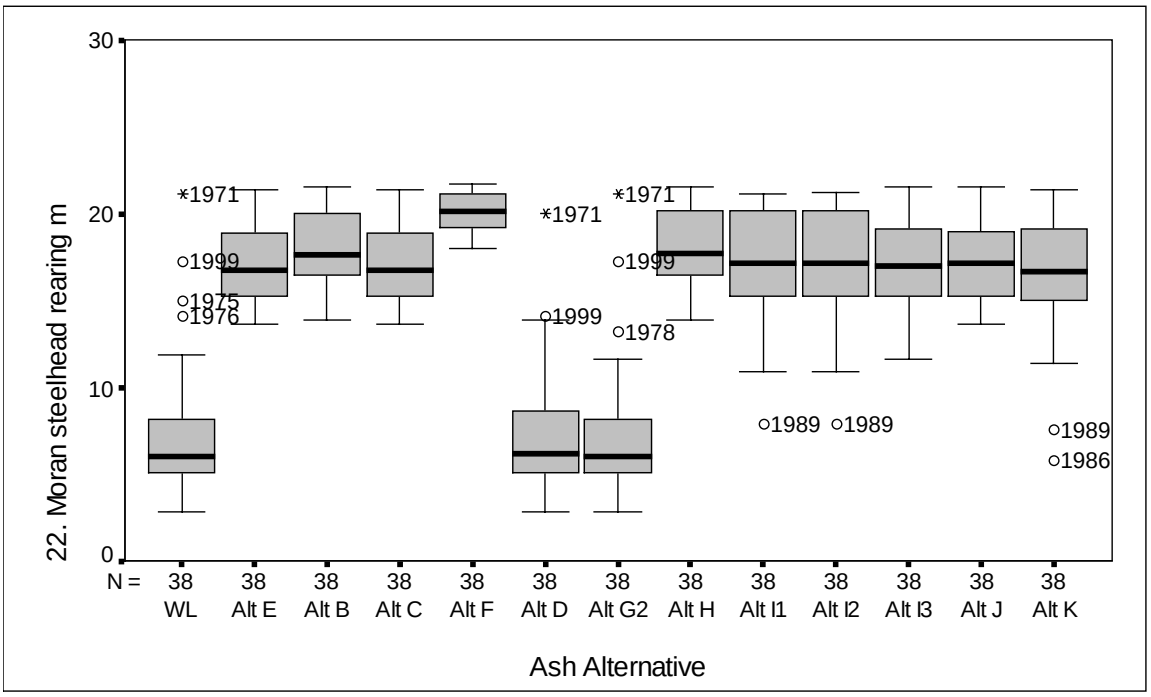
PM No. 19 Elsie Fish Flow Needs Met (days) (max = 365)



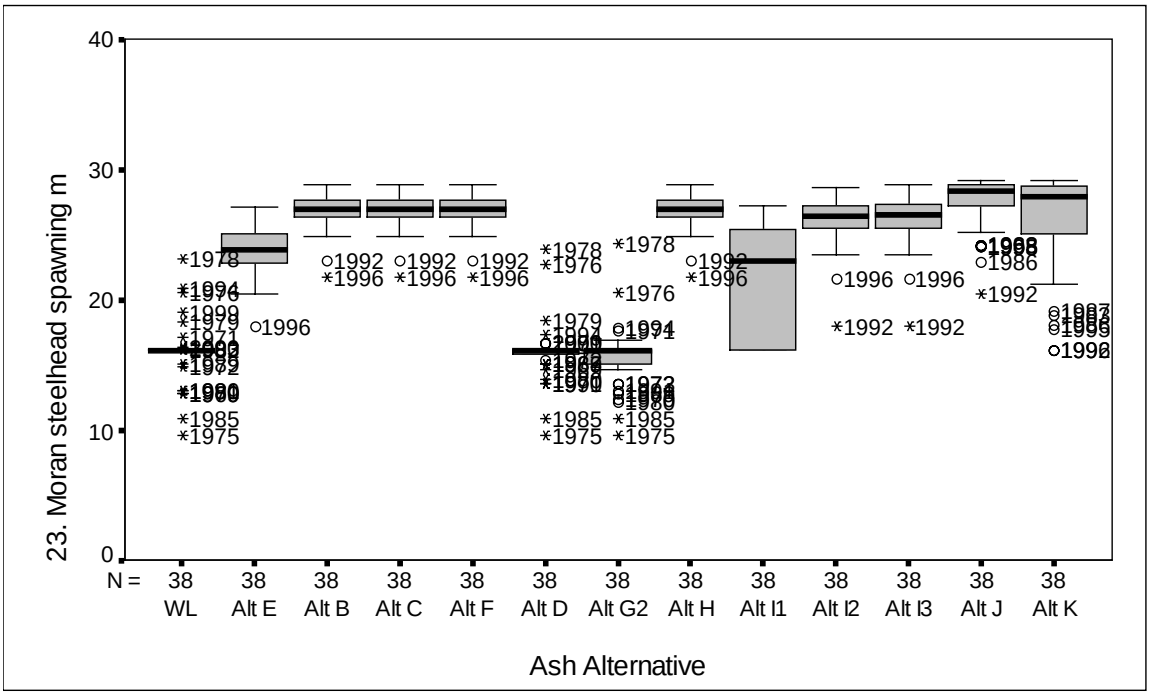
PM No. 20 Elsie Min. Daily Flow (m^3/s) (year round)



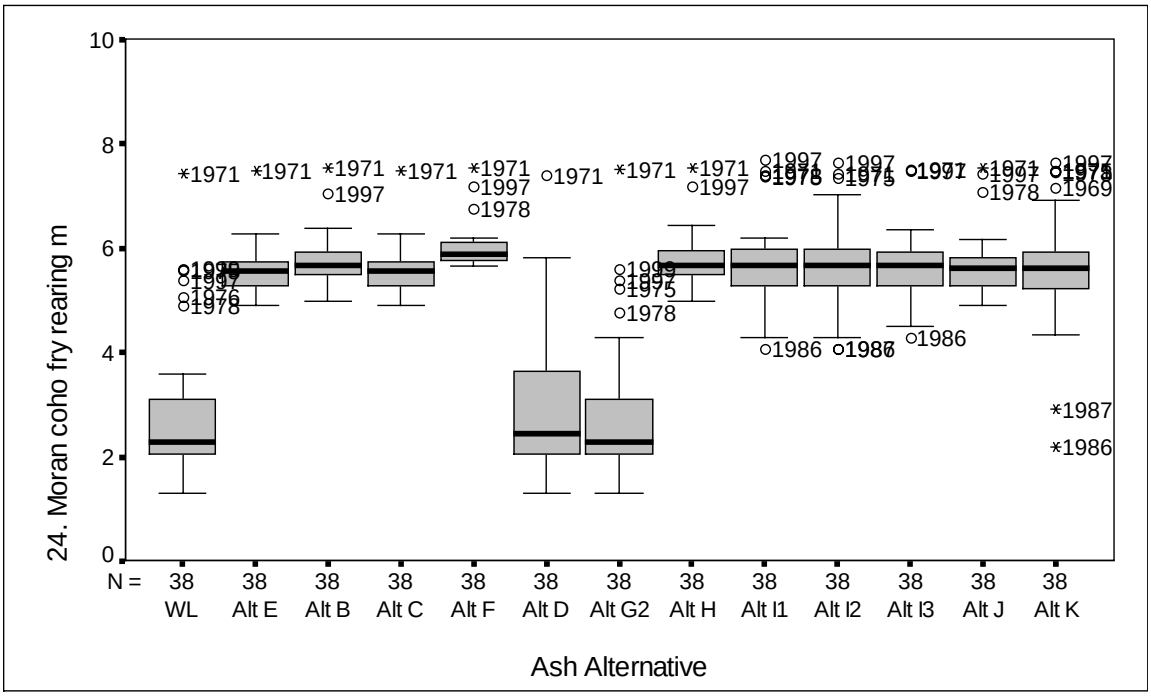
PM No. 21 Elsie Mean Daily Flow During CSFP (m^3/s) (Aug - Sept)



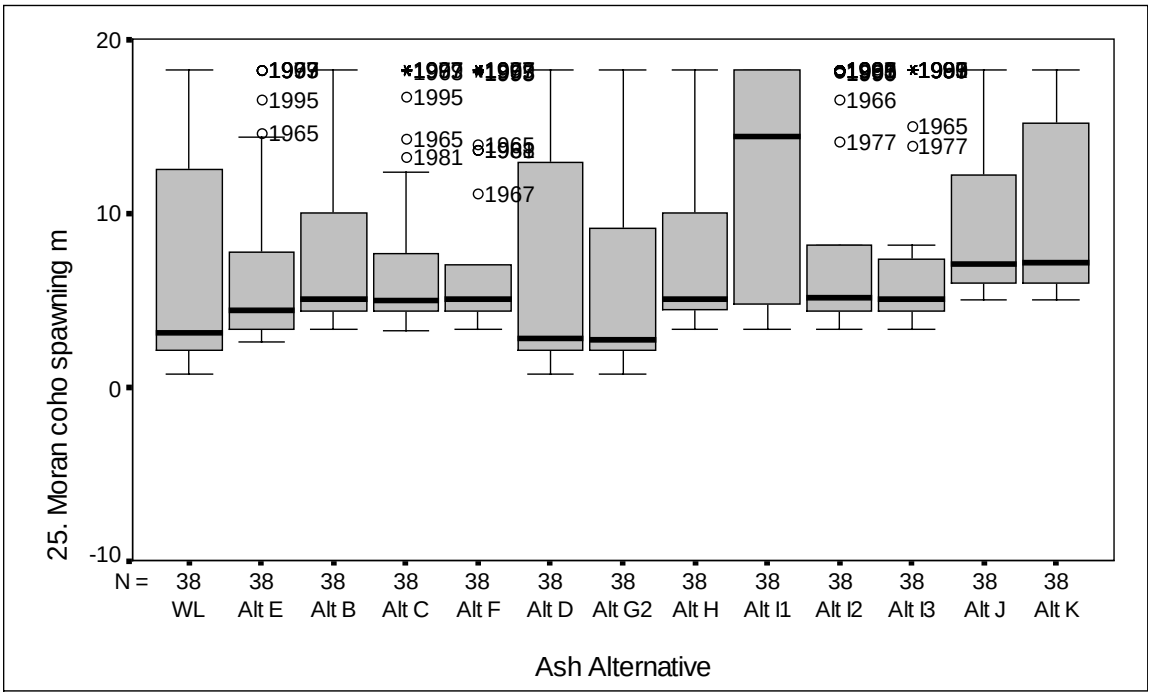
PM No. 22 Sum of Steelhead Parr Rearing WUW (m)



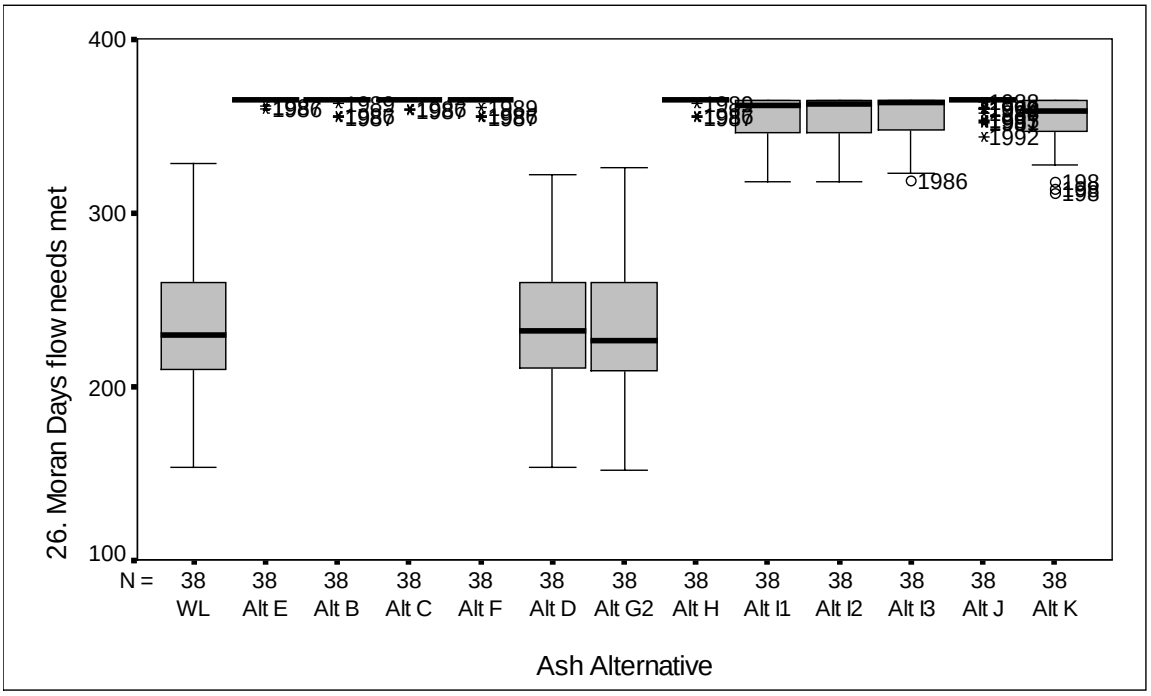
PM No. 23 Sum of Steelhead Spawning WUW (m)



