

**The Columbia River and
Duncan Dam Water Use Plans:
A Comparison
of Past and Present
Commitments and Actions
SUMMARY**

Prepared on behalf of

Columbia
Basin **trust**

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NOTE TO READERS

**THIS SUMMARY REPORT REFLECTS
CURRENT DATA AND INFORMATION
AS OF MAY 2013**

BACKGROUND AND CONTEXT

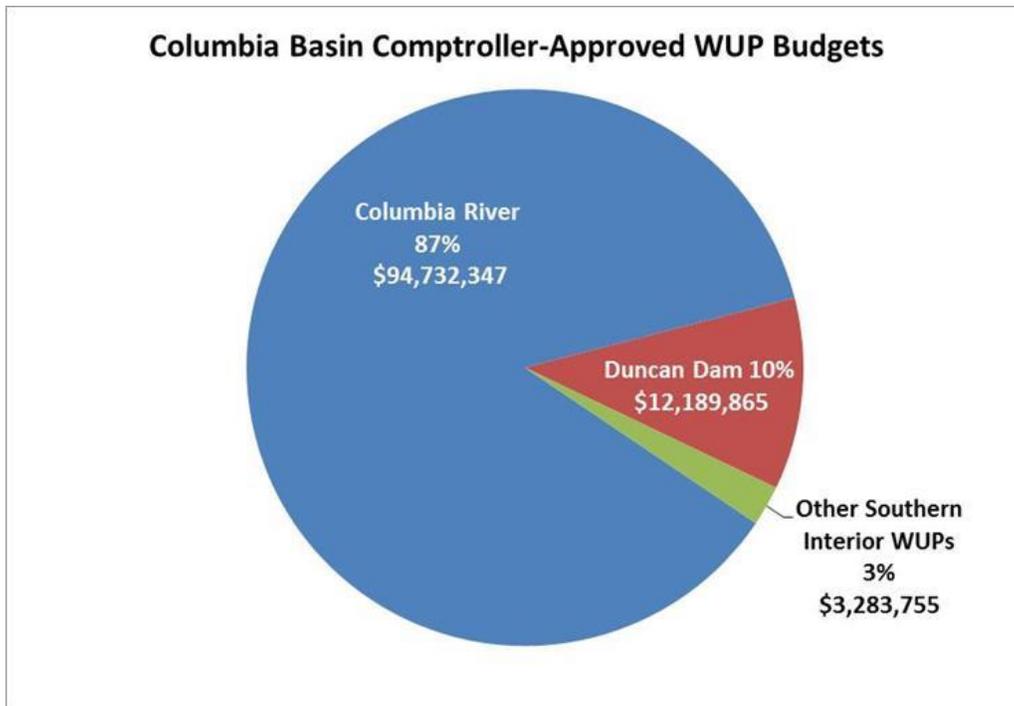
Community input received through the Columbia River Treaty (CRT) Review process in 2011 and 2012 indicated that Basin residents want more information about the implementation of the Columbia River and Duncan Dam Water User Plans (WUP).

This summary report provides an overview of the origin and process for Water Use Planning in BC, and reviews the implementation status of the Columbia River and Duncan Dam WUP projects to-date.

The Columbia River and Duncan Dam WUPs have the most significant impacts on Basin residents and account for more than 95 per cent of WUP expenditures in the Columbia River Basin (the Basin) and more than 80 per cent of the region's WUP projects and monitoring studies. There are six other WUPs in the Basin. They are not addressed in this report. See Table 2 for a list of Columbia Basin WUPs.

This document was prepared using publicly-available reference materials and information provided by BC Hydro, the Province of BC and Columbia Basin Trust. Input on this document was provided by BC Hydro and the Comptroller of Water Rights (CWR).

Figure 1: Currently Approved Budgets for Columbia Basin WUPs¹



¹ This graphic uses the most up-to-date information regarding total Comptroller of Water Rights-approved Terms of Reference expenditures; therefore it does not align with the total ToR Duncan Dam WUP costs found in Table 2.

WATER USE PLANNING OVERVIEW

ORIGINS OF WATER USE PLANS

The water use planning process in BC evolved from BC Hydro, the federal Department of Fisheries and Oceans (DFO), and the provincial government and their proactive approach to reviewing and balancing economic, social and environmental interests in water management at water-flow-regulating facilities such as hydroelectric dams. These parties, First Nations and stakeholders, were concerned about the impacts of water flows on a range of values such as fisheries, aquatic habitats, cultural sites and economic development. Additionally, the public was interested in understanding the impacts of hydroelectric dams and water flows on various values (i.e. recreation, wildlife, flood control and heritage values) and how these could be addressed in dam operations and water flow decisions.

WUPs attempt to identify options to achieve a more balanced operating regime while recognizing various objectives and respecting legal and regulatory scope constraints. WUPs focus on incremental changes to operations, but do not address historical impacts related to the building of dams and reservoirs. Due to the high value of power generation in some systems, operational changes are not considered feasible, and objectives are addressed through physical works and monitoring in lieu of operational changes. Physical works could include activities such as debris management, boat ramps, nutrient fertilization programs, weir construction, etc. Monitoring projects could include archeological site erosion, wildlife and riparian monitoring, etc.

