

EXECUTIVE SUMMARY

Water Use Planning was announced in 1998 to ensure provincial water management decisions reflect changing public values and environmental priorities. A Water Use Plan (WUP) is a technical document that, once reviewed by provincial and federal regulatory agencies and First Nations, and accepted by the provincial Comptroller of Water Rights, defines how water control facilities will be operated. The Water Use Plan is based on recommendations for a preferred operating strategy resulting from a public participatory water use planning process. The public process and recommendations for the Clowhom Water Use Plan are documented in this report.

Clowhom Hydroelectric Facility

The Clowhom hydroelectric facility was commissioned in 1958 and is located on the Sunshine Coast within the Sunshine Coast Regional District. The Clowhom Reservoir receives water from a 382 square kilometre (km²) drainage basin that is subject to large, short-term fluctuations in inflows. The watershed includes the Clowhom River, as well as a number of smaller streams entering the sides of the river and the reservoir. The Clowhom Reservoir inundates two existing lakes, which are impounded by a 21 metre high concrete gravity dam. The dam structure includes two gated spillways, usually operated by an auto-program that reduces the peak spill discharge by surcharging the reservoir during times of high inflows.

To generate power, water is passed through a penstock and turbine, which has a maximum capacity of approximately 100 cubic metres per second (m³/s). Currently, turbine discharge is limited to 82.18 m³/s by the existing Water Licence¹. The Clowhom generating station has a capacity of 33 megawatts (MW), with a typical output of 27 to 30 MW. The average energy production at the facility is 120 gigawatt-hours (GWh), which represents 0.25 per cent of the production of the entire BC Hydro system. Typically the facility runs around the clock during the summer snowmelt period and fall storms. During the remainder of the year it is operated as a peaking plant, running during heavy load hours only, to meet the demands of domestic load and to take advantage of market opportunities when the value of electricity increases.

The current Water Licence allows the storage of 81 million cubic metres (Mm³) for power generation, with a maximum elevation of 53.34 metres. The normal reservoir operating range is between elevations of 47 metres and 53.34 metres, which represents

¹ The Water Licence discharge limit constrains generation at most head levels; however, at reservoir elevations below 47 metres, the discharge is constrained by limits on the output of the generator to avoid damage to the equipment operating under (relatively) low head. For example, between 46 and 47 metres, the generator is limited to 25 megawatts (MW) or less, which corresponds to approximately 67 m³/s or less discharge. In general, more water is required to produce the same power output as the head decreases. For example, at 53 metres head (close to full pool), 70 m³/s produces 30 MW, whereas at 48 metres head, almost 80 m³/s is needed to produce the same 30 MW. At 53 metres, 100 m³/s generates about 40 MW, while at 48 metres, flow volumes of 100 m³/s will only produce approximately 36 MW.

approximately 47 Mm³ of storage. The reservoir receives inflows ranging from 0 to 600 m³/s per day, with an average of 37 m³/s per day. At low inflows, the reservoir contains about a week of generation potential if the plant is run continuously.

The Clowhom hydroelectric facilities are in the asserted traditional territory of Sechelt First Nation. Most of the land around Clowhom Reservoir is Crown owned. BC Hydro owns land in the area. Interfor, a forestry company, has a log boom area at the head of Salmon Inlet and maintains a road in the watershed, which includes a bridge over the dam spillway. A private fishing lodge is situated on Salmon Inlet south of the reservoir and BC Hydro's property. Two cabins on the north side of the reservoir have seasonal residential licenses of occupation granted by the B.C. Ministry of Water, Land and Air Protection.

Consultative Committee Process

The Clowhom water use planning process was announced in a news release on 9 September 2002 and was followed by a Public Open House on 23 September 2002. The Clowhom Water Use Plan Consultative Committee and its Fish and Wildlife Technical Subcommittee were formed next, with the first meeting of the Consultative Committee main table held on 24-25 September 2002.