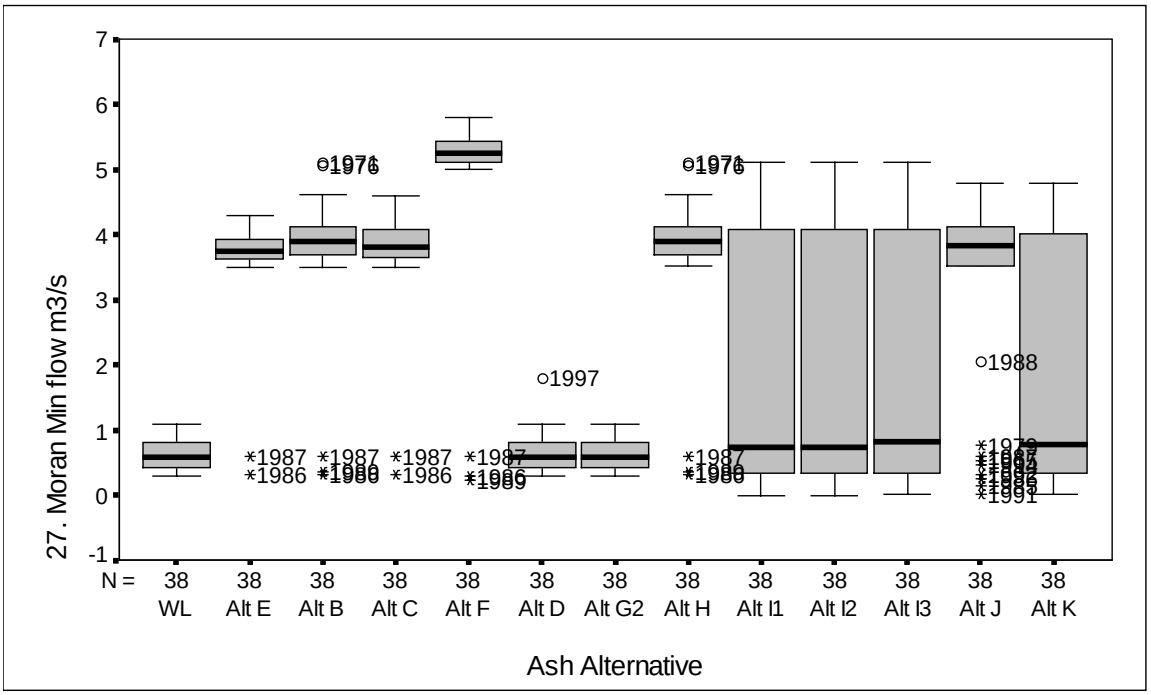
PM No. 24 Sum Coho Fry Rearing Weighted Usable Width (m)



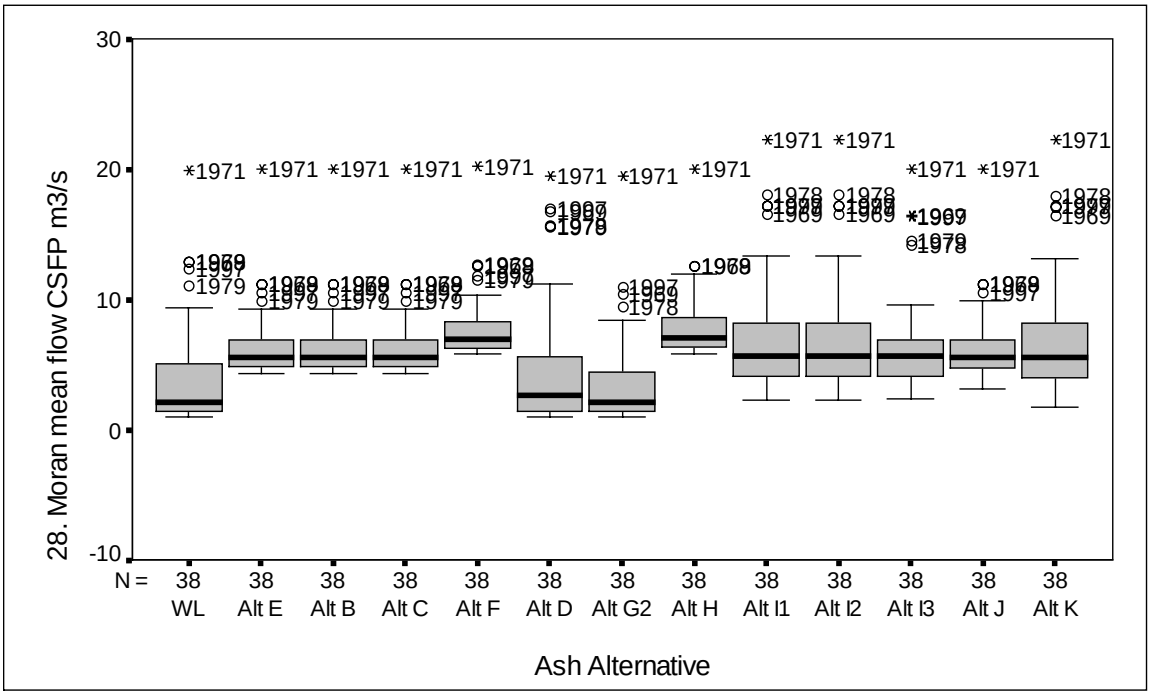
PM No. 25 Sum Coho Spawning Weighted Usable Width (m)



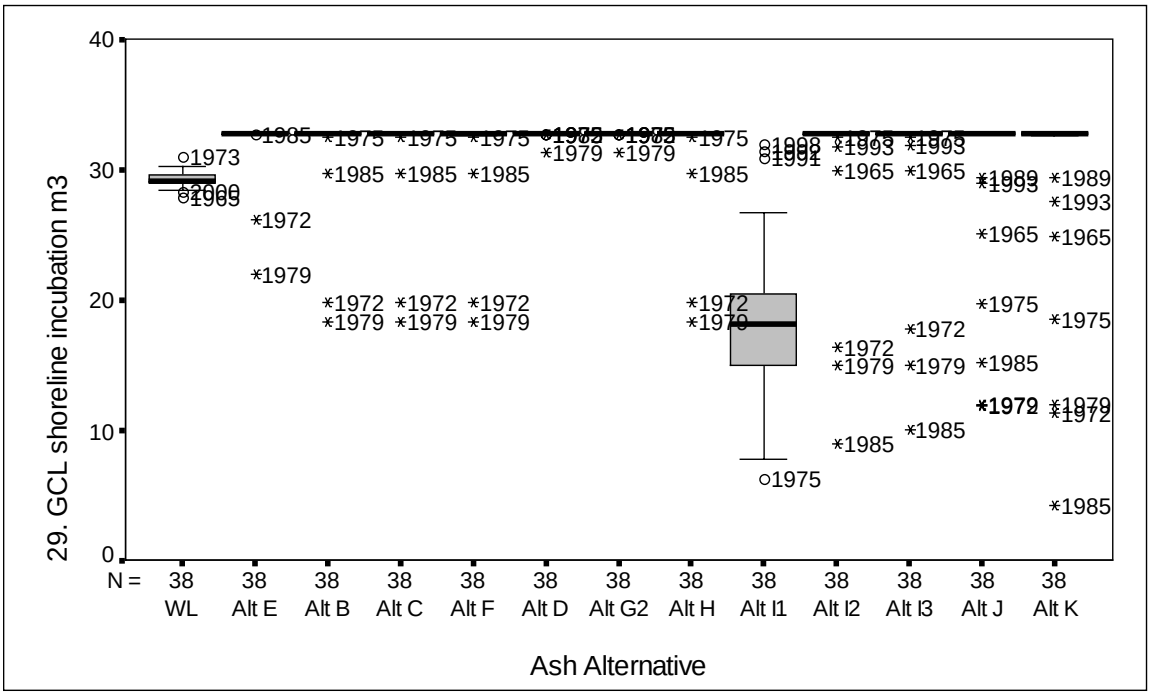
PM No. 26 Moran Fish flow needs met (days) Max=365



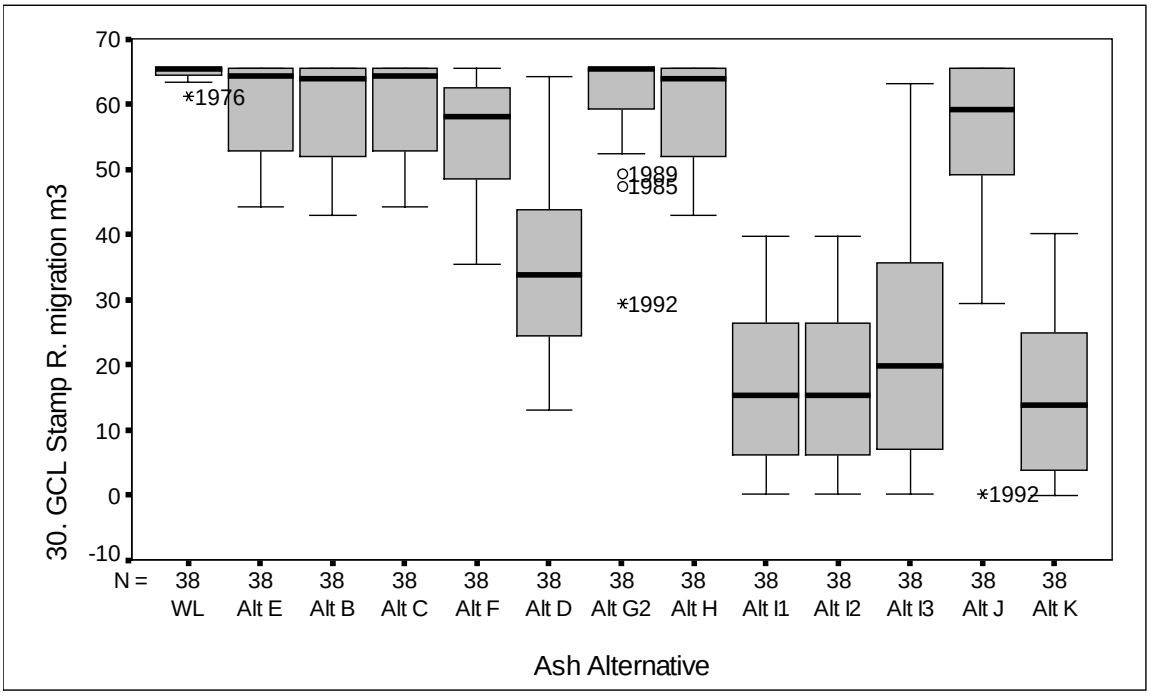
PM No. 27 Moran Min daily flow (m3/s). Year round.



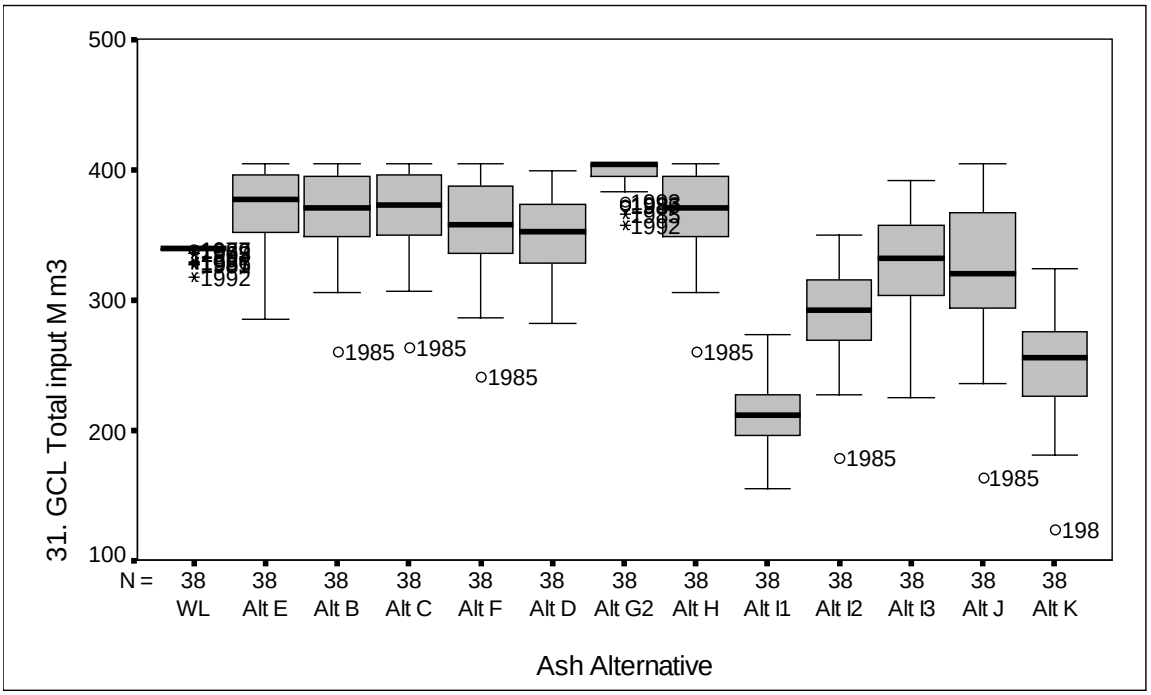
PM No. 28 Moran Mean daily flow during CSFP (m3/s). Aug-Sept



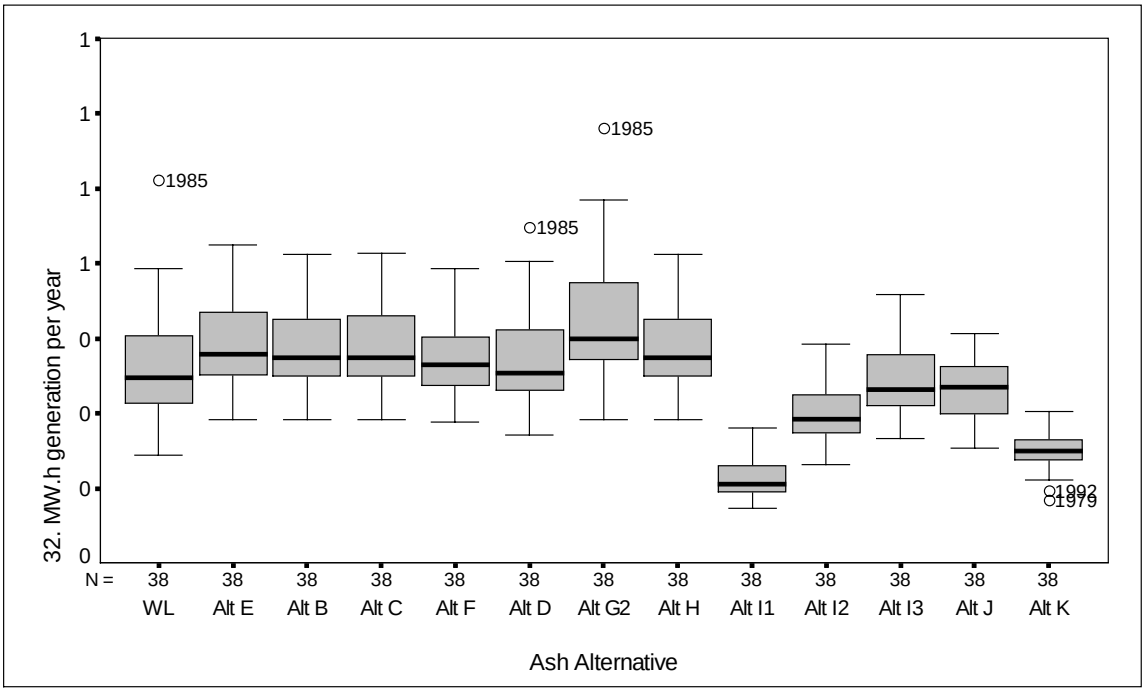
PM No. 29 Shoreline egg incubation (M m3 diversion in February)