Under the BC [Water Act](#), the CWR has the authority to issue water licences and orders. As part of water licensing procedures, hydroelectric power and water control facilities in BC can be required to undertake WUPs. The CWR designates which facilities must complete WUPs. Under the Provincial *Water Act*, BC Hydro was ordered to complete WUPs on their water licences: 23 WUPs for BC Hydro's 30 facilities spanning 27 BC watersheds. Once completed, WUPs are submitted to the CWR to review, approve and clarify licence rights through Orders under the *Water Act*. The WUP process is an approved approach for use by all owners and operators of water-flow-regulating facilities, although to-date, BC Hydro is the only licensee that has undertaken WUPS.

Eight WUPs have been completed in the Columbia Basin. See Table 2 for a list of Columbia Basin WUPs. No WUP was completed for Kootenay Lake because Libby Dam in Montana and its reservoir, the Kooconusa – which directly influence water flows and levels on Kootenay Lake – are not governed by a BC water licence. Through commercial agreements, BC Hydro manages water on the lower Kootenay River, but the hydroelectric facilities are not owned by BC Hydro and therefore were excluded from the WUPs.

There are fewer BC Hydro WUPs than facilities as some WUPs cover multiple facilities that operate cooperatively on the same river systems. For instance, the Columbia River WUP covers the operations of three facilities: Mica, Revelstoke and Hugh Keenleyside dams.

THE WATER USE PLANNING PROCESS

The Province of BC established the [Water Use Planning Guidelines](#) to outline the WUP process for licensees and inform stakeholders about participating in the process. The guidelines include structured decision-making, which is an organized approach to developing and evaluating alternatives using facts and values and making defensible choices.

Table 1: Water Use Planning Guidelines Process

BC's Water Use Planning Guidelines Process		
Step	Description	Generalized
1	Initiate a WUP process for the particular facility.	Initiation
2	Scope the water-use issues and interests.	
3	Determine the consultation process and initiate it.	Consultation
4	Confirm the issues and interests in terms of specific water-use objectives.	
5	Gather additional information on the impacts of water flows on each objective.	
6	Create operating alternatives for regulating water use to meet different interests.	
7	Assess the trade-offs between operating alternatives in terms of the objectives.	
8	Determine and document the areas of consensus and disagreement.	
9	Prepare a draft WUP and submit it to the CWR for regulatory review.	Review & Approve
10	Have the Province review the draft plan and issue a provincial decision.	
11	Review the authorized WUP and issue a federal decision.	
12	Monitor compliance with the authorized WUP.	Monitor & Review
13	Perform a periodic WUP review.	

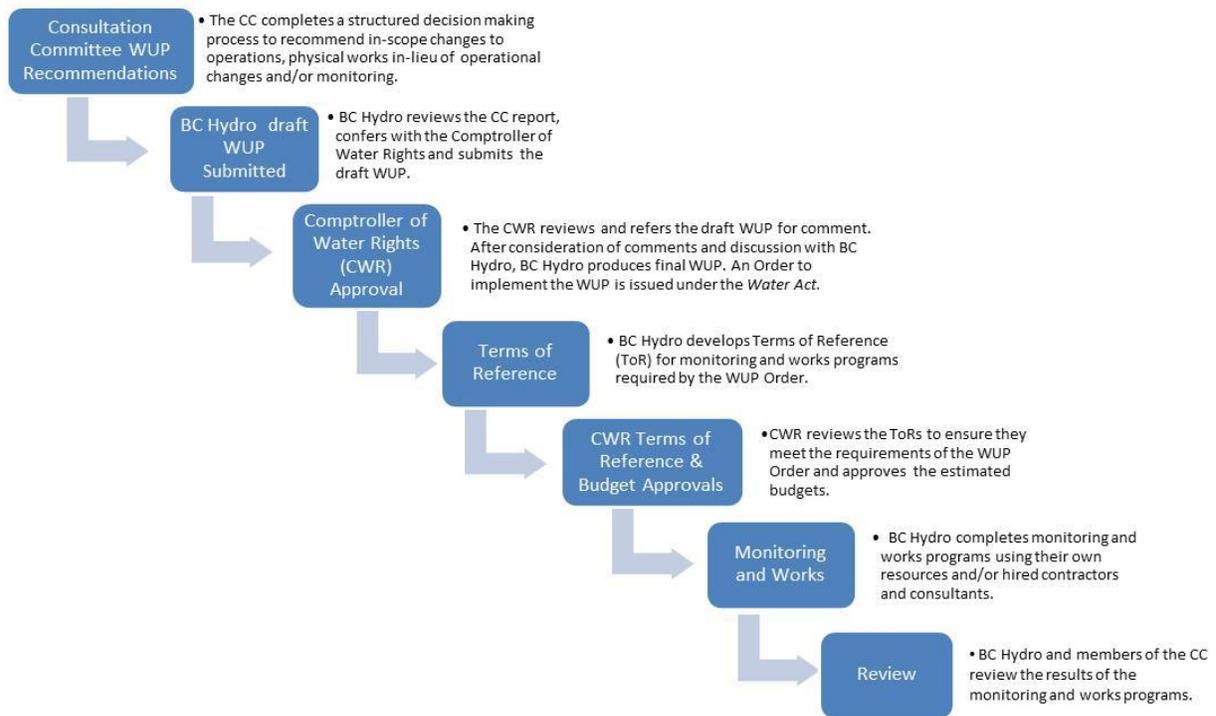
In addition to the guidelines' thirteen-step process, BC Hydro developed the following principles as a way to identify how they would undertake their WUP processes. These principles created an open process focused on achieving general consensus within the constraints of the WUPs.