The Committee consisted of Members and Observers. The key difference between them was that Members were entitled to participate in decision-making that would lead to final recommendations whereas the Observers' role was limited to providing input. The Fish and Wildlife Technical Subcommittee provided technical support for the Consultative Committee.

The Consultative Committee included representatives from:

- BC Hydro
- BC Ministry of Water, Lands and Air Protection
- Clowhom Lodge
- District of Sechelt
- Fisheries and Oceans Canada
- Interfor (Sechelt Division)
- Reservoir cabin owners
- Sechelt First Nation
- Sunshine Coast Regional District
- Sunshine Coast Rod and Gun Club.

The Consultative Committee held three two-day meetings between September 2002 and May 2003 to work through the steps outlined in the provincial *Water Use Plan Guidelines* (Province of British Columbia, 1998). The Fish and Wildlife Technical Subcommittee also met during that period to support the work of the Consultative Committee.

Issues and Objectives

The Consultative Committee explored issues and interests that could be affected by facility operations. Several studies were conducted to explore the issues put forward by the Consultative Committee. After careful assessment, 6 key issues with 18 associated objectives were pursued by the committee in the water use planning process (Table 1). A set of objectives was developed based on these issues in order to structure and guide decision-making. The Consultative Committee then established performance measures for all objectives (except Heritage and Culture, and Wildlife for reasons outlined in the paragraph below) in order to determine the degree to which each objective would be achieved by changes to the Clowhom facility's operations. Table 1 summarizes the main issues and the associated objectives.

Heritage and Culture, and Wildlife objectives were not directly included in the decision making process with performance measures due to a lack of data. However, general assumptions were used to help guide thinking about these objectives. In the case of Heritage and Culture, a working hypothesis was used that provided direction regarding the impacts of flooding or dewatering of archaeological sites. Contributions by the Sechelt First Nation member provided additional insight for the Consultative Committee. In the case of Wildlife, the Committee adopted the working hypothesis that changes in operational practices that lead to better reservoir conditions for fish also provide ancillary wildlife benefits.

Alternatives and Trade-offs

Operating alternatives were then developed to satisfy the various interests and objectives of the Consultative Committee members, and trade-offs between interests were made in an attempt to find the best balance. This was an iterative process, as the Consultative Committee evaluated alternatives and then developed new alternatives by refining, combining and modifying existing alternatives to better meet and balance competing objectives. In the later stages of the process, the Consultative Committee considered a final set of six alternatives. After thorough discussion of the trade-offs involved, they chose a single alternative by consensus.

Table 1: Summary of Issues and Objectives for the Clowhom Water Use Plan

Issue	Objective
Fish	<ul style="list-style-type: none"> Maximize littoral zone productivity. Minimize the number and frequency of spill events that may cause spillway entrainment.
Power Generation	<ul style="list-style-type: none"> Maximize the amount of energy generated at the facility. Maximize the revenue from energy production. Maximize the security of supply (capacity) to the lower Sunshine Coast. Maximize flexibility to meet system energy needs for domestic load or market (Available Firm Energy). Minimize the Greenhouse Gas (GHG) impacts of operations (by maximizing the amount of non-GHG energy generated at the facility).
Recreation	<ul style="list-style-type: none"> Maximize the number of days that the reservoir is sufficiently full to cover exposed tree stumps, and hence minimize boating hazards (safety). Maximize the number of days that the reservoir is sufficiently full to ensure safe operation and general utility of the Clowhom Lodge dock (safety and use). Maximize the number of days that the reservoir is sufficiently full to ensure easy boat passage through the BC Hydro debris booms, as well as access to docking sites in the lower Clowhom River (access and safety). Maximize the number of days that the reservoir is sufficiently full to give the impression that it is a natural lake ecosystem (aesthetics).
Spills	<ul style="list-style-type: none"> Minimize the magnitude and frequency of spill events that may cause bridge damage. Minimize the magnitude and frequency of spill events that may impact industry booming grounds.
Heritage and Culture	<ul style="list-style-type: none"> Protect heritage resources. Maintain access to known archaeological sites. Maintain and enhance opportunities for community resource use activities. Maintain and enhance opportunities for spiritual and ceremonial use.
Wildlife	<ul style="list-style-type: none"> Minimize impact on wetlands above the Clowhom Reservoir.