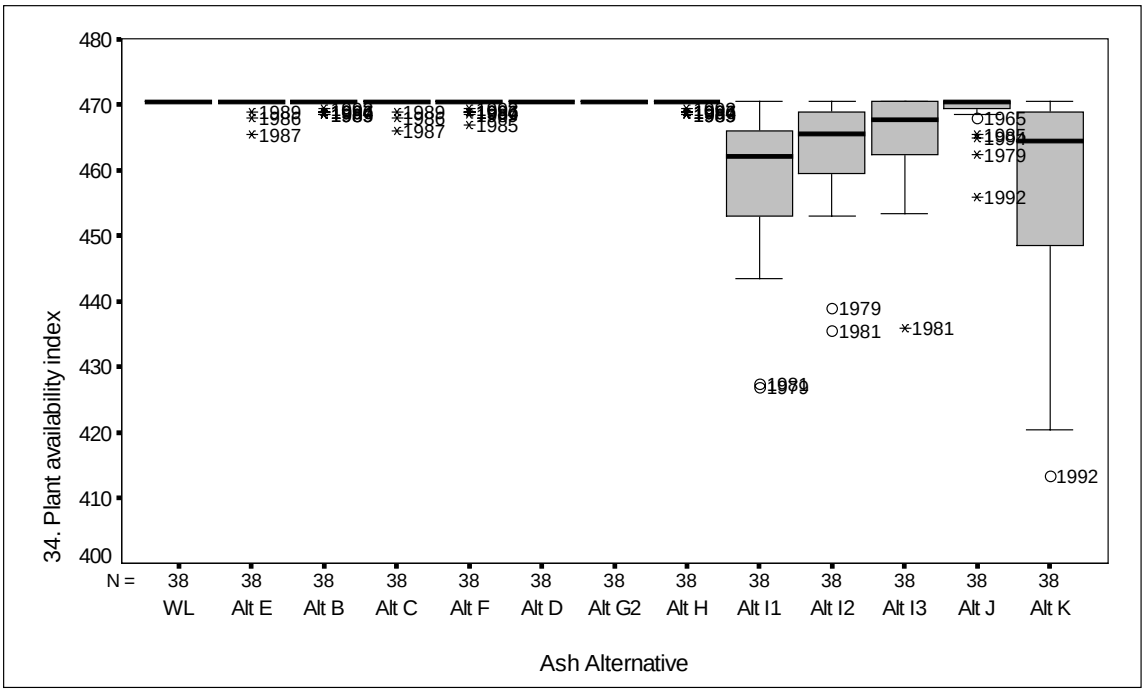
PM No. 30 Spawner migration Stamp R.(M m3 diversion Aug-Oct15)



PM No. 31 Total inflow to GCL



PM No. 32 MW h generated per acre-foot of water inflow



PM No. 34 Plant availability with no restrictions

APPENDIX L: SUPPORTING RATIONALE FOR COMMITTEE MEMBER SUPPORT AMONG FOUR OPERATING ALTERNATIVES

Consultative Committee Member	Alternative E	Alternative C	Alternative I2	Alternative J
Alberni Valley Enhancement Association	**Block** ▪ Go with one and Alternative C is it. Alternative E would basically do the same as Alternative C ▪ Consensus achieved on Alternative C	**Accept with Conditions** ▪ In my opinion is the best all round alternative along with the general monitoring and intervention as outlined during the 25 June 2002 meeting	**Block** ▪ Go with one and Alternative C is it	**Block** ▪ Not feasible during low flows
Alberni-Clayoquot Regional District	**Block** ▪ I understood from the Fish Technical Subcommittee that Alternative C was a better alternative for fish with 5 m^3/s from November to April	**Accept with Conditions** ▪ Provided the best alternative if concerns about the archaeology sites are dealt with ▪ In addition, the other conditions identified for mitigation and intervention can be dealt with through monitoring and intervention	**Block** ▪ Lower flows into Great Central Lake and less power generation	**Block** ▪ During some low flow periods this cannot be met
Alberni-Clayoquot Regional District, Sproat Lake Area Director	**Block** ▪ Fish Technical Subcommittee preferred Alternative C, for better fish options. ▪ Power generation is minimally different between Alternatives E and C	**Accept with Conditions** ▪ Best overall alternative, for interests, First Nations issues (i.e. Archaeology sites) need further assurances around monitoring and intervention policies	**Block** ▪ Great Central Lake flows are less ▪ Concerns for fish farm and hatchery intakes ▪ Less power generating capacity	**Block** ▪ Cannot maintain flows in low periods

Consultative Committee Member	Alternative E	Alternative C	Alternative I2	Alternative J
BC Hydro reps: Representatives 1 and 2	**Accept with Conditions** ▪ In our opinion Alternative E provides the best balance among the key performance measures that are of significance to BC Hydro. For power benefits Alternative E is at approximately the midpoint between the power benefits expected from operating under the constraints of the existing Water Licence ($9.6 M) and the power benefits that we may see if all Water Licence constraints were removed ($10.9 M). There are only two key fish performance measures that score higher with other alternatives and in our opinion a monitoring program will determine whether or not there is a significant difference in performance between Alternative E and Alternatives B, C, and F	**Accept with Conditions** ▪ Alternative C is an acceptable operating alternative slightly lower power benefits with slightly higher benefits to fish. Provides opportunities for First Nations to investigate archaeological sites.	**Block** ▪ Low power benefits	**Block** ▪ Low power benefits
Fisheries and Oceans	**Block** ▪ Alternative E, based on PM No. 15 identified by Fish Technical Subcommittee, does not perform as well as Alternative C	**Accept with Conditions** Alternative C preferred based on Fish Technical Subcommittee recommendations and overall best performance for ranked Fish Technical Subcommittee performance measures, in particular steelhead par rearing downstream of Elsie Reservoir	**Block** ▪ Alternative I2 is not able to maintain minimum flows as per PM No. 20 and 27 and reduces input into Great Central Lake, PM No. 31 considerably	**Block** ▪ Alternative J reduces input into Great Central Lake, PM No. 31 considerably

Consultative Committee Member	Alternative E	Alternative C	Alternative I2	Alternative J
Hupacasath First Nations Representatives 1 and 2	**Block** ▪ Not the best scenario for fish values	**Accept with Conditions** ▪ Best for fish downstream of dam ▪ Moves flow regime towards natural hydrograph ▪ Conditions: ▪ $$ for habitat survey/restoration ▪ $$ monitoring and collection of artifacts (mitigative salvage or protection) ▪ $$ trout barriers removed in tributaries	**Accept with Conditions** ▪ Best alternative for protecting archaeological sites ▪ Best alternative for maximizing wildlife habitat restoration ▪ Best alternative for trout productivity in reservoir	**Accept with Conditions** ▪ Moves toward natural hydrograph ▪ Prevents archaeology erosion ▪ Higher flows for Great Central Lake
Ministry of Sustainable Resource Management	**Block** ▪ Not enough water during winter months for steelhead rearing ▪ Less of a natural hydrograph	**Accept with Conditions** ▪ Higher fall flows support better steelhead spawning ▪ Higher winter flows support better steelhead rearing ▪ Conditions address First Nations archaeological issues ▪ Better flow regime overall for GLC issue	**Block** ▪ High cost - $1.5 million - not justified - reservoir trout rearing benefit not clear	**Block** ▪ High cost - $500 000 ▪ Natural hydrograph provided with inflows below Elsie and 3.5/5 m^3/s provides good flow regime just below Elsie Dam ▪ Fish benefits from higher flows not justified ▪ May jeopardize water requirements at GLC

Consultative Committee Member	Alternative E	Alternative C	Alternative I2	Alternative J
Ministry of Water, Land and Air Protection	**Block** ▪ Reduced steelhead spawning habitat ▪ Level flow doesn't reflect natural variability	**Accept with Conditions** ▪ Concept of 2 flows "more natural" ▪ Addresses concerns for archaeological, and data collection for reservoir trout spawning and lake productivity ▪ Highest recommended alternative of Fish Technical Committee ▪ Increased Hydro [power] value over [existing] Water Licence	**Block** ▪ Not able to provide certainty of Moran [Creek] minimum flows (also wide variability of flows) ▪ Too much reduction in Hydro revenue	**Block** ▪ Multiple years of low/nil flows at Moran Creek ▪ Less Hydro value than existing Water Licence
NorskeCanada	**Accept with Conditions** ▪ Scores well in terms of water diverted to Great Central Lake ▪ Equivalent score to Alternative C on Fish Technical Subcommittee priorities ▪ High [value of] Power score should help to "fund" the recommended mitigation/intervention	**Accept with Conditions** ▪ Scores well in terms of water diverted to Great Central Lake ▪ Scores better than Alternative E for PM No. 16 (steelhead spawning) ▪ Good score on Fish Technical Subcommittee priorities (downstream fish) ▪ Need conditions to address/protect Archaeological protection Scores well on power to "fund" mitigative/monitoring measures	**Block** ▪ "Robs" too much water from Great Central Lake ▪ Very low minimum flows [in Ash River]at Elsie [below dam] and Moran Creek	**Accept with Conditions** ▪ Acceptable score in terms of water diverted to Great Central Lake ▪ Good score on "in reservoir" values ▪ Support principle of "natural hydrograph"
Regional Aquatic Management Society	**Block** ▪ To achieve consensus	**Accept with Conditions** I accept Alternative C because it addresses fish issues in the Ash River below the dam The conditions are that wildlife, trout and archaeology concerns are dealt with	**Block** ▪ Not enough water for the upper Stamp	**Block** ▪ Not enough water for the upper Stamp

Consultative Committee Member	Alternative E	Alternative C	Alternative I2	Alternative J
Tseshaht First Nations	**Block** ▪ Aboriginal concerns [are] to wildlife, fish, artifacts	**Accept with Conditions** ▪ Aboriginal concerns [are] to wildlife, fish, artifacts	**Accept with Conditions** ▪ Aboriginal concerns [are] to wildlife, fish, artifacts	**Accept with Conditions** ▪ Aboriginal concerns [are] to wildlife, fish, artifacts

APPENDIX M: HYDROGRAPH AND RESERVOIR ELEVATIONS UNDER THE RECOMMENDED OPERATING ALTERNATIVE C

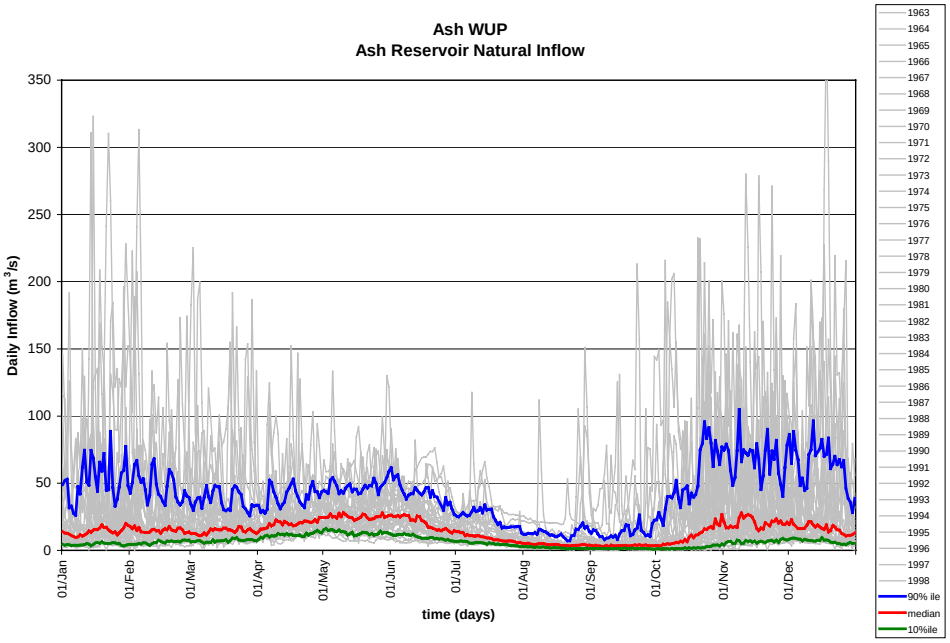


Figure M-1: Historic natural inflows to Elsie Lake Reservoir - 1963 to 2000. Basis for estimated reservoir and Ash River hydrographs under water use Alternative C