- **Recognition of Multiple Objectives:** Recognizes a variety of cultural, economic, environmental, safety and social objectives.
- **Legal and Regulatory Constraints:** Does not alter existing legal and constitutional rights and responsibilities, or constrain future enactments.
- **Framework for WUP Discussions:** Offers flexibility to accommodate the needs of specific water control facilities and their impacts on water use, and include participants in the process.
- **Trade-offs Within Constraints:** Recognizes trade-offs among different water users and interests that can be characterized in monetary and non-monetary terms.
- **Inclusiveness of WUP Consultative Process:** Provides flexibility and the opportunity for interested parties to participate in meaningful ways.
- **Role of Information in the WUP Process:** Uses information to develop the WUP in a timely manner to support an examination of a full range of operating alternatives.

- **Review and Revision of WUPs:** Undertakes periodic reviews consistent with the nature of the issues and the degree of information uncertainty. Ongoing revisions are based on adaptive management practices and will be incorporated into the WUP documentation.

The goal of the consultation phase (Steps 3-8 above) is to provide an opportunity for interested parties to participate in plan development in a meaningful manner. The consultation phase of a WUP is advisory in nature in which the licensee (BC Hydro) and the CWR determine how best to include interested parties in a Consultative Committee (CC). The CC defines specific water use objectives and using performance measures for each objective, aids in defining a set of alternative operating regimes or projects to achieve the objectives. Discussions are structured to identify and explore a range of alternative operating regimes and to seek compromises across interests while remaining within regulatory and other boundaries. Consensus on operating alternatives and projects is a goal, but not a requirement of the WUP Consultation process. Figure 2 below outlines the WUP process.

Figure 2: Operational Overview WUP Process



WATER USE PLANNING IMPLEMENTATION AND FUNDING

The licensee (BC Hydro) must draft a Terms of Reference (ToR) and budget for all WUP monitoring studies and physical works projects. Once the projects are approved by the CWR, the licensee is obligated under the WUP Order to commence the project within the project’s scope and budget. The implementation work is undertaken directly by BC Hydro or by its hired contractors or consultants. The ToR for each monitoring study and physical works outlines timelines for initiation and completion. All of the Columbia River WUP’s monitoring and physical works are scheduled to be completed in 2019. The Duncan Dam WUP’s monitoring and physical works projects will be completed in 2018.

Funding to implement WUP projects is generally provided by the licensee (BC Hydro), although some projects are eligible for remissions, which are applied to the water rental fees that the licensee is required to pay the Province for use of publically-owned water. Remissions apply only where the effect of the WUP order reduces power benefits to the licensee in favour of non-power benefits. The Province committed up to \$50 million a year for all WUPs in BC in the form of remissions and BC Hydro committed the remaining funds. BC Hydro reports annually to the CWR on the progress and budgets of its WUP obligations and provides a public summary via [Annual Reports](#).

Table 2 below outlines the WUP budgets for all BC Hydro WUPs in the Columbia Basin. As previously noted, the table shows that the majority of WUP funds expended in the Columbia Basin are focused on the Columbia and Duncan WUPs.²

Table 2: Overview of Columbia Basin WUP Budgets and Projects

Columbia Basin WUPs	Approved ToR	Expenditure to Dec 31, 2012	Monitoring Plans	Physical works	Total # of WUP projects
Aberfeldie	\$717,348	\$495,592	5	1	6
Columbia	\$94,732,347	\$43,618,539	63	33	96
Duncan	\$12,189,865	\$5,159,910	17	3	20
Elko	\$145,778	\$144,825	3	-	3
Seven Mile	\$415,599	\$332,352	2	-	2
Spillimacheen	\$131,099	\$422,053	3	-	3
Walter Hardman	\$278,641	\$636,935	6	2	8
Whatshan	\$945,692	\$918,159	4	2	6
Total	\$108,691,319	\$51,728,365	103	41	144

ADAPTIVE MANAGEMENT

The Water Use Planning Guidelines emphasize the need for adaptive management practices to collect and analyze new information, and incorporate it into WUP reviews and revisions. Adaptive management enables changes to be made to WUP projects outside of the formal WUP review, resulting in more timely changes where required. The ToR for WUP projects can be updated as new information is gathered during implementation, increasing operational effectiveness and success of projects.

² BC Hydro cannot increase its costs to address issues outside of its mandate of flood control and power generation as any increased costs would affect ratepayers and taxpayers. Only the Province and/or the British Columbia Utilities Commission has the authority to direct BC Hydro to undertake any additional activities or costs beyond its mandate. Thus the WUP process was ordered by the Province as it would necessarily lead to increased activities and additional costs beyond BC Hydro’s core mandate.