Consensus Operating Alternative

The Consultative Committee reached a consensus agreement on a preferred operating alternative. The specific recommendations of this agreement are described below.

- ***Reservoir Elevation Constraints:***

Maximum reservoir operating elevation: 53.34 metres.

Minimum reservoir operating elevation: 49 metres.

The minimum reservoir elevation is a constraint that will only be violated for: 1) special maintenance requiring deep drawdowns, 2) emergencies and 3) dam safety requirements.

The Comptroller of Water Rights and BC Hydro are to determine the compliance measurements to be used.

- ***Water Licence Instantaneous Diversion Limit:***

Increase current diversion licence limit of 82.18 m³/s to 100 m³/s.

- ***Annual Maintenance Drawdowns:***

The Consultative Committee identified a strong preference for drawdowns to occur in March, and for notification whenever annual maintenance drawdowns are scheduled outside the month of March.

- ***Special Maintenance Deep Drawdowns:***

The Consultative Committee recommended coordinating the timing of special maintenance drawdowns with annual maintenance drawdowns in March if possible to minimize impacts. Committee members also recommended notification of their organizations whenever these events are scheduled.

The Consultative Committee indicated that the Water Comptroller should monitor the timing and number of deep drawdowns (below 49 metres) requested by BC Hydro to ensure that they are an “infrequent” event.

- ***Notification Protocol:***

All organizations represented on the Clowhom Water Use Plan Consultative Committee and the Comptroller of Water Rights will be notified of: 1) all special maintenance deep drawdown events, and 2) drawdown events for annual maintenance when the event is scheduled to occur at any time other than March.

- ***Emergencies and Dam Safety:***

Emergencies and dam safety requirements take precedence over the operational constraints outlined in this Consultative Committee Report.

The anticipated impacts of implementing these recommended operating constraints are summarized in Table 2. Key uncertainties relating to expected impacts will be addressed through the recommended monitoring program developed by the Consultative Committee, as outlined in the next section.

Table 2: Anticipated Impacts from the Consultative Committee’s Recommended Operating Alternative Relative to Current Operations

	Change	Anticipated Impacts
Fish	Positive +	Average annual gains of 14 hectares (ha) of effective littoral zone (ELZ) could result in a more ecologically productive reservoir, increasing fish numbers and fish size.
	Negative –	An average additional 3 spill-days per year could result in additional loss of fish from the reservoir over the spillway from the current level.
Power	Positive +	An average annual increase of 2162 megawatt-hours (MWh) of energy generated at the facility per year.
	Positive +	An average annual increase of \$150,000 in average annual revenue from energy production (inclusive of revenue attributable to changes in Capacity).
	Positive +	An average annual gain of 5.1 megawatts (MW) in the security of supply (capacity) to the lower Sunshine Coast/Vancouver Island.
	Negative –	An average annual loss of 2066 megawatt-hours (MWh) of Available Firm Energy which means some loss in flexibility to meet system energy needs for domestic load or market demand.
	Positive +	An annual average of 662 tonnes of carbon dioxide equivalent (t CO ₂ e) of greenhouse gas emissions will be <i>avoided</i> owing to the change in operations at the Clowhom facility.
Recreation	Positive +	An average gain of 46 weighted recreational days per year. This improvement will reduce boating hazards, improve safe operation and general utility of the Clowhom Lodge dock, improve passage through the BC Hydro debris booms, improve access to docking sites in the lower Clowhom River (just upstream of the reservoir) and generally improve the reservoir aesthetics.
Spills	Positive +	On average over time, spills that could impact the bridge in the spillway (flows greater than 600 m ³ /s) will recur less often: every 4.6 years instead of every 3.4 years.
	Neutral ∅	No change in the frequency of spill events (flows greater than 200 m ³ /s) impacting industry booming grounds from the current operations. The current BC Hydro notification protocol will continue.