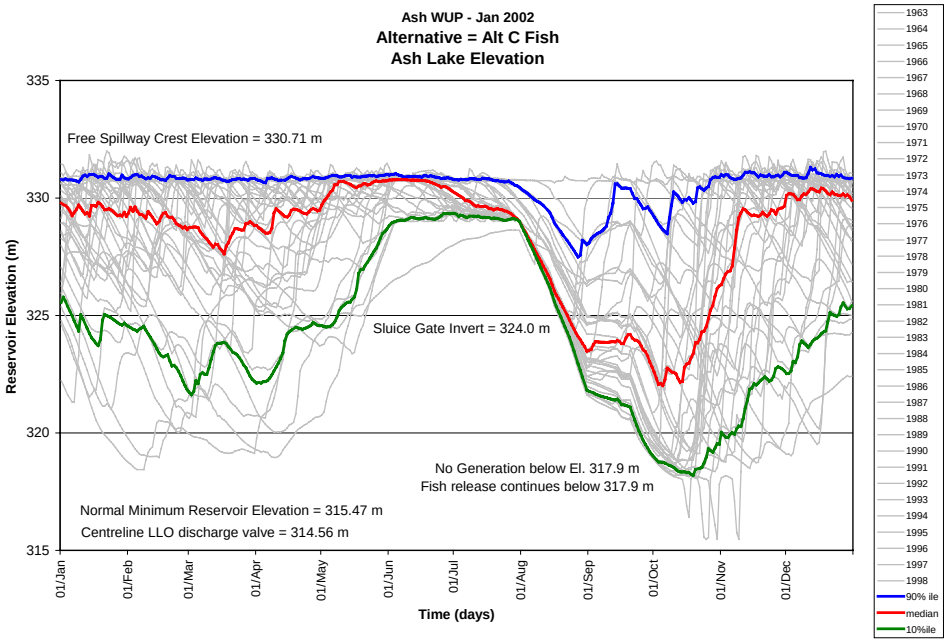


Figure M-2: Reservoir elevations under Alternative C

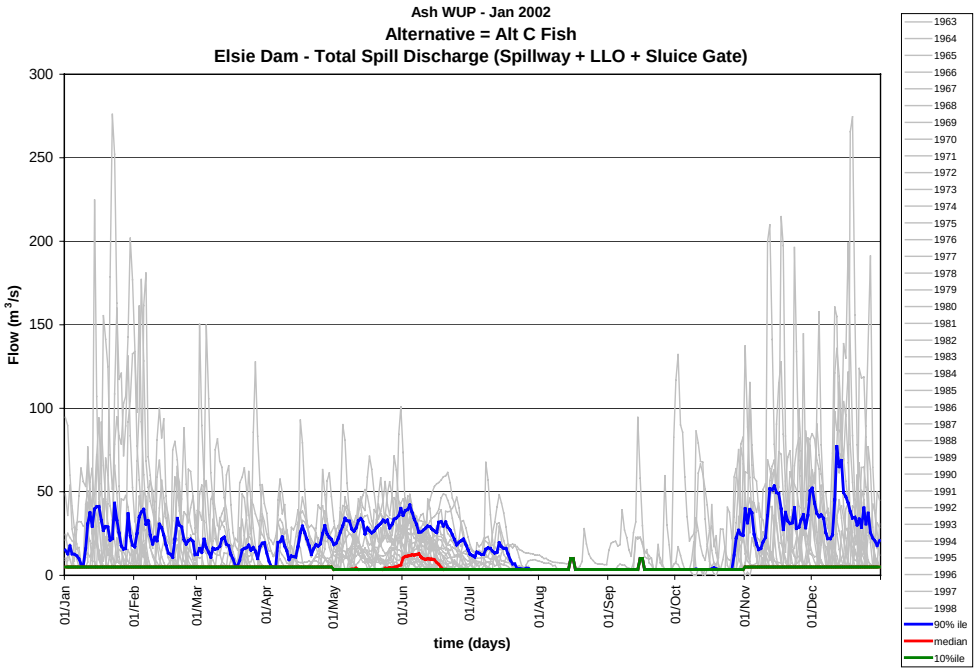


Figure M-3: Total releases from Elsie Dam (free spills + controlled releases from Low Level Outlet) into the middle Ash River under Alternative C

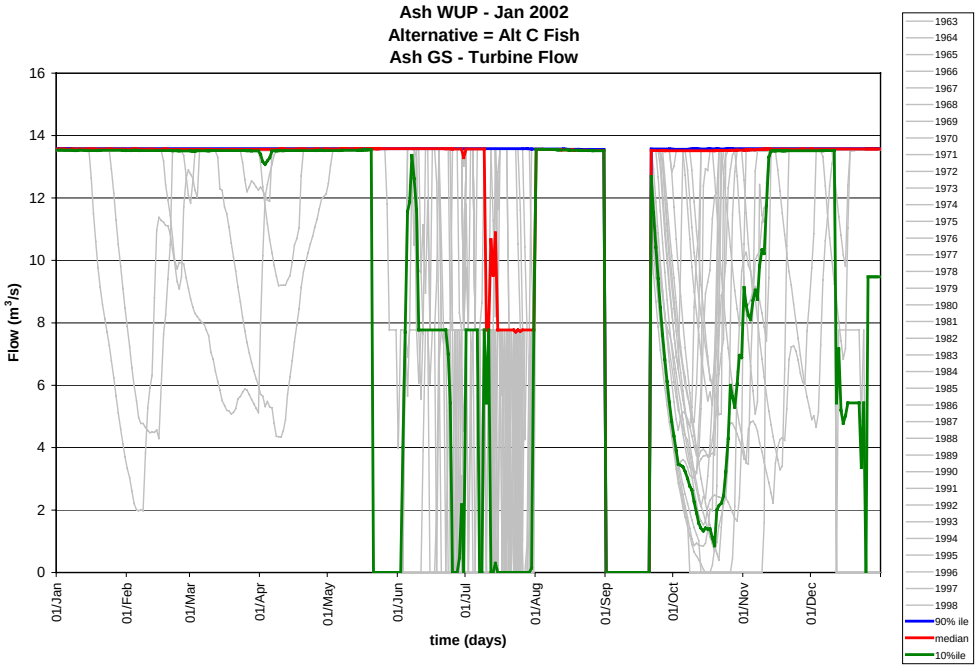


Figure M-4: Turbine discharges from Elsie Lake Reservoir under Alternative C

APPENDIX N: ELIGIBILITY CRITERIA FOR WATER USE MONITORING STUDIES

DRAFT

Water Use Planning Monitoring Program: Principles,
Decision Tree, and Required Information

BACKGROUND:

The Water Use Plans for the BC Hydro facilities will contain recommended operational changes that are designed to address issues identified during the development of the Water Use Plans. However, in light of the five year time frame to develop these Water Use Plans, a significant amount of uncertainty may exist regarding the effectiveness of the recommended operational changes. This uncertainty is largely due to the difficulty in drawing scientifically defensible conclusions with a limited database. In some cases there will be a need, therefore, to verify the effectiveness of the recommendations put forward by the Water Use Plan Consultative Committees. These specific Water Use Plans will contain a post-Water Use Plan monitoring program that will provide additional data designed to measure the results/effectiveness of the operational changes specified by the Comptroller of Water Rights for each of the facilities.

Additional to this, the provincial water use planning Guidelines outline that the individual Water Use Plans will specify monitoring programs and reports for preparation by the licensee to enable provincial and federal regulatory authorities (Comptroller of Water Rights and Department of Fisheries) to assess compliance with the authorized Water Use Plan. In order to address this aspect of the Water Use Plan, BC Hydro will provide the Comptroller of Water Rights the mechanisms and information detailing the actual implementation of the operational change. These may include flow measuring devices and regular reporting schedules of actual flow levels.

MONITORING PROGRAM ELEMENTS

The primary objectives of the post Water Use Plan Monitoring Program will be to assess whether the operational changes, as specified in the Water Use Plan, provide the expected results (in terms of the performance measures and/or the fundamental objectives), or whether the operations need further adjustment (which could include adjustment back to pre-Water Use Plan operations):

- In the case of Water Use Plans with passive adaptive management aspects (i.e., a single change in flow regime from the licensed flows), the studies will assess specific parameters related to performance measures and fundamental objectives.

- With respect to Water Use Plans with active adaptive management aspects (i.e., two or more significant changes to flow regimes during a set period of time), studies will assess the response of the selected flow regimes against expected performance measure response or its ability to address the objectives.

PRINCIPLES

The individual Water Use Plan Consultative Committees will be responsible for defining and prioritizing the recommended post-Water Use Plan monitoring studies. The recommendations for monitoring studies will be included in the Consultative Committee Report and the Water Use Plan presented to the Comptroller. Each monitoring study will be designed to meet the following principles:

- An expected result from each study must have the potential to change the way water is used at BC Hydro facilities.
- Each study must have the ability to distinguish between competing hypotheses. This can be assessed using a range of techniques, from a calculation of statistical power to professional judgment around the weight of evidence.
- Each study must be able to show results in a timely manner (e.g., by the next scheduled Water Use Plan period).
- Each study must show cost effectiveness by demonstrating that it is the least expensive way to generate that level of learning both within that Water Use Plan and across other Water Use Plan monitoring plans.

In order to ensure that the above principles are met, requests for monitoring studies should be described in sufficient detail to allow the evaluation of objectives, methodologies, deliverables, and estimated costs. This information will be collected by having the subgroups, and then the Consultative Committee, fill out the "Information Matrix for Water Use Plan Monitoring Requests" found on Page N-4.

DECISION TREE FOR EVALUATING WATER USE PLAN MONITORING REQUESTS

The following decision tree (Figure N-1) embodies the principles of monitoring laid out by the ad hoc Water Use Plan interagency committee developing monitoring protocol. This tree is to be used in conjunction with input from the Water Use Plan MC, RVAT and FAT and will be used by the facilitator to assist subgroups and the Consultative Committee in assessing monitoring requests. Note that this process does not address monitoring activities that are geared towards assessing compliance to the Water Use Plan. Step 1 starts at the subgroup level and this process is carried out for each proposed study.

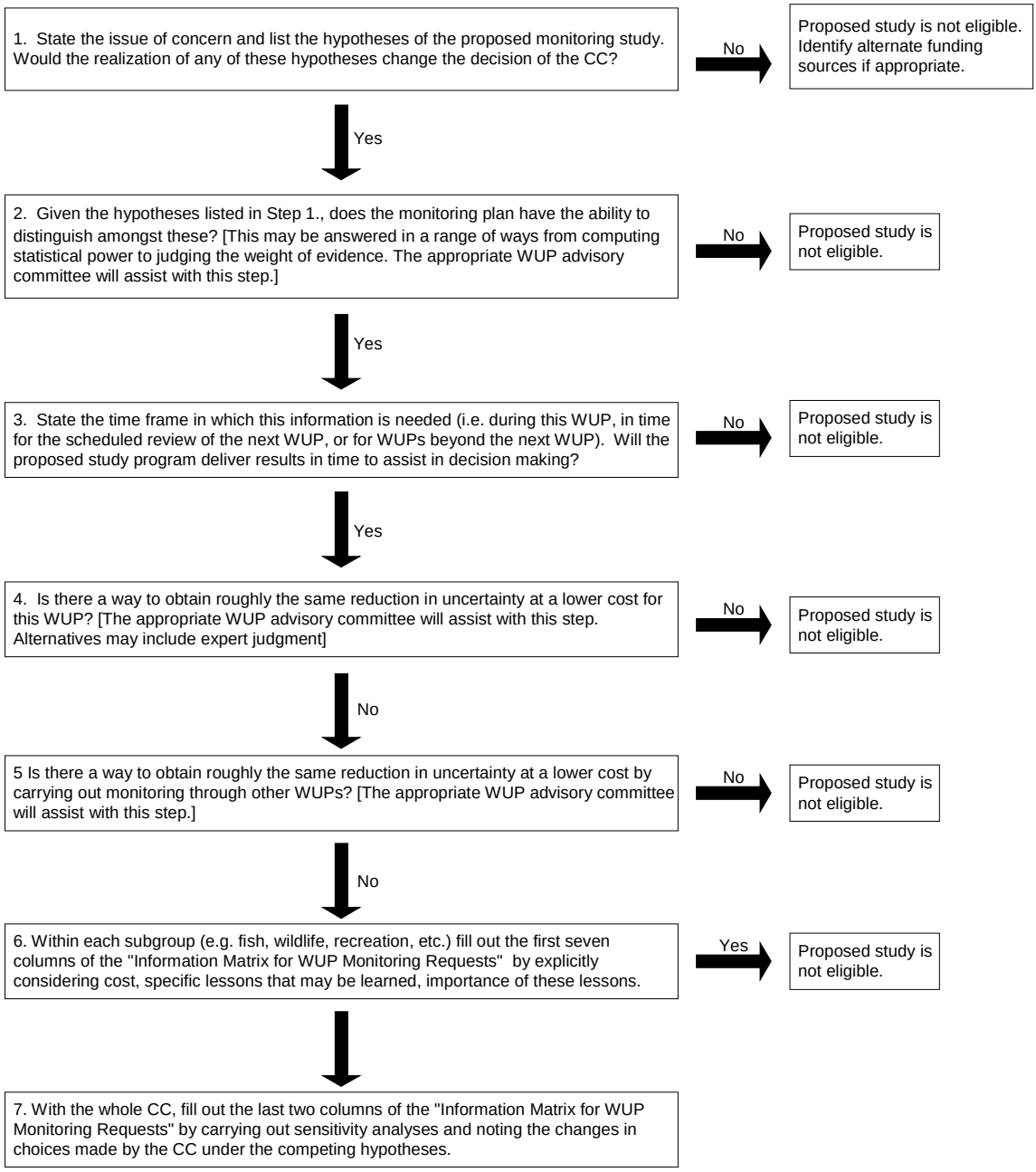


Figure N-1: Decision Tree for Evaluating Water Use Plan Monitoring Requests

Table 0–1: Information Matrix for Water Use Plan Monitoring Requests (subgroups fill out the first seven columns, the last two are filled out at the Consultative Committee level)

I. Study (Water Use Plan, Title of Study, Interest Area)	II. Description	III. Data Gap Addressed (list the issue, the competing hypotheses, and the estimates of the probability of these competing hypotheses being true.)	IV. Amount of learning expected through monitoring (high, medium or low)	V. Estimated Duration of Study Program.	VI. State the time frame in which this information will be used: before the next Water Use Plan, during the next Water Use Plan, after the next Water Use Plan.	VII. Estimated Cost (including lost power values)	VIII. Willingness of Consultative Committee to change water allocation (high, medium, or low)	IX. Rating of Study

"WILLINGNESS TO CHANGE WATER ALLOCATION" SCALE EXPLAINED

These scales will be developed once the final choice of the Consultative Committee has been made. At that time, key uncertainties about the PMs and/or their link to fundamental objectives can be tested through sensitivity analyses, and the change in the support from the Consultative Committee for the various alternatives considered can be observed.

High Importance:	It is *clear* that the Consultative Committee will change its final choice if one of the alternative hypotheses prevails. This change includes a shift in support *away* from the original choice made and the convergence of the Consultative Committee's support on another, *existing* alternative.
Medium Importance:	A large shift in support away from the final choice of the Consultative Committee takes place under one of the competing hypotheses. This shift in support may include some people preferring to block the original choice of the Consultative Committee. However, *it is not clear* that another, *existing* alternative would be chosen by the Consultative Committee under this competing hypothesis.
Low Importance:	A shift in support away from the final choice of the Consultative Committee may occur. However, *it is clear* that the final choice of the Consultative Committee will not be changed to another, existing alternative. This decision may be a non-consensus Water Use Plan.

LEARNING SCALES EXPLAINED

High	Monitoring study will definitely lead to quantitative discrimination among all of the competing hypotheses.
Medium	Monitoring study will likely lead to the ability to discriminate quantitatively among some of the competing hypotheses.
Low	Likely to allow only qualitative comparisons among a few competing hypotheses.

RATING OF STUDY EXPLAINED

High Importance:	It is clear that there is a consensus, or close to consensus, agreement that this monitoring program should be included as a request within the consultative report.
Medium Importance:	There is no clear consensus within the group as to whether this monitoring program should be included as a request within the consultative report.
Low Importance:	There is a consensus, or close to a consensus, agreement that this monitoring plan should not be included as a request within the consultative report.

APPENDIX O: ASH WATER USE PLAN MONITORING PROGRAMS

1.0 INTRODUCTION

A cornerstone of water use planning is proving the effectiveness of chosen operating regimes to demonstrate benefits to the Province. Performance Measures calculated for the Ash River Water Use Plan defined quantitatively our understanding of the relationship between river flow and fish and wildlife in the Ash River and Elsie Lake Reservoir. Based on simulations of different operating alternatives, a subset of resulting performance measures was selected for monitoring following the implementation of the Ash River Water Use Plan.

1.1 First Nations Archaeology Resources and Traditional Use

At the June 2002 Consultative Committee meeting, an Archaeological Artifacts in Elsie Lake Reservoir Monitoring Program was proposed. A number of activities have been undertaken, during and following the Ash River Water Use Plan consultative committee process, to address these archaeological and traditional use issues, including:

- an archaeological inventory and impact assessment,
- an assessment of options to protect the large lithic scatter that was identified in Elsie Lake Reservoir,
- collection of surface artifacts from the large lithic scatter site,
- installation of an erosion monitoring system for the large lithic scatter site,
- a mitigative salvage of the large lithic scatter site, and
- cataloguing of artifacts from the large lithic scatter site,

BC Hydro, the Hupacasath First Nation and the provincial Archaeology Planning and Assessment Branch are currently reviewing the results of these activities completed to date. It is expected that the review of the results of the archaeological management work completed to date will help the Archaeology Planning and Assessment Branch, BC Hydro and First Nations establish what steps remain to be taken to complete the post-Ash River Water Use Plan monitoring activities

1.2 Fish

Fish and wildlife performance measures for the Ash River Water Use Plan included four fish performance measures in the reservoir, four fish performance measures in the middle Ash River, four fish performance measures in the lower Ash River, and six auxiliary fish performance measures. In addition there was one wildlife performance measure identified. In total, 21 performance measures were calculated with which to assess fish and wildlife. Through the review of performance measures over each operating alternative, two performance measures emerged as most capable of detecting significant differences and measuring those attributes of fish and wildlife given importance by the technical committee.

Within the Fish Technical Subcommittee there was no consensus that a single performance measure was most valuable, however, most Fish Technical Subcommittee members have focussed on steelhead parr rearing habitat in the middle Ash River as the key riverine performance measure. In addition, this performance measure has the ability to discriminate between alternatives based on its Minimum Incremental Significant Change (MISC) value. The two performance measures of interest for the monitoring program are steelhead parr in the Ash River (Performance Measure No. 15) and wildlife habitat adjacent to Elsie Lake Reservoir (Performance Measure No. 13). Wildlife habitat was assessed with a single performance measure that measured the area of habitat dewatered during drawdowns and potentially available to wildlife, providing that drawdowns were sufficiently long to allow vegetation to establish. In addition, a third performance measure, which dealt with the migratory success of steelhead (Performance Measure No. 14), was taken as a given and used as a constraint in each operating regime by imposing a requirement to release pulse flows.

Monitoring programs are described for each performance measure. The Steelhead Parr Monitoring Program, the Steelhead Migration Monitoring Program, and the Elsie Lake Reservoir Riparian Wildlife Habitat Monitoring Program are described below. The management questions and research hypotheses addressed by each program are defined. The individual monitoring programs are also evaluated for eligibility under the Ash River Water Use Plan as per the Eligibility Criteria for Water Use Monitoring Studies. The rationale for each monitoring program, program design, and the methods to be used and the budget are also provided.

The Consultative Committee discussed five fish and wildlife habitat monitoring programs. However, the monitoring programs for steelhead parr abundance, reservoir trout rearing habitat, reservoir riparian wildlife habitat, and Ash River riparian wildlife habitat do not satisfy the Water Use Plan Monitoring Principles and therefore, are ineligible for funding under water use planning. Descriptions of these monitoring programs are provided in the event that funding can be provided from other non-Water Use Plan sources.

1.2.1 Steelhead Parr Monitoring Program

Management Questions and Research Hypotheses

The primary management question for the monitoring program is: do increases in the minimum flow in the middle Ash River increase the growth, abundance or both of steelhead trout parr? Given this management question, and the selection of a single preferred alternative that implies a passive adaptive management design, the primary hypothesis is: Ho: existing flow is better, and alternative hypothesis is Ha: the preferred Alternative C is better.

The key water use decision affected is the amount of water released into the Ash River at Elsie Dam for fish habitat. This water could otherwise be used to generate electricity, therefore, the decision has implications for both power and fish values.

Adherence to Water Use Plan Monitoring Principles

The provincial Water Use Plan Guidelines outline that the individual Water Use Plans will specify monitoring programs and reports for preparation by the licensee to enable provincial and federal regulatory authorities (Comptroller of Water Rights and Fisheries and Oceans Canada to assess compliance with the authorized Water Use Plan. The primary objectives of the post Water Use Plan Monitoring Program is to assess whether the operational changes, as specified in the Water Use Plan, provide the expected results (in terms of the performance measures and/or the fundamental objectives), or whether the operations need further adjustment (which could include adjustment back to pre-Water Use Plan operations). Each monitoring study must obey the principles of efficacy, sensitivity, timeliness, and cost-effectiveness to qualify for funding under Water Use Plan monitoring.

The proposed Steelhead Parr Monitoring Program does not meet the principle of sensitivity because there is an insufficient difference between the existing flow regime and that proposed to provide the required minimum detectable increment of change. Furthermore, the proposed alternative increases both power values and fish habitat above those provided in the current operating regime, therefore, the primary hypothesis will not affect the decision between current operations and the preferred alternative (although other alternatives that do increase power values but not fish habitat could be implemented and these would create such a contrast).

Given that the proposed monitoring program does not meet Water Use Plan monitoring principles, the program is not eligible for Water Use Plan funding. However, a monitoring program may be undertaken if funding can be obtained from other sources.

Rationale

Based on a consensus of Fish Technical Subcommittee members, steelhead parr are proposed for monitoring in the middle Ash River, consistent with the selection of this variable as a performance measure. In addition, all juvenile fish species captured during the monitoring, particularly coho salmon, will be monitored, as the habitats occupied by these species will be sampled in the course of monitoring for steelhead trout abundance.

The focus on steelhead reflects the high interest of the Fish Technical Subcommittee and Consultative Committee in this species in the Ash River. At present, only the anadromous fish species confirmed to migrate past Dickson Falls are steelhead, and juveniles of this species rear in the middle Ash River, immediately downstream of Elsie Dam. The proximity of the middle Ash River to the Elsie Dam increases the sensitivity of this habitat to changes in flow, therefore monitoring of these habitats is more likely to detect environmental change induced by operational changes.

Steelhead live one or more years in freshwater as juveniles prior to migrating to sea as a smolt. Steelhead fry, the term given the juveniles when they first emerge from the gravel until their first winter of life, are the most abundant fish species during the summer and fall each year, however, their numbers decline severely during the first fall/winter of life. The abundance of steelhead fry (fry recruitment) in any one year is determined primarily by the number of adults spawning in the spring of that year. Fry recruitment will be low in those years when few adult steelhead return to spawn. Therefore, the abundance of steelhead is driven by adult abundance, making fry abundance a poor indicator of the effects of operational regimes.

Adult steelhead abundance reflects three factors: the number of smolts going to sea in previous years, the percentage of the marine steelhead population maturing in a given year, and the survival rate between smolt and adult life stages (marine survival). Operational changes are expected to affect the abundance of steelhead adults by increasing the number of smolts, however, this benefit may not be apparent for many years, given the overriding influence of marine survival.

Steelhead parr, the life stage between fry and smolt, may reside in the river for 1 to 3 years. The abundance of this life stage is expected to be more sensitive to operational changes than fry or adults. Accordingly, the monitoring will focus on the abundance of steelhead parr.

Monitoring Program Design

The purpose of environmental monitoring is to confirm and measure environmental change. To confirm change for the proposed operational change, the abundance of steelhead parr must be compared to either:

(a) before-after (the abundance of steelhead parr before the change, the baseline); or

(b) control-treatment (the abundance of steelhead parr compared to another river, the control).

These options, and variants on these, are alternative monitoring program designs. The best design will have the greatest chance of detecting and measuring the change in steelhead parr abundance.

For other Water Use Plans the monitoring programs proposed follow a before-after design, with a monitoring phase of several years (up to a decade) consisting of two phases, a baseline and an implementation phase. The implementation phase is a single continuous phase for passive adaptive management programs but, in an active adaptive management program, may be a series of sub phases where different alternatives are implemented. An advantage of the before-after design is that it avoids difficulty inherent to finding and monitoring of an appropriate control. Experimental controls are universal in laboratory conditions, where the preparation of a control is as simple as filling another test-tube. In nature, however, controls are more difficult to find because each habitat is different, reflecting the influence of numerous environmental factors. To overcome this variability, a habitat must be selected where the dominant environmental factors mirror those in the treatment habitat: in practice this is difficult. In fact, the variation in the control habitat may reduce the chance of successful monitoring. Given this, the most promising design is before-after.

The proposed change in operation can be classified, in the context of environmental monitoring, as a 'press' or long-term change. The successful monitoring of such change requires an appropriate time scale that we know from other Water Use Plans will typically be in the order of decades (Paul Higgins, Research Biologist, BC Hydro, pers. comm. 2002). Successful monitoring is defined as that which focuses not only the variable of interest, but measures this both accurately and precisely, over a long enough period that the influence of other factors can be eliminated as the reason for the change. This latter point is crucial because fish populations are influenced by many factors including climate, water quality, and predators, thus the observed change in a fish population may not be a result of operational changes, but rather a change in these other factors. To reduce the probability that an observed change actually resulted from one of these other factors, we must monitor long enough to see the influence of the operational change over that from other factors.

The existing data on steelhead parr in the Ash River are too limited to provide the establishment of a baseline. Griffiths (1993) sampled only three sites in the middle Ash River in a single year, and more recent sampling as part of the Steelhead Recovery Plan has focussed on fry habitat and therefore does not represent parr habitat. Accordingly, it is necessary to monitor the abundance of steelhead for years to develop a baseline.

The Consultative Committee proposes to implement the preferred Alternative C immediately. This precludes baseline monitoring prior to implementation. Interestingly, the baseline flow regime over the past five years (1996-2000) is not that different from the preferred alternative. Although during those years the minimum daily flow each year at Elsie Lake Reservoir has ranged from 0 m3/s to 3.16 m3/s, the median flow during the critical stream flow period (September-October) has ranged from 4.27 m3/s to 9.43 m3/s annually. It appears that despite a water licence that allows the release of a minimum flow of considerably lower than the preferred alternative, most often BC Hydro has released water in excess of the preferred alternative. In fact, the Ash River Water Use Plan environmental model predicts that steelhead parr habitat will be 24% lower under the preferred alternative than during the period from 1996 to 2000. This estimate is based on numerous assumptions, but does provide a useful comparison in the context of the alternatives reviewed for the Ash River Water Use Plan, and suggests that there will no detectable change in steelhead parr habitat.

Given that the Consultative Committee wishes to implement the preferred alternative immediately and that recent operations are similar to those for the preferred alternative, baseline monitoring prior to implementation of the preferred alternative will not take place. Based on the 'Decision Tree for Evaluating Water Use Plan Monitoring Requests', the proposed steelhead parr monitoring program does not meet the criteria for Water Use Plan monitoring funding requests because it has no ability to distinguish between current operating alternatives (the existing and preferred alternative). Accordingly, the program is not eligible for Water Use Plan monitoring funding.

In the future, operations may be altered to either

(a) reduce minimum flow requirements; or

(b) increase them, based on the outcome of future Water Use Plans on the Ash River.

To provide an adequate baseline data set for potential future monitoring programs for future Water Use Plans, a baseline monitoring program is proposed. The funds for this monitoring program would have to come from a source other than the Water Use Plan monitoring funds because Water Use Plan monitoring principles require that monitoring programs be able to show results by the next Water Use Plan period. Clearly, if the baseline period alone extends to the next

Water Use Plan, as is proposed for this monitoring program, the principle has not been met.

Given that future operations, beyond the preferred alternative, are unknown, it is not possible to specify the design of the full monitoring program, which in turn makes it impossible to ensure that the design of the baseline program is adequate. Given this, the program has been modelled after that used for the Bridge River Water Use Plan, to at the very least, provide a control for that monitoring program and for other Water Use Plan monitoring programs that may be undertaken on other rivers in the future (despite the limitations of control-treatment designs discussed earlier).

Methods

The methods to be used for this program will follow those for the Bridge River Water Use Plan, within the constraint of the budget defined for this program. An overview level of detail is provided in this document: detailed methods will be obtained from BC Hydro staff when the monitoring program is implemented.

Temperature and Flow

Water flow is monitored by BC Hydro at Elsie Dam. This information will continue to be collected and will be used as a measure of flow in the Middle Ash River. However, the middle Ash River extends for 10 km downstream to Dickson Lake and receives inflow from several tributaries, accordingly, a second flow monitoring station will be established at the forestry road crossing upstream of Dickson Lake. A continuous recording pressure sensor will be established and a stage-discharge curve will be established to convert the pressure readings into discharge data. Water temperature will be monitored with Hobo Stowaway(thermographs, located immediately downstream of Elsie Dam and at the forestry road crossing.

Fish Species Composition, Growth, and Abundance

The fish species of interest is steelhead trout, however, Griffiths (1993) detected cutthroat trout in the middle Ash River in 1992 and there is interest in the Consultative Committee in the possibility that coho salmon may ascend Dickson Falls and enter the middle Ash River in the future. Accordingly, all fish species will be identified.

The sampling program will be as follows:

1. Sampling units will be defined on the middle Ash River (Elsie Dam downstream to Dickson Lake) by randomly selecting sampling sites within riffle habitats expected to produce high numbers of steelhead parr (and stratified-random approach where superior units represent a single stratum).

2. Each unit will be sampled to estimate fish abundance:

    (a) Electrofishing via the multiple removal method (on foot or by boat as required)

    (b) Snorkel survey (a second measure of abundance that will corroborate electrofishing results, particularly in faster, deeper habitats)

3. The habitat in each sampling unit will be characterized by measuring:

    (a) Area of sampling units (area of enclosures for electrofishing and area of snorkelled)

    (b) Weighted usable area by measuring depth and velocity and quantifying cover at two transects across each sampling unit (as per the instream flow study methodology)

    (c) Spot water temperature (in addition to the continuous temperature recorders)

4. Size at age will be measured by collecting scales and measuring length and weight from each fish collected.

5. The habitat units will be sampled at the time of fry emergence in July and again in October each year, and the growth rate of age classes of steelhead juveniles will be inferred from seasonal size at age data.

6. Steelhead parr captured will be marked with pit tags to allow the emigration/immigration from each sample site to be calculated as to document movement patterns within the Ash River.

7. The number of sample sites is estimated at 20, based on budget.

Considerations for a sampling are that sampling sites must be large enough to match the habitat requirements and distribution of steelhead parr. Griffiths (1993) sampled areas of ~25 m2 to 40 m2 at three sites in the middle Ash River where he caught 1 to 3 parr per site. Given this apparent low density of parr (<10 per 100 m2) we suggest that each site be a minimum of 200 m2, with approximate site dimensions of 50 m by 4 m. Each site should be snorkel surveyed one day prior to sampling by electrofishing.

Budget

The budget for this work is estimated to be $50,000 per annum. The budget is broken down in the attached table by labour and expenses, showing hourly rates, hours, unit type, and unit cost. Labour was priced based on typical consulting rates.

Table 0–1: Steelhead Parr Monitoring Program Budget (annual)

Field Labour								
Item	**Hourly Rate**	**10 hour day**	**Sites per day**	**Cost per Site**	**Sites**	**Trips**	**Days**	**Total Cost**
Biologist	$50	$500	2	$250	20	2	20	$10,000
Technician	$30	$300	2	$150	20	2	20	$6,000
Technician	$30	$300	2	$150	20	2	20	$6,000
Subtotal								$22,000
Office Labour								
Item	**Hourly Rate**	**10 hour day**					**Days**	**Total Cost**
Biologist	$50	$500					10	$5,000
Technician	$30	$300					20	$6,000
Subtotal								$11,000
Expenses								
Item		**Units**	**No. Units**	**Daily rate**	**Days**	**Trips**		**Total cost**
Accommodation		person days	3	$100	10	2		$6,000
Truck		days	1	$100	10	2		$2,000
Fuel		days	1	$50	10	2		$1,000
Shockers, equipment		days	1	$125	10	2		$2,500
Pit tags		tag	800	$5				$4,000
Pit tag reader		reader	1					$1,000
Report production								$500
Subtotal								$17,000
Total								**$50,000**

1.2.2 Adult Steelhead Migration Monitoring Program

Management Questions and Research Hypotheses

The primary management question for the monitoring program is: will pulse flows releases in the middle Ash River maximize the rate of adult steelhead migration? Given this management question, and the selection of a single preferred alternative that implies a passive adaptive management design, the primary hypothesis is: Ho: existing flow is better, or alternatively Ha: the preferred Alternative C is better. Note that the pulse flow can be modified in timing and hourly rate within the given water budget of 10 m3/s over two days, thus several alternative forms of the release are possible within the single alternative.

The key water use decision affected is the amount of water released into the Ash River at Elsie Dam for fish steelhead migration. This water could otherwise be used to generate electricity, therefore, the decision has implications for both power and fish values.

Adherence to Water Use Plan Monitoring Principles

The provincial Water Use Plan Guidelines outline that the individual Water Use Plans will specify monitoring programs that meet principles, as described for the Steelhead Parr Monitoring Program above. Each monitoring study must meet the principles of efficacy, sensitivity, timeliness, and cost-effectiveness to qualify for funding under Water Use Plan monitoring.

The proposed Adult Steelhead Monitoring Program will meet all four principles. The proposed alternative may increase access to fish habitat, and therefore, steelhead abundance, but at a cost to BC Hydro, therefore, information obtained under this program will affect the decision on whether or not to release flow. This benefit will be readily detectable by comparing fish distribution immediately prior to and following a pulse flow release, as is discussed below. The study will provide conclusive results annually, and therefore is expected to confirm or refute the null hypothesis within five years of implementation. The methods chosen are the most direct available at any cost, and the information gained will not be available through other Water Use Plan monitoring programs, therefore, the program is cost-effective in the context of the site-specific learning provided.

Rationale

Members of the Fish Technical Subcommittee reviewed existing data, visited Dickson and Lanterman Falls, and applied their expert judgement to estimate the required pulse flow required to stimulate and enable adult steelhead to migrate upstream past the obstructions.

The studies suggested that a pulse flow averaging 10 m3/s over a two-day period was sufficient to stimulate adult steelhead migration. However, the hourly flow regime over the two-day period, and the seasonal timing of the pulse flow has not been examined in the field, therefore additional information is required to refine the pulse flow release to maximize fish migration. To test the effectiveness of different pulse flow releases additional field observation is required over multiple years. It is expected that within five years of study the effectiveness of the pulse flow release can be confirmed and that the 'shape' of the release can be refined to maximize fish migration.

Monitoring Program Design

The design of the monitoring program is a before-after design. Pulse flow releases will be timed when adult steelhead are holding at the base of Dickson Falls, as determined by direct observation in season. The pulse flow will be released for a two-day period, and the response of adult fish will be directly observed. The baseline portion of the program is the week of observation immediately prior to the pulse flow release: the treatment portion is the release and week observation following. Each pulse flow release will, in effect, be an experiment with a baseline and treatment regime, a before and after period, during which observations will be made.

Methods

Adult steelhead presence will be determined by direct observation. Prior to and following the pulse flow release, steelhead distribution throughout the Ash River will be documented by snorkel counts. This method is currently used by Ministry of Water, Land and Air Protection to enumerate adult steelhead the specific methods will follow their protocols. This work will also provide an estimate of adult escapement that can be used to inform the analysis of fish species abundance in the Steelhead Parr Monitoring Program, by providing an estimate of spawning population and fry recruitment.

During the pulse flow release, leap attempts at Dickson Falls will be observed and the number, exact location, time and success of these leaps will be recorded. The methods for this work will follow that completed for the Ash River Water Use Plan. The work will focus on Dickson Falls, however, should other barriers emerge as concerns, these too may be monitored.

Budget

The budget for this work is estimated to be $15,000 per annum. The budget is broken down in the attached table by labour and expenses, showing hourly rates, hours, unit type, and unit cost. Labour was priced based on typical consulting rates.

Table 0–2: Steelhead Migration Monitoring Program Budget (annual)

Field Labour						
Item	**Hourly Rate**	**10 hour day**		**Trips**	**Days**	**Total Cost**
Biologist	$50	$500		1	10	$5,000
Technician	$30	$300		1	10	$3,000
Subtotal						$8,000

Office Labour								
Item	**Hourly Rate**	**10 hour day**	**Sites per day**	**Cost per site**	**Sites**	**Trips**	**Days**	**Total Cost**
Biologist	$50	$500					2	$1,000
Technician	$30	$300					5	$1,500
Subtotal								$2,500

Expenses						
Item	**Units**	**No. Units**	**Daily rate**	**Days**	**Trips**	**Total cost**
Accommodation	Person days	2	$100	10	1	$2,000
Truck	Days	1	$100	10	1	$1,000
Fuel	Days	1	$50	10	1	$500
Equipment	Days	1	$80	10	1	$800
Report production						$200
Subtotal						$4,500
Total						**$15,000**

1.2.3 Reservoir Trout Rearing Habitat

Management Questions and Research Hypotheses

The primary management question for the monitoring program is: will Alternative C increase trout rearing habitat in the Elsie Lake Reservoir? Given this management question, and the selection of a single preferred alternative that implies a passive adaptive management design, the primary hypothesis is: Ho: existing operations provide the most trout rearing habitat in the tributaries of Elsie Lake Reservoir, and the competing alternative is Ha: preferred Alternative C provide the most trout rearing habitat in tributaries of Elsie Lake Reservoir.

The Fish Technical Subcommittee faced the uncertainty of whether trout reared in the tributaries to the reservoir, in the reservoir body itself, or both. In the absence of information, the Consultative Committee developed a performance measure (Performance Measure No. 11) to assess the quantity of trout rearing habitat in tributary streams under different operating alternatives. This performance measure was based on habitat attributes and not the presence/absence of rearing trout in those reaches.

The key water use decision affected is the annual operating regime of Elsie Lake Reservoir, which reflects both the amount of water used for power generation and the water released into the Ash River for fish habitat.

Adherence to Water Use Plan Monitoring Principles

The provincial Water Use Plan Guidelines outline that the individual Water Use Plans will specify monitoring programs but meet principles, as described for the Steelhead Parr Monitoring Program above. Each monitoring study must satisfy the principles of efficacy, sensitivity, timeliness, and cost-effectiveness to qualify for funding under Water Use Plan monitoring.

The proposed Elsie Lake Reservoir Trout Rearing Habitat Monitoring Program does not satisfy the monitoring program principle of sensitivity. Reservoir elevations will be similar under both current operations and Alternative C. Under current operations over the past five years, the median annual trout rearing habitat was 0 m: under Alternative C trout rearing habitat will be 7 m of stream length. This difference in the quantity of rearing habitat will not be sufficient to provide the required minimum detectable increment of change.

Given that the proposed monitoring program does not meet the Water Use Plan monitoring principles, the program is not eligible for Water Use Plan funding. However, a monitoring program may be undertaken if funding can be obtained from other sources.

Rationale

In the absence of specific information for Elsie Lake Reservoir, the Fish Technical Subcommittee worked on the assumption that trout reared in the tributaries to the reservoir. As such the Consultative Committee developed a performance measure based on the length of trout rearing habitat available in the tributaries within the reservoir drawdown zone. Different operating alternatives provide different quantities of trout rearing habitat. The rationale for an Elsie Lake Reservoir Trout Rearing Habitat Monitoring Program is to establish the degree to which trout rear in the tributaries. If trout rear in the reservoir then maintaining reservoir elevations to protect rearing habitat drops from consideration in future decision making.

Methods

Trout rearing patterns will be monitored by an annual program of stream sampling that will include:

- Electrofishing via the multiple removal method to determine fish abundance
- Minnow trapping to provide comparative index information for electrofishing
- Snorkelling of major tributaries

- Flow and temperature measurement

Five tributary streams will be sampled, out of the 20 tributaries examined during the Water Use Plan. These tributaries will be selected once the results of the 2002 Bridge Coastal Restoration Program study have been reviewed, but will include the upper Ash River, Katlum Creek, and Ramsay Creek. Two sites will be established on each stream, and sampling will take place in the spring and fall months, tentatively during April and September. Based on the smaller size of these tributaries, we expect that production (sites/day) will be double that in the Ash River downstream of Elsie Lake Reservoir and that five sites can be covered per day.

Budget

The budget for this work is estimated to be $15,750 per annum (5 years total).

Table O-3: Elsie Lake Reservoir Trout Rearing Monitoring Program Budget (annual)

Field Labour								
Item	**Hourly Rate**	**10 hour day**	**Sites per day**	**Cost per site**	**Sites**	**Trips**	**Days**	**Total Cost**
Biologist	50	$500	4	$125	10	2	5	$2,500
Technician	30	$300	4	$75	10	2	5	$1,500
Subtotal								$4,000
Office Labour								
Item	**Hourly Rate**	**10 hour day**					**Days**	**Total Cost**
Biologist	50	$500					5	$2,500
Technician	30	$300					10	$3,000
Subtotal								$5,500
Expenses								
Item		**Units**	**No. Units**	**Daily rate**	**Days**	**Trips**		**Total cost**
Accommodation		Person days	3	$100	5	2		$3,000
Truck		Days	1	$100	5	2		$1,000
Fuel		Days	1	$50	5	2		$500
Shockers, equipment		Days	1	$125	5	2		$1,250
Report production								$500
Subtotal								$6,250
Total								**$15,750**

1.3 Riparian Wildlife Habitat

1.3.1 Elsie Lake Reservoir Riparian Wildlife Habitat Monitoring Program

Management Questions and Research Hypotheses

The primary management question for the monitoring program is: will Alternative C increase wildlife habitat in the riparian habitats surrounding Elsie Lake Reservoir? Given this management question, and the selection of a single preferred alternative that implies a passive adaptive management design, the primary hypothesis is: Ho: existing reservoir operation is better, and the competing alternative is Ha: the preferred Alternative C is better.

The key water use decision affected is the annual operating regime of Elsie Lake Reservoir, which reflects both the amount of water used for power generation and the water released into the Ash River for fish habitat.

Adherence to Water Use Plan Monitoring Principles

The provincial Water Use Plan Guidelines outline that the individual Water Use Plans will specify monitoring programs but meet principles, as described for the Steelhead Parr Monitoring Program above. Each monitoring study must obey the principles of efficacy, sensitivity, timeliness, and cost-effectiveness to qualify for funding under Water Use Plan monitoring.

The proposed Elsie Lake Reservoir Riparian Wildlife Habitat Monitoring Program will not meet these principles.

The program does not meet the principle of sensitivity because there is little difference between the current reservoir operating regime and that proposed to provide the required minimum detectable increment of change. Furthermore, the proposed alternative increases both power values and wildlife habitat above those provided by the existing water licence. Therefore, the primary hypothesis will not affect the decision between current operations and the preferred alternative (although other alternatives that do increase power values but not wildlife habitat could be implemented, and vice versa, and these would create such a contrast). The cost effectiveness of the program is questionable as the monitoring of riparian wildlife habitat for other Water Use Plans may provide information that will be able to answer the management question.

Given that the proposed monitoring program does not meet Water Use Plan monitoring principles, the program is not eligible for Water Use Plan funding. However, a monitoring program may be undertaken if funding can be obtained from other sources.

Rationale

Wildlife habitat in riparian areas adjacent to Elsie Lake Reservoir was of interest in the Water Use Plan, and a performance measure was constructed that estimated wildlife habitat as the inverse of drawdown area wetted each year. The preferred Alternative C does not provide an increase in wildlife habitat compared to the current operating regime but was selected over other alternatives that did. Given this, the preferred alternative will not result in a detectable change in wildlife habitat and therefore cannot in the context of Water Use Plan be the target of a monitoring program. Nevertheless, there is interest in wildlife habitat and future Water Use Plans may recommend alternatives to increase benefits to this interest.

There is no time series of wildlife habitat data in riparian areas adjacent to Elsie Lake Reservoir; hence there is at present no baseline for this resource. As the Consultative Committee has recommended that the preferred alternative be implemented immediately, there is no opportunity to provide baseline information for this Water Use Plan.

Wildlife habitat in riparian areas adjacent to Elsie Lake Reservoir can be monitored to provide baseline information that may be of use in the future should alternatives be implemented to increase wildlife habitat.

Methods

The riparian wildlife habitat will be monitored by:

a) observing habitat use by wildlife on a quarterly basis each year for four years, and

b) examining vegetation over five year intervals for a ten year period.

Wildlife habitat use will be assessed by foot survey through the riparian habitats at the northeast end of Elsie Lake Reservoir. Direct observations of mammals, birds, amphibians, and reptiles will be recorded, as will indicators of habitat use such as tracks, scats, and browse sign. This work will take place in four consecutive years to establish a baseline of habitat use.

Vegetation growth and succession will be monitored in Years 1, 6 and 11 following Water Use Plan implementation. Aerial photographs will be used to document vegetation assessing vegetation growth and habitat use. Riparian areas will be photographed through a low-level over flight. The resultant photomosaic will be geo-referenced and used to delineate vegetation types. The riparian habitats will be ground-truthed by establishing transects along which sampling quadrats will be randomly placed. Vegetation composition and status will be described within each quadrat.

Budget

The budget for this work is estimated to be $13,800 per annum (4 years total) for the habitat use work, and $12,500 per annum (3 years total) for vegetation growth. The budgets are broken down in the attached table by labour and expenses, showing hourly rates, hours, unit type, and unit cost. Labour was priced based on typical consulting rates. The annual costs of the program for the two budgets combined are: Year 1: $26,300, Years 2-4: $13,800, Years 6 and 11: $12,500.

Table O-4: Elsie Lake Reservoir Riparian Wildlife Habitat Monitoring Program Budget - Habitat Use (Years 1-4)

Field Labour							
Item	**Hourly Rate**	**10 hour day**			**Trips**	**Days**	**Total Cost**
Biologist	$50	$500			4	2	$4,000
Technician	$30	$300			4	2	$2,400
Subtotal							$6,400
Office Labour							
Item	**Hourly Rate**	**10 hour day**	**Sites per day**	**Cost per site**	**Sites**	**Trips**	**Days**	**Total Cost**
Biologist	$50	$500					5	$2,500
Technician	$30	$300					5	$1,500
Subtotal								$4,000
Expenses							
Item	**Units**	**No. Units**	**Daily rate**	**Days**	**Trips**	**Total cost**	
Accommodation	Person days	2	$100	2	4	$1,600	
Truck	days	1	$100	2	4	$800	
Fuel	days	1	$50	2	4	$400	
Equipment	days	1	$50	2	4	$400	
Report production						$200	
Subtotal						$3,400	
Total						**$13,800**	

Table O-5: Elsie Lake Reservoir Riparian Wildlife Habitat Monitoring Program Budget – Vegetation (Years 1, 6, 11)

Field Labour								
Item	**Hourly Rate**	**10 hour day**				**Trips**	**Days**	**Total Cost**
Biologist	$50	$500				1	5	$2,500
Technician	$30	$300				1	5	$1,500
Subtotal								$4,000
Office Labour								
Item	**Hourly Rate**	**10 hour day**	**Sites per day**	**Cost per site**	**Sites**	**Trips**	**Days**	**Total Cost**
Biologist	$50	$500					5	$2,500
Technician	$30	$300					5	$1,500
Subtotal								$4,000
Expenses								
Item		**Units**	**No. Units**	**Daily rate**		**Days**	**Trips**	**Total cost**
Accommodation		person days	2	$100		1	5	$1,000
Truck		days	1	$100		1	5	$500
Fuel		days	1	$50		1	5	$250
Equipment		days	1	$50		1	5	$250
Aerial overflight		hours	1	$1,000		1	1	$1,000
Report production								$1,500
Subtotal								$4,500
Total								**$12,500**

1.3.2 Ash River Wildlife Riparian Habitat and Use Monitoring Program

Management Questions and Research Hypotheses

The primary management question for the monitoring program is: will Alternative C increase wildlife habitat in the riparian habitats along the Ash River? Given this management question, and the selection of a single preferred alternative that implies a passive adaptive management design, the primary hypothesis is: Ho: existing flow releases are better, and the competing alternative is Ha: flow releases under preferred Alternative C are better.

The key water use decision affected is the amount of water released into the Ash River at Elsie Dam to maintain riparian habitat. This water could otherwise be used to generate electricity, therefore, the decision has implications for power values, wildlife, and river fish values.

Adherence to Water Use Plan Monitoring Principles

The provincial Water Use Plan Guidelines outline that the individual Water Use Plans will specify monitoring programs but meet principles, as described for the Steelhead Parr Monitoring Program above. Each monitoring study must obey the principles of efficacy, sensitivity, timeliness, and cost-effectiveness to qualify for funding under Water Use Plan monitoring.

The proposed Ash River Wildlife Riparian Habitat and Use Monitoring Program will not meet these principles. The program does not meet the principle of sensitivity. There is little difference between the existing flow releases from Elsie Dam into the Ash River compared to preferred Alternative C to provide the required minimum detectable increment of change. Furthermore, there is no data for the Ash River relating the effect of flow regimes to the quantity or quality of riparian habitat. Finally, the cost effectiveness of the program is questionable, as the monitoring of riparian wildlife habitat for other Water Use Plans may provide information that will be able to answer the management question.

Given that the proposed monitoring program does not meet Water Use Plan monitoring principles, the program is not eligible for Water Use Plan funding. However, a monitoring program may be undertaken if funding can be obtained from other sources.

Rationale

Wildlife habitat in riparian areas along the Ash River was of interest in the Water Use Plan. The Consultative Committee conducted a brief overview assessment of wildlife habitat along the Ash River below Elsie Dam. This overview showed there was little flood plain ecosystem along the Ash River between Elsie Dam and Dickson Lake. However, there was an important provincially Red-listed CWHxm2/Ss-Salmonberry ecosystem located where the Ash River flows into Dickson Lake. The water use planning process did not investigate wildlife habitat or wildlife use along the Ash River between Dickson Lake and the Stamp River.

Currently, the Hupacasath First Nation is conducting an inventory of small mammals present in the Ash River riparian habitat. Hupacasath First Nation had further interest in an inventory of larger mammals including deer, elk, and bear along the Ash River.

Methods

The inventory of larger mammals will involve direct observation of animals plus observations of denning and resting sites, signs of browse, and scat. Details of the budget and project scope will be developed by study proponents. The annual cost of the program is expected to be $10,000 for 5 years.

APPENDIX P: DOCUMENTATION OF ACCEPTANCE BY COMMITTEE MEMBERS OF FINAL DRAFT ASH RIVER WATER USE PLAN CONSULTATIVE COMMITTEE REPORT

ASH RIVER WATER USE PLAN

To:
Sue Foster
Project Manager
Ash River Water Use Plan

Fax: 604 528 2905
Phone: 604 528 2737

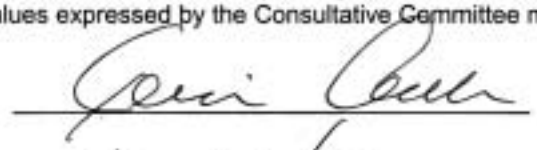
From:

KEVIN CONLIN
ASH WUP CONSULTATIVE COMMITTEE MEMBER
MINISTRY OF SUSTAINABLE RESOURCE MANAGEMENT

Ash River Water Use Plan Consultative Committee Report

The final draft Ash River Water Use Plan Consultation Committee Report records the deliberations of the Ash River Water Use Plan Consultative Committee and provides the context for the committee's recommendations for the future operations of the Ash River hydroelectric facility.

The undersigned confirm that this Report captures the water use interests, objectives and associated values expressed by the Consultative Committee members during the process.

Signed: 

Date: May 27/03

JUN. 10. 2003 2:15PM R. D. ALBERNI-CLAYQUOT NO. 5278 P. 1/1

ASH RIVER WATER USE PLAN

To:
Sue Foster
Project Manager
Ash River Water Use Plan

Fax: 604 528 2905
Phone: 604 528 2737

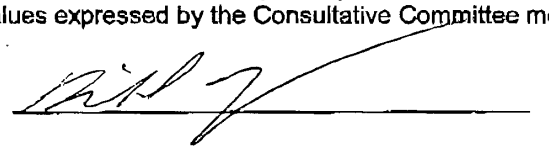
From:

Mike Irg
Alberni-Clayoquot Regional District
3008 Fifth Avenue
Port Alberni, B.C. V9Y 2E3

Ash River Water Use Plan Consultative Committee Report

The final draft Ash River Water Use Plan Consultation Committee Report records the deliberations of the Ash River Water Use Plan Consultative Committee and provides the context for the committee's recommendations for the future operations of the Ash River hydroelectric facility.

The undersigned confirm that this Report captures the water use interests, objectives and associated values expressed by the Consultative Committee members during the process.

Signed: 

Date: June 10/03

ASH RIVER WATER USE PLAN

To:
Sue Foster
Project Manager
Ash River Water Use Plan

Fax: 604 528 2905
Phone: 604 528 2737

From:
Glen Rasmussen
Fisheries + Oceans Canada

Ash River Water Use Plan Consultative Committee Report

The final draft Ash River Water Use Plan Consultation Committee Report records the deliberations of the Ash River Water Use Plan Consultative Committee and provides the context for the committee's recommendations for the future operations of the Ash River hydroelectric facility.

The undersigned confirm that this Report captures the water use interests, objectives and associated values expressed by the Consultative Committee members during the process.

Signed:

Date: April 24, 2003

From: Cross, Larry (Alberni) [Larry.Cross@norskecanada.com]

Sent: 2003, May 14 11:24 AM

To: 'sue.foster@bchydro.com'

Subject: Ash River final draft report

I have reviewed the final draft of the Ash River CC report dated April 16, 2003 and am acknowledging my acceptance. The report accurately represents the discussions, interests and recommendations of the consultative committee.

Larry Cross

NorkseCanada, Port Alberni Division

From: WooK@pac.dfo-mpo.gc.ca
Sent: 2003, May 07 8:00 AM
To: sue.foster@bchydro.com
Subject: RE: Final Draft of Ash River Water Use Plan Consultative Committe e Report (16 April 2003)

This e-mail is to acknowledge receipt and acceptance of the Final Draft of the Ash River Water Use Plan Consultative Committee Report.

I have the following comments:

Page 2-2, Figure 2-1, A more detailed map with additional First Nations names was provided to the Hupacasath First Nations. I've attached a copy is you wish to consider using it.

<<Stamp-Nuu-Chah-Nulth-kw2.wmf>>
Page 2-4, Photo 2-1, Saddle Dams 2-4 (inclusive) are still not identified even though referred to in the text (i.e. page 2-6).

Page 6-8, 2nd para., "...into Great Central Lake compared to 37 million... and 373 million..." - **should read 371 and not 37**.

Thank you.

Ken Woo
Oceans/Watershed Planning and Restoration
Habitat and Enhancement Branch (13th Floor)
Fisheries and Oceans Canada
Suite 200 - 401 Burrard St., Vancouver, B.C., V6C 3S4
E-mail: wook@pac.dfo-mpo.gc.ca
Ph: (604)666-6386, Fax: (604)666-0292, Cell: (604)786-1125

From: Veary, Tom

Sent: 2003, May 20 12:09 PM

To: Brownlow, Harry; Foster, Sue

Subject: RE: Ash River WUP Final Draft

Sue, I agree with the ASH RIVER WUP (Final Draft) in it's present format. I echo Harry's appreciation for all the work you have put into completing the WUP.

Regards, Tom

-----Original Message-----

From: Brownlow, Harry

Sent: 2003, May 16 2:53 PM

To: Foster, Sue

Cc: Veary, Tom

Subject: Ash River WUP Final Draft

Sue,

I agree with what is included in the Ash River WUP (Final Draf) April 2003 and have no further comments. Congratulations on finishing.

Regards,

Harry

APPENDIX Q: FIRST NATION COMMENTS ON FINAL DRAFT ASH RIVER WATER USE PLAN CONSULTATIVE COMMITTEE REPORT AND BC HYDRO RESPONSES

BC hydro

THE POWER IS YOU

Sue Foster
Project Manager
Ash River Water Use Plan
Phone: (604) 528-2737
FAX: (604) 528-2905

Dave Watts
Chief Councilor of Tseshaht First Nation
P.O. Box 1218
Port Alberni, British Columbia
V9Y 7M1

May 29, 2003

Dear Chief Councilor Watts:

Thank you for your 23 May 2003, letter outlining Tseshaht First Nation's comments on the final draft Ash River Water Use Plan Consultative Committee Report. As per my 16 April 2003 letter to the Consultative Committee, your letter and this response will be included in an appendix of the Consultative Committee Report.

The Ash River water use planning consultative committee process was initiated in September 2000 and finished in June 2002. In January 2001, the Ash River Consultative Committee, including Tseshaht First Nation developed and adopted Terms of Reference and a consultative work plan based on the *Water Use Plan Guidelines* (British Columbia, 1998). One representative from Tseshaht First Nation and a Nuu-chah-nulth Tribal Council fisheries advisor participated as members of the Consultative Committee and the Fish Technical Subcommittee. Capacity funding was provided to the Tseshaht First Nation representative and the fisheries advisor.

Based on discussions with Tseshaht First Nation representatives during the introductory meetings, and throughout the Ash River water use planning consultative process, BC Hydro understood that the Tseshaht First Nations' claimed traditional territory extended up the Somas River to near the confluence with the Sproat River. During the comment period for the draft Consultative Committee Report, Tseshaht First Nation confirmed that they consider the Ash River hydroelectric facilities to be within their claimed territory. Tseshaht First Nation's claimed territory is documented in the Ash River Water Use Plan Consultative Committee Report.

On 25 June 2002, the Ash River Water Use Plan Consultative Committee reached unanimous acceptance of alternative C as the preferred operating regime for the Ash River hydroelectric facility. Tseshaht First Nation also accepted alternatives I2 and J. During this meeting, the Consultative Committee agreed in principal to an Archaeological Artifacts in Elsie Lake Reservoir Drawdown Zone monitoring program, although no terms of reference or detailed estimates were available at the time. Subsequent to the June 2002 Consultative Committee meeting, a number of archaeology-related activities that had been proposed under the cultural monitoring program have been completed.

British Columbia Hydro & Power Authority 6911 Southpoint Drive Burnaby, BC V3N 4X8 (E04)
www.bchydro.com

BC Hydro, First Nations and the provincial Archaeology Planning and Assessment Branch are currently reviewing the results of these activities completed to date. It is expected that the review of the results of the archaeological management work completed to date will help the Archaeology Planning and Assessment Branch, BC Hydro and First Nations establish what steps remain to be taken to complete the post-Ash River Water Use Plan monitoring activities.

As per the provincial *Water Use Plan Guidelines*, the Consultative Committee Report is a record of the water use issues and interests discussed, and the trade-offs among different operating alternatives to meet stakeholder objectives. The purpose of this report is to document the consultative process and present the recommendations of the Committee to the BC Comptroller of Water Rights. First Nation rights and title issues and historic grievances arising from the initial construction of the facilities are specifically excluded from Water Use Plans as they are considered part of other processes. As you raise this as an issue in your letter, a representative from BC Hydro's Aboriginal Relations will contact you to further discuss.

At this time, BC Hydro will prepare the draft Ash River Water Use Plan based on the recommendations included in the Ash River Consultative Committee Report. The operational changes and the monitoring program recommended by the Ash River Consultative Committee will be implemented once the Comptroller of Water Rights and government approve the Ash River Water Use Plan.

Sincerely,

Sue Foster

c Jim Mattison, Water Comptroller
Randy Brant, BC Hydro Aboriginal Relations
Graeme Matthews, BC Hydro WUP Program Manager

BC hydro

THE POWER IS YOURS

Sue Foster
Project Manager
Ash River Water Use Plan
Phone: (604) 528-2737
FAX: (604) 528-2905

Chief Judith Sayers
Hupacasath First Nation
5323 River Road
Box 211
Port Alberni, B.C.
V9Y 7M7

May 29, 2003

Dear Chief Sayers:

Thank you for your 8 May 2003, letter outlining Hupacasath First Nation's comments on the final draft Ash River Water Use Plan Consultative Committee Report. As per my 16 April 2003 letter to the Consultative Committee, your letter and this response will be included in an appendix of the Consultative Committee Report.

Committee Recommendations as to Facility Operating Alternatives
On 25 June 2002, the Ash River Water Use Plan Consultative Committee reached unanimous acceptance of alternative C as the preferred operating regime for the Ash River hydroelectric facility. Hupacasath First Nation also accepted alternatives I2 and J. During this meeting, the Consultative Committee agreed in principal to an Archeological Artifacts in Elsie Lake Reservoir Drawdown Zone monitoring program, although no terms of reference or detailed estimates were available at the time. Subsequent to the June 2002 Consultative Committee meeting, BC Hydro and the Hupacasath First Nation completed a number of archeology-related activities that had been proposed under the cultural monitoring program. BC Hydro, First Nations and the provincial Archaeology Planning and Assessment Branch are currently reviewing the results of these activities completed to date. It is expected that the review of the results of the archaeological management work completed to date will help the Archaeology Planning and Assessment Branch, BC Hydro and First Nations establish what steps remain to be taken to complete the post-Ash River Water Use Plan cultural monitoring activities.

It is disappointing that Hupacasath First Nation has now indicated that they wish to withdraw their acceptance of Alternative I2, J and C.

Ash River Water Use Planning Consultation Process
The Ash River water use planning consultative committee process was initiated in September 2000 and finished in June 2002. In January 2001, the Ash River Consultative Committee, including Hupacasath First Nation developed and adopted Terms of Reference and a consultative work plan based on the *Water Use Plan Guidelines* (British Columbia, 1998). Two representatives from Hupacasath First Nation and a Nuu-chah-nulth Tribal Council fisheries advisor participated as members of the Consultative Committee and the Fish Technical Subcommittee. Representatives from the Hupacasath First Nation were also members of the First Nation Heritage and Archaeology Resources Subcommittee and the Wildlife Technical Subcommittee. Capacity funding was provided to the Hupacasath First Nation representatives and the fisheries advisor. Funding was also provided to Hupacasath First Nation to conduct a thorough archaeological inventory and impact assessment for Elsie Lake Reservoir during the water use planning process.

British Columbia Hydro & Power Authority 6911 Southpoint Drive Burnaby, BC V3N 4X8 (E04)
www.bchydro.com

As per the provincial *Water Use Plan Guidelines*, the Consultative Committee Report is a record of the water use issues and interests discussed, and the trade-offs among different operating alternatives to meet stakeholder objectives. The purpose of this report is to document the consultative process and present the recommendations of the Committee to the BC Comptroller of Water Rights. First Nation rights and title issues and historic grievances arising from the initial construction of the facilities are specifically excluded from Water Use Plans as they are considered part of other processes.

Tseshaht First Nation Claim
Based on discussions with Tseshaht First Nation representatives during the introductory meetings, and throughout the Ash River water use planning consultative process, BC Hydro understood that the Tseshaht First Nations' claimed traditional territory extended up the Somas River to near the confluence with the Sproat River. During the comment period for the draft Consultative Committee Report, Tseshaht First Nation confirmed that they consider the Ash River hydroelectric facilities to be within their claimed territory.

Next Steps
At this time, BC Hydro will prepare the draft Ash River Water Use Plan based on the recommendations included in the Ash River Consultative Committee Report. The operational changes and the monitoring program recommended by the Ash River Consultative Committee will be implemented once the Comptroller of Water Rights and government approve the Ash River Water Use Plan.

Sincerely,

Sue Foster

c Jim Mattison, Water Comptroller
Randy Brant, BC Hydro Aboriginal Relations
Graeme Matthews, BC Hydro WUP Program Manager

Tseshaht
First Nation

Tel: (250) 724-1225
Fax: (250) 724-4385

P.O. Box 1218, Port Alberni, B.C. Canada V9Y 7M1

May 23, 2003

BC Hydro and power Authority
6911 South Point Drive, Edmond 09
Burnaby BC
V3N 4X8

Dear: Sue

RE: The Consultative Committee Report for the Ash River Water Use Plan

We the Tseshaht First Nation would like you to know that we practice our aboriginal rights in the project area. It raises question in your final draft as to the lack of participation in all studies conducted by the other Nation and that Tseshaht was not part of these studies. We would look to being compensated and that we say that this is within our Traditional Territory.

We know that Tseshahts interests were not met and our concern is with our Salmon fisheries at the times the damn is open, we've noticed it's been more often that water levels or so high it becomes very difficult to set our seine net to fish for our people.

1. We have the right to hunt & fish
2. We have the right to Water
3. We have the right to gather plant species
4. We have the right to harvesting timber
5. We have an Economic Interest to be met

Yours truly,

Dave Watts
Chief Councilor of Tseshaht

Nuu-chah-nulth Nation

Hupačasath **First Nation**
Ph. (250) 724-4041
Fx. (250) 724-1232
judiths@hupacasath.ca
5500 Ahahaswinis Drive
Box 211
Port Alberni, BC
V9Y 7M7

May 8, 2003

BC Hydro
6911 Southpoint Drive
Burnaby, BC
V3N 4X8

Attention: Sue Foster
Project Manager
Ash River Water Use Plan

Dear Sue:

I write on behalf of the Hupacasath First Nation and further to my letters of April 2003 regarding additional comments on the draft Ash River Consultative Committee Report. Subsequent to my letters, you forwarded the Hupacasath a copy of the Final Draft of the Consultative Committee Report drafted by B.C. Hydro. In the circumstances, the Hupacasath are left to comment herein on the Final Draft Report.

Page 1-1 of the Final Draft Report states the purpose of the report, namely, "to document the consultative committee process and present the recommendations of the Ash River Water Use Plan Consultative Committee." Accordingly, I will direct our comments in this letter to the process and the recommendations as characterized by B.C. Hydro in the Final Report. Before doing so, however, I wish to make a few comments on the inherent deficiencies of the consultative committee process led by B.C. Hydro.

Inherent Deficiencies in the Ash River Water Use Planning Consultation Process

The Final Draft Report states at page 1 of the Executive Summary, "the consultative committee process followed the steps outlined in the 1998 provincial government's *Water Use Plan Guidelines*." The Guidelines in turn state at pages. 1 and 10:

> WUP's must recognize existing legal and constitutional rights and responsibilities, as set out in legislation and court decisions.

> These include existing rights and responsibilities under… constitutionally protected… aboriginal rights and title…

The leading court decisions setting out the law of consultation responsibilities with respect to aboriginal rights and title are *Taku River Tlingit First Nation v. Ringstad*, 2002 BCCA 59 and *Haida Nation v. British Columbia*, 2002 BCCA 147 and 462. These cases form the basis of the provincial governments 2002 consultation policy regarding unrecognized aboriginal rights and title.

Problematically, the Water Use Planning Guidelines allegedly followed by the consultation committee are not based on the *Taku River Tlingit* or *Haida Nation* court decisions. They are based on the outdated policies of the provincial government from 1998.

Consequently, the Ash River consultation committee process has been inherently deficient with respect to accommodation of Hupacasath interest, rights in and title to the Ash River watershed. There has been no accommodation of such interests, rights and title by way of compensation for losses or the sharing of benefits resulting from future operations of the Ash River Hydroelectric facility. Such accommodation was precluded, as was redress for rights and title infringements flowing from the initial construction and passed operations of the facility (see page 1-1 of the Final Draft Report).

When we entered into the WUP process, we had been advised by BC Hydro that we would establish a grievance process to address issues that would not be encompassed in the WUP. We started to establish a grievance process, but in October 2001, BC Hydro informed Hupacasath in a meeting specifically called to deal with the grievance procedure, that they would no longer participate in such a process. In good faith we remained in the Water use plan even though we had agreed to participate on the grounds that we would have a forum to deal with issues that would not be dealt with in the WUP. Hupacasath First Nation felt we had no alternative but to commence legal proceedings with respect to these issues and did so in January of 2002.

Recording Deficiencies in the Ash River Water Use Planning Consultation Process

Despite its inherent deficiencies, the Hupacasath participated in the Water Use Planning consultation committee process as a way to make the best of a flawed process that at least had the potential to result in mitigation of the impacts on Hupacasath aboriginal interests, rights and title flowing from the operation of the Ash River hydroelectric facility.

Hupacasath energy is not well spent at this time in further itemizing Hupacasath disagreement with Final Draft Report contents. In the end, it is the Hupacasath view that B.C. Hydro's conflicting interest, as water license holder with respect to the Ash River Hydroelectric facility, relative to Hupacasath aboriginal interests and rights in, and title to, the Ash River watershed is reflected in B.C. Hydro's drafting of the Final Draft Report.

Committee Recommendation as to Facility Operating Alternatives

Page 6-20 of the Draft Final Report states,

> The Hupacasath First Nation participated in the trade-off process to narrow down the operating alternatives to three acceptable alternatives that would take into account most of their aboriginal rights.

The reality is that the Hupacasath refused to say one option was the preferred option as they were making the best of a problematic situation. In the circumstances, there was no compensation or benefit sharing being offered to the Hupacasath as a trade off for favouring one of the three operating alternatives that each partially mitigated the impacts of the hydroelectric facility on Hupacasath rights. It is misleading to suggest that the Hupacasath accepted three operating alternatives on the basis that the alternatives fully took account their aboriginal rights.

More importantly, the Hupacasath equally accepted operating alternatives C, J and I2 on certain conditions (see pages 6-20 and 7-8 of the Final Draft Report). These conditions related to B.C. Hydro making funding available for archaeological and traditional use programs. Furthermore, the acceptance of alternatives C, J and I2 was premised on the conditional elimination of operating alternative K preferred by the Hupacasath (see 6-16 of the Draft Final Report). This elimination was on conditions including funding being made variously available for archaeological excavation above the Elsie Lake dams.

It is the Hupacasath view that B.C. Hydro has failed to meet the above mentioned conditions for the acceptance of operating alternatives C, J and I2 and the elimination of option K (see for example page O-3 of the Final Draft Report). This is compounded by the inherent deficiencies I have already discussed. Consequently, with this letter the Hupacasath First Nation declares that it Blocks operating alternatives C, J and I2 and fully Supports operating alternative K (see section 6.3 of the Final Draft Report).

For all these reasons, the Hupacasath do not sign off on the Final Draft Report as provided by Step 8 of the *Water Use Plan Guidelines*, p. 3.

Tseshaht Claim

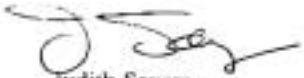
In our letter of January 19, 2003 we asked for the following change

"The Ash River hydroelectric facility is in the asserted traditional territory of the Hupacasath First Nation. The Tseshaht were invited to participate as their asserted territory includes the Somass River up to the Sproat River and impacts from the facility were a possibility."

You did not incorporate these changes in the final draft but suggested other wording. The court cases are very clear. You do not just accept a First Nation's claim on their say so in a newly claimed area. Tseshaht First Nation through all the years of the BCTC process has never claimed this area. Their documentation shows the end of their boundary not quite at Sproat Lake. Throughout the entire WUP process they never claimed this area. It is now unfair that you

> would include this in the Final Report unless you have taken the time to ask Tseshaht to provide documentation with respect to their newly expanded claim into an area they never claimed before. We therefore request that our original suggested wording be put in the final report.

Respectfully,



Judith Sayers

GLOSSARY

LIST OF ABBREVIATIONS

FTC	Fish Technical Subcommittee
WTC	Wildlife Technical Subcommittee
cm	centimetre
ha	hectares (area). 1 ha = 10 000 m^2
m^3/s	discharge or flow rate in cubic metres per second
M m^3	millions of cubic metres (volume)
m	metre