WUP REVIEW

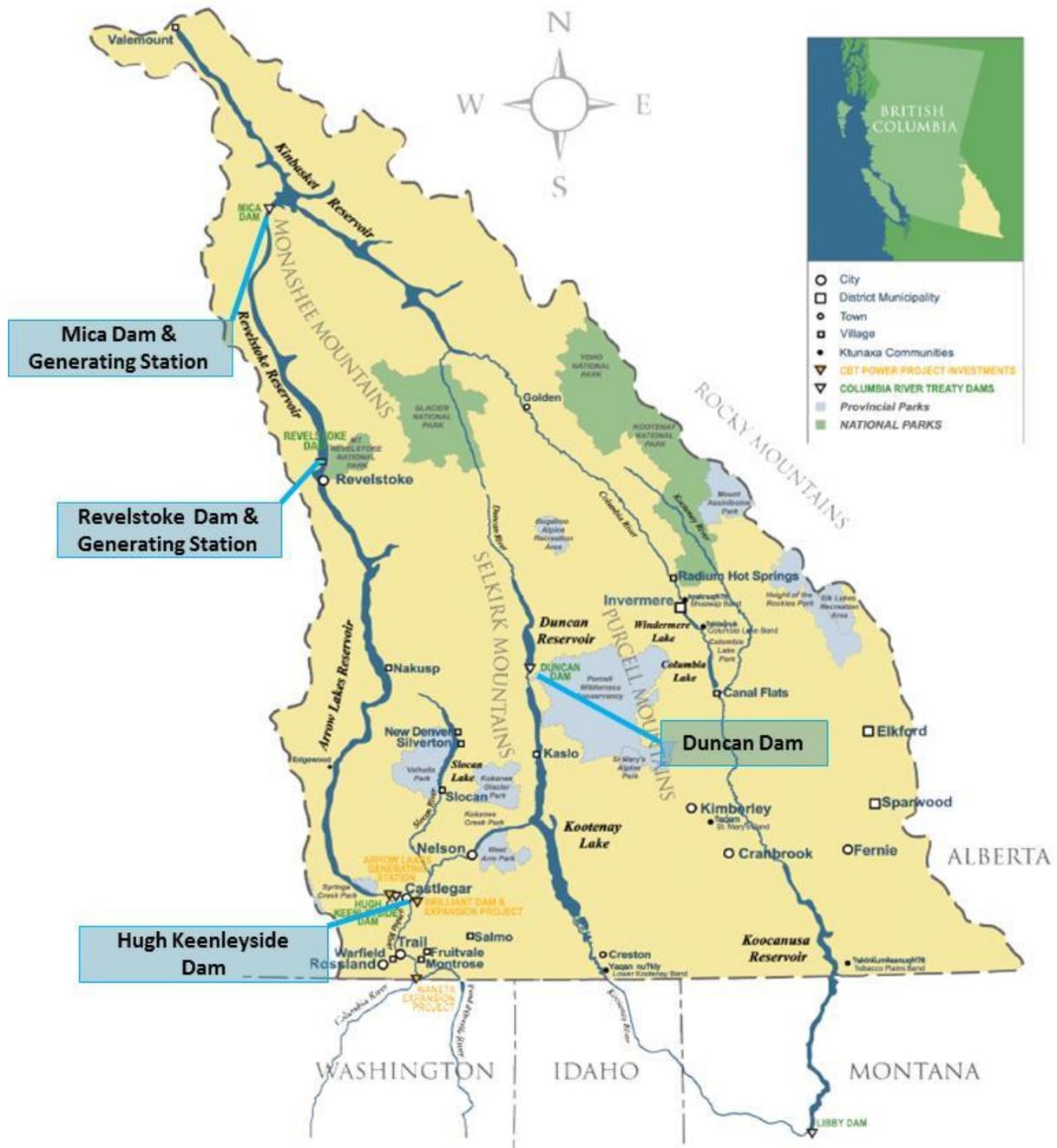
The WUPs recommend a scheduled review period and identify issues that could trigger early review of a facility and its water use impacts. The WUP review process is used to determine the effectiveness of the WUP operating regime and projects. BC Hydro reports annually on the progress and budgets of its WUP obligations and provides a summary via [Annual Reports](#).

A full review of the Columbia River WUP obligations is scheduled for 2021 - 13 years after implementation. A full review of the Duncan Dam WUP was recommended 10 years after implementation and a full review is scheduled for 2019.

An interim review of the Columbia River WUP is scheduled for April 2014. This focused on the results of monitoring studies to assess the effectiveness of the “soft constraints” on the Arrow Lakes Reservoir operations, physical works progress and collecting information to address data gaps (see below). The outcomes of this five-year review will be used to assess the potential need to review the Arrow Lakes Reservoir Operations component of the WUP. An earlier review of the WUPs could be triggered if significant risks are identified that could result in a recommendation to change operations.

FACILITIES IN COLUMBIA RIVER & DUNCAN DAM WUPS

Figure 3: Canadian Columbia Basin BC Hydro Facilities Included in the Columbia River and Duncan Dam WUPs



COLUMBIA RIVER WUP

The Columbia River WUP considers operations at three operating facilities: Mica, Revelstoke and Hugh Keenleyside dams. WUPs have some legal and regulatory constraints as they cannot alter existing legal and constitutional rights and responsibilities or constrain future enactments. The WUP Guidelines

identify the [Columbia River Treaty](#) (CRT) as one of the international agreements (Canada and the U.S.) to be taken into account when preparing WUPs. The CRT requires specific water flows across the U.S. border on a weekly basis; therefore the scope of operational changes in the Columbia River WUP was limited by the CRT. However, there is flexibility to implement operational changes if both Canada and the U.S. agree to the changes, and it is beneficial to both countries or if the sum of water releases at Duncan and Arrow are unchanged from the official CRT request and flood control is met at each facility. The Mica Dam/Kinbasket Reservoir and Hugh Keenleyside Dam/Arrow Lakes Reservoir resulted from the CRT, although Revelstoke was developed later as a result of the regulation improvements provided by the storage in Kinbasket Reservoir.

FACILITIES INCLUDED IN THE COLUMBIA RIVER WUP

MICA DAM/GENERATING STATION AND KINBASKET RESERVOIR

Mica Dam, an earth-filled dam was completed in 1973 and created Kinbasket Reservoir. It was built under the CRT and is the largest of the three CRT projects. The Mica Dam is located on the Columbia River about 138 km north of Revelstoke. The generating station has four units with 1,805 megawatts (MW) of capacity, which will increase by a further 1,000 MW following installation of the Mica 5 & 6 Generating Units (scheduled for completion in 2015). Kinbasket Reservoir can store up to 12 million acre feet of water and covers 21,000 square kilometres (km²). Water levels in the Kinbasket Reservoir normally fluctuate by 30 metres each year and it is licensed for fluctuations up to 47 metres.

REVELSTOKE DAM/GENERATING STATION AND REVELSTOKE RESERVOIR

Revelstoke Dam, an earth-fill wing and concrete gravity dam was completed in 1984 and created Revelstoke Reservoir. Revelstoke Dam is located on the Columbia River about 130 km downstream from Mica Dam and eight km north of the city of Revelstoke. With the 2010 addition of a fifth generating unit, the generating station has a generating capacity of 2,480 MW. Revelstoke Reservoir extends 130 km upstream to the tail waters of Mica Dam. The reservoir's normal maximum fluctuation is 4.5 metres. The regulated release of water from Mica Dam provides just over 70 per cent of the inflow into Revelstoke Reservoir.

HUGH KEENLEYSIDE DAM/ARROW LAKES GENERATING STATION AND ARROW LAKES RESERVOIR

Hugh Keenleyside Dam, an earth and concrete dam, was completed in 1968 and created the Arrow Lakes Reservoir. It is located on the Columbia River eight km upstream from the city of Castlegar. Hugh Keenleyside Dam was originally designed for water storage and did not produce hydroelectricity. Hugh Keenleyside dam created the 230 km-long Arrow Lakes Reservoir, which can store up to 7 million acre feet of water. The normal annual fluctuation in water levels in the Arrow Lakes Reservoir is about 12 metres and it is licensed for fluctuations up to 20 metres annually.

In 2002, the Arrow Lakes Generating Station was completed next to the Hugh Keenleyside Dam and it has a generating capacity of approximately 185 MW. The Arrow Lakes Generating Station is jointly owned and operated by Columbia Power Corporation (CPC) and Columbia Basin Trust (CBT). The

Columbia River WUP is not expected to affect operations at the Arrow Lakes Generating Station, but if WUP projects have impacts on other hydropower projects along the same river, the licensee is required to appropriately compensate for any adverse impacts resulting from WUP implementation.

COLUMBIA RIVER WUP

The consultation phase of the water-use planning process for BC Hydro's Columbia River project was initiated in August 2000 and completed in June 2004. In July 2005, BC Hydro, on behalf of the Consultative Committee (CC), completed the CC Report. The CC (39 active participating members) did not reach consensus on their report.

In July 2006, the draft Columbia River WUP was submitted to the CWR. The draft WUP was sent out to regulatory agencies, First Nations and interested stakeholders for review. In January 2007, the CWR approved the final [Columbia River WUP](#) and issued an Order to BC Hydro to implement the conditions proposed in the WUP and prepare ToRs for the monitoring and physical works projects. The CWR accepted most of the recommendations from the CC. However, there have been some cases where the CWR did not order the recommendations. The Columbia River WUP is intended to be implemented over a 13-year period.

Both the Revelstoke and Mica generating facilities were built with space for additional generation, which may be required to address peak energy demand. The Columbia River WUP was approved before generation was added, therefore BC Hydro undertook two additional Columbia River WUP consultation processes to account for the addition of Revelstoke 5 and Mica 5 & 6 generating units, which resulted in [addenda to the Columbia River WUP](#), which were approved by the CWR in August 2010.

The three operating facilities included in the Columbia River WUP are operated as an integrated system, thus it is difficult to clearly understand the operational impacts of each dam. As a result, a majority of the projects under the Columbia River WUP are focused on collecting information to determine impacts of operations. The Columbia River WUP recommended some operational changes, as well as monitoring and physical works projects (comprehensively addressed in Information and Management Plans).

COLUMBIA RIVER WUP OPERATIONAL CHANGES

The Province made a policy decision to limit operational changes in the Columbia River WUP as the value of power generation revenue from the Columbia River facilities was deemed higher priority than other values. The scope of operational changes in the Columbia River WUP was further limited because of the Columbia River Treaty and Non-Treaty Storage Agreement (NTSA). The CC did not recommend any operational constraints on Kinbasket Reservoir, Revelstoke Reservoir or Arrow Lakes Reservoir, but it did recommend two operational changes. The CC recommended a Revelstoke Minimum Flow requirement, and "soft constraints" on Arrow Lakes Reservoir.

Revelstoke Minimum Flow: A minimum flow of 142 m³/s (5 kcfs) was recommended to increase ecological productivity and juvenile fish use, increase adult fish abundance, condition and growth, and trigger rainbow trout spawning in the mid-Columbia River. To determine the benefits of a year-round minimum flow release to ecological productivity of the river, a baseline flow regime was established and monitored. Based on results, the Revelstoke Minimum Flow requirement has been implemented and monitoring will continue until the Columbia River WUP full review, scheduled for 2021.

Arrow Lakes Reservoir Soft Constraints: Due to the absence of a re-negotiated NTSA, the CC recognized that it wasn't possible for BC Hydro to unilaterally implement monthly constraints that were recommended for Arrow Lakes Reservoir under the proposed operating alternatives across all water years. Therefore, they developed "soft constraints," which are objectives for various interests (e.g. culture and heritage, erosion, fish, recreation, vegetation, wildlife, etc.) in addition to power and flood control to help guide operational decisions. It is recognized that the "soft constraints" have a number of conflicting objectives and the degree to which they are met depends on weather and runoff conditions, CRT and non-Treaty obligations and system requirements. Operational requirements and CRT obligations take precedence over these interests in every instance when no flexibility exists, although "soft constraints" are considered when BC Hydro establishes the Columbia system operational plans.

Where operational flows and reservoir filling can be altered to deliver on the "soft constraints," operations can maximize these identified interests. The degree to which an individual objective is met will vary by water year and the requirements of competing objectives. Significant monitoring plans are in place to review the implementation of the "soft constraints."

COLUMBIA RIVER WUP MANAGEMENT PLANS

In developing the Columbia River WUP, significant data gaps were recognized given the large geographic scope of the project, complexity of issues, time period for completion and funds allocated. As a result, some issues were not effectively addressed through the process. In order to ensure information would be available to inform future decision-making and WUP reviews, Information Plans and Management Plans were developed and reviewed by the CC.

- **Information Plans** were developed to address lack of data or need for further studies related to operational and non-operational physical works. The projects under Information Plans aim to collect information either to develop baseline impacts of current regulated water flows or to track the effects of implementing a new operational water flow regime (e.g. Kinbasket Reservoir Fish and Wildlife Information Plan).
- **Management Plans** were developed to address responsible and effective implementation and monitor the results of WUP projects (e.g. Mid-Columbia White Sturgeon Recovery Program).

Under each of these plans, there are often a series of monitoring and physical works projects. For example, under the Columbia River White Sturgeon Management Plan, there are 12 monitoring studies and six physical works projects.

COLUMBIA RIVER WUP IMPLEMENTATION

The tables below provide a summary of activities, costs and implementation status of WUP projects (including those under Management and Information Plans) with detail regarding delays and issues that have occurred. The WUPs were developed using adaptive management to account for realities that might result in delays and/or barriers to implementation. Enabling the adaptation of WUP project objectives and scope can more effectively achieve the overall WUP objectives.

Table 3 Total Columbia River WUP Costs and Projects (as of May 2013)

Projects	Total	Complete	Pending Conditional Studies or Assessments	Issue or Delay	In Progress	Expenditures		
						CC Estimate	Actual and Forecast Total	Variance
Monitoring Studies	63	3	1	4	55	\$32,862,000	\$66,092,698	\$33,230,698
Physical Works	33	8	6	2	17	\$22,710,000	\$27,845,270	\$5,135,207
Total	96	11	7	6	72	\$55,572,000	\$95,732,048	\$40,160,048

In addition to monitoring studies and physical works, \$124,604 was expended on reports and \$1,669,534 on sturgeon coordination. Sturgeon coordination includes the project management costs across all sturgeon studies.

A summary of the monitoring studies and physical works listed in Table 3 is provided in the tables below by reservoir area. The CC cost estimates noted in Table 3 were developed in 2004 and inflation was not factored into the budget, therefore accounting for inflation would increase the budget by approximately 17.6 per cent. Pending Conditional Studies or Assessments refers to projects that will only proceed if studies and/or the costs of the project are feasible or desirable, or projects that are triggered by events such as a spill.

Some of the WUP monitoring studies and physical works projects were recommended for multiple facilities, while others are specific to individual facilities. The information below outlines projects that apply to multiple facilities, and then details projects that are facility-specific.

KINBASKET AND ARROW LAKES RESERVOIR HERITAGE MANAGEMENT PLAN

This management plan aims to reduce the operational impacts to archeological sites in the Kinbasket, Arrow Lakes and Revelstoke reservoirs. This plan includes the development of a management strategy, inventories of known archeological sites, monitoring of operational impacts and intervention. BC Hydro and First Nations will use the information gathered to develop a strategy focused on locating undiscovered sites, mitigating risk of erosion due to reservoir operations and effectiveness-monitoring. The WUP CC Heritage Management Plan recommendations included significant costs for site remediation. These were not ordered by the CWR, as these activities were outside the authority of the *Water Act*.

Table 4 Kinbasket and Arrow Lakes Heritage Management Plan Costs and Projects

Projects	Total	Complete	Pending Conditional Studies or Assessment	Issue or Delay	In Progress	Expenditures		
						CC Estimate	Actual and Forecast Total	Variance
Monitoring Studies	3	-	-	-	3	\$286,000	\$587,557	\$301,557

KINBASKET AND ARROW LAKES RECREATION MANAGEMENT PLAN

The Kinbasket and Arrow Lakes Recreation Management Plan focuses on improving recreational opportunities in Kinbasket and Arrow Lakes reservoirs, as well as the lower Columbia River. The CC recognized that operational changes to address recreation were not cost-effective, therefore, they recommended implementation programs related to debris management and boat access improvements.

The CC supported boat access improvements conditional on the CWR approval that these improvements meet WUP criteria and feasibility studies for cost-effectiveness and impacts on other interests.

In order to develop ongoing debris management programs, a debris management committee was formed for Arrow Lakes Reservoir; two were formed for Kinbasket Reservoir (Golden and Valemout). The first five years of the debris management plan under the Columbia River WUP was completed in 2012. The committees reviewed the progress to-date and developed a debris strategy for the next five years. The CWR approved the proposed strategy for the next three years, at which time the strategy is to be reviewed again with the goal of achieving manageable levels of debris on both reservoirs by the end of the WUP implementation period.

Table 5 Kinbasket and Arrow Lakes Recreation Management Plan Costs and Projects

Projects	Total	Complete	Pending Conditional Studies or Assessments	Issue or Delay	In Progress	Expenditures		
						CC Estimate	Actual and Forecast Total	Variance
Monitoring Studies	1	-	-	-	1	n/a*	\$582,316	n/a*
Physical Works	22	5	5	1	11	n/a*	\$11,954,860**	n/a*
*The CC estimated ToR items cannot be sufficiently related to each other to establish meaningful comparison costs.								
**Several of the ToR for Boat Ramp Costs have not been finalized at this time so this table does not account for all potential costs.								

In addition to monitoring studies and physical works, \$47,328 was spent on reports.

Concern has been raised by Basin residents regarding slow progress on boat ramp construction to address recreational impacts from operations. Boat ramps enable residents to access reservoirs for recreation, therefore, boat ramps are a high priority and can address ongoing impacts of operations.

Of all the WUP-related project areas, boat ramp construction has required many changes to its ToR in order to adapt to operational realities. This is partially due to engineering issues, as well as higher than anticipated boat-ramp-related costs.

Delayed Projects:

Additional detail on the status (as of 2013) of Columbia River WUP boat ramp projects can be found in Appendix 1.

KINBASKET AND ARROW LAKES RESERVOIRS RE-VEGETATION MANAGEMENT PLAN

In lieu of maintaining lower reservoir elevations during growing season, the Columbia River WUP recommends re-vegetation programs in Kinbasket and Arrow Lakes reservoirs to maximize vegetation growth in the drawdown zones to benefit littoral productivity, large river habitat, wildlife habitat, shoreline erosion and archeological site protection.

Table 5 Kinbasket and Arrow Lakes Reservoirs Re-vegetation Management Plan Costs and Projects

Projects	Total	Complete	Pending Conditional Studies or Assessments	Issue or Delay	In Progress	Expenditures		
						CC Estimate	Actual and Forecast Total	Variance
Monitoring Studies	10	1	-	-	9	\$4,955,000	\$10,862,265	\$5,907,265
Physical Works	3	-	-	1	2	\$4,920,000	\$5,673,009	\$753,009

In addition to monitoring studies and physical works, \$18,280 was spent on Reports.

Delayed Project:

Kinbasket and Arrow Lakes reservoirs Re-vegetation Program Physical Works: Due to high water and surcharge conditions on Kinbasket Reservoir, planting for 2012 was deferred and the sedge seedlings were grown out to the next cell size for planting in a future year. The sedge seedlings will be planted either in Kinbasket or Arrow Lakes Reservoir in 2013 depending on which water elevation forecast presents the most favorable planting conditions.

Planting methods will be re-evaluated and alternative planting projects are being identified for the nursery stock seedlings that were grown in 2011 for 2012. If no alternate project can be identified, BC

Hydro will seek CWR approval for a smaller-scale planting program that may be employed in the Bush Arm.

COLUMBIA RIVER WHITE STURGEON MANAGEMENT PLAN

The WUP recommended a number of monitoring programs and physical works to support decision-making on water flows and future activities to rebuild white sturgeon populations in the Columbia River. The CC agreed that fish management in the Columbia River mainstem should focus on white sturgeon, as they are listed as an endangered species under Canada’s Species at Risk Act (SARA). The major concern to-date with respect to white sturgeon in the Columbia River is that the level of natural recruitment is insufficient to maintain self-sustaining populations.

Table 6 Columbia River White Sturgeon Management Plan Costs and Projects

Projects	Total	Complete	Pending Conditional Studies or Assessments	Issue or Delay	In Progress	Expenditures		
						CC Estimate	Actual and Forecast Total	Variance
Monitoring Studies	13	2	1	2	8	\$4,540,000	\$12,331,703	\$7,791,703
Physical Works	6	2	1	-	3	\$14,440,000	\$8,485,114	-\$5,954,886

In addition to monitoring studies and physical works, \$15,870 was spent on reports and \$1,669,534 was expended on sturgeon project coordination.

Physical works cost estimates were higher than actual ToR implementation costs, as the initial CC costs included total costs from all the potential sturgeon program options that could have been undertaken. Only some options were approved by the CWR, therefore, the ToR only represents the costs of the programs being undertaken, not the costs of all the potential options.

Delayed Projects:

Kinbasket Juvenile Sturgeon Detection and Habitat Use: This monitoring program is conditional and its implementation is contingent on the outcomes of a technical review in 2015. A decision was made at the Mid-Columbia White Sturgeon Management Plan mid-term review in 2012 to focus on questions related to sturgeon recovery in the Arrow Lakes Reservoir before conducting concurrent work in Kinbasket Reservoir.

Mid-Columbia River Spawning Habitat Assessment: The implementation of this two-year monitoring program was originally scheduled for 2009 and 2011, but was delayed until 2010 and 2012 to allow coordinated delivery with another project (see below) due to similarities in program design, data requirements and analyses. The activities are currently ongoing (as of May 2013).

Lower Columbia River Opportunistic Assessment of High-flow Events: The implementation of this two-year monitoring program was delayed until 2010 and 2012 to allow coordinated delivery with the Mid-

Columbia River Spawning Habitat Assessment project, noted above, due to similarities in program design, data requirements and analyses. The activities are currently ongoing (as of May 2013).

Lower Columbia Sturgeon Physical Works: This physical works project is presently on the conditional list as its implementation is contingent on the outcome of the related feasibility study. The results from the feasibility study (CLBWORKS-28 Lower Columbia River: Planning and Assessment of White Sturgeon Physical Works) will directly inform the development of the ToR for this study. The CWR will review and decide whether to approve the ToR for this project.

KINBASKET RESERVOIR FISH AND WILDLIFE INFORMATION MANAGEMENT PLAN

The CC was unable to recommend operational changes for Kinbasket Reservoir due to a lack of information about fish and wildlife populations, the ecosystems that support them and the effects of altered operations. The Kinbasket Reservoir Fish and Wildlife Information Plan includes several studies to better understand reservoir ecology and the influence of current operations on fish and reservoir productivity, fish stranding and the Valemount peat land.

Table 7 Kinbasket Reservoir Fish and Wildlife Information Plan Costs and Projects

Projects	Total	Complete	Pending Conditional Studies or Assessments	Issue/Delay	In Progress	Expenditures		
						CC Estimate	Actual and Forecast Total	Variance
Monitoring Studies	14	0	0	1	13	\$5,470,000	\$10,161,787	\$4,691,787

In addition to monitoring studies, \$10,022 was expended on reports.

Delayed Project:

Mica Dam Total Gas Pressure Monitoring and Abatement Program: This project experienced a one-year delay in 2011 and 2012 sampling due to installation work on Mica 5 & 6 generating units. The monitoring project is now on track and the delay should not impact the success of the program. A final report date has been set for December 31, 2013.

REVELSTOKE FLOW MANAGEMENT PLAN

The CC recommended a year-round minimum flow of 142 m3/s (5 kcfs) from Revelstoke Dam to support fish and fish habitat in the Mid-Columbia River. The plan includes a number of monitoring studies to help resolve data gaps, reduce technical uncertainties, and assess the effectiveness of the minimum flow to ecological productivity of the river. The plan is a 14-year adaptive management program and studies will monitor outcomes of the recommended operational changes, and will inform future operating decisions. The approach of the program is a “before/after” comparison to estimate the responses of key physical and biological variables to the minimum flow release.

Table 8 Revelstoke Flow Management Plan Costs and Projects

Projects	Total	Complete	Pending Conditional Studies or Assessments	Issue/Delay	In Progress	Expenditures		
						CC Estimate	Actual and Forecast Total	Variance
Monitoring Studies	5	-	-	1	4	\$4,090,000	\$8,446,007	\$4,356,007

In addition to monitoring studies, \$5,177 was expended on reports.

Delayed Project:

Mid-Columbia River Adult Fish Habitat Use: The study is scheduled to be carried out over six years with the first three years completed. The remainder of the program has been deferred to 2014 to be completed in 2016. View the [Year 3 Study](#).

ARROW LAKES RESERVOIR OPERATIONS MANAGEMENT PLAN

The CC developed “soft constraints” for the operation of Arrow Lakes Reservoir to benefit various interests. The degree to which an individual objective is met will vary by water year and the requirements of competing objectives. There are nine monitoring studies under this plan and the information gained from these studies will assist in assessing the effectiveness of implementing the “soft constraints.”

Table 9 Arrow Lakes Reservoir Operations Management Plan Costs and Projects

Projects	Total	Complete	Pending Conditional Studies or Assessments	Issue/Delay	In Progress	Expenditures		
						CC Estimate	Actual and Forecast Total	Variance
Monitoring Studies	9	-	-	-	9	\$5,486,000	\$12,937,945	\$7,451,945

In addition to monitoring studies, \$13,244 was spent on reports.

ARROW LAKES RESERVOIR WILDLIFE MANAGEMENT PLAN

This plan is aimed at improving wildlife habitat and helping mitigate the impacts of operations of the Arrow Lakes Reservoir. It includes feasibility and planning studies as part of the design and implementation of the physical works projects, and monitoring studies to assess the effectiveness of these works in providing benefits to wildlife, in particular nesting and migrating birds.

Table 10 Arrow Lakes Reservoir Wildlife Management Plan