Monitoring Program

During the Clowhom water use planning process, the Consultative Committee chose a preferred operating alternative based in part on the available information concerning operational impacts on fish and wildlife, as well as culture and heritage. Limited information was available on these issues beyond the initial studies conducted as part of the process. As a result the Consultative Committee made assumptions in order to move ahead with recommendations. However, several potential monitoring studies were designed to address key uncertainties and answer specific questions that may affect future decisions about facility operations.

During their final meeting on 27 May 2003, the Consultative Committee evaluated these potential monitoring programs and agreed by consensus to recommend the *Clowhom Monitoring Plan*. This is a 20-year plan that includes the following programs.

- **Hunters/Fishers Log of Fish and Wildlife Observations:** These surveys would assist with monitoring fish and wildlife in the reservoir and surrounding area. This data, in conjunction with other survey data will help determine if predicted fish benefits/losses are being realized from changes in operations. This includes both wildlife logs and creel survey data.
- **Air Photography:** This survey would track changes in Clowhom Valley vegetation communities and allow analysis on possible impacts on these communities from changes in operations.
- **Bi-annual Fish Survey:** This is a low-level bi-annual fish survey to monitor fish in the reservoir using the same methodology as the Clowhom fish report to quantify relative changes in fish condition, abundance, and diversity.
- **Juvenile Habitat Use Survey:** This survey would determine where juvenile salmonids rear in the system and whether BC Hydro facility operations changes under this water use plan have a negative impact. It would also test the assumption that rearing is resilient to operational changes.
- **Low Level Littoral Productivity Survey:** This survey is designed to help validate the transferability of data related to effective littoral zone to the Clowhom reservoir from other BC Hydro monitoring programs and to monitor the littoral zone for changes in productivity under the new operations. This study would inform the consideration of impacts to fish populations of future operating alternatives.
- **Archaeology Survey:** This program includes on-going data collection and monitoring to fill some of the information gaps that exist related to Heritage Resources and the Clowhom Reservoir:
 - *Phase 1* will involve completing existing program and artifact recovery.
 - *Phase 2* will involve implementing Opportunistic Monitoring. When the reservoir is drawn down below elevation 49 metres inventory work and any necessary steps to protect heritage and cultural resources will occur, including cataloguing and removal if required to ensure the protection of artifacts. This is expected to occur three times during the 20-year monitoring period.

Table 3 provides an overview of the implementation schedule and cost for the Committee's recommended monitoring program. It should be noted that the Net Present Value (NPV) of the monitoring assumes a discount rate of eight per cent, and the Levelized Annual Cost (LAC) was calculated assuming an interest rate of eight per cent and a time horizon of 20 years. As demonstrated in the table below, most of the work will take place in the first five years of the plan (particularly in Year 1).

- A comprehensive evaluation report of the monitoring data is issued after 10 years.

The Consultative Committee also recommended that the implementation of operating changes and monitoring programs begin as soon as the Clowhom Water Use Plan has been reviewed by provincial and federal regulatory agencies and First Nations, and approved by the provincial Comptroller of Water Rights.

Conclusion

In summary, the Clowhom Water Use Plan Consultative Committee came to consensus agreement on a package of recommendations that is expected to achieve net¹ benefits (or be neutral) for all interests: Fish, Power Generation, Recreation, Spills, Heritage and Culture, and Wildlife.

The consultative process itself provided a forum for sharing information, promoting understanding of various affected interests and perspectives, exploring alternative ways to operate the facility, evaluating impacts in a structured way and making clear choices about trade-offs between interests using both technical/scientific information and participants' values.

¹ For some interests (e.g., fish and power), the Committee's recommended operating alternative is expected to have both positive and negative impacts on that interest. The use of the word "net" here is meant to indicate the Committee believed the overall impact of their package of recommendations would be positive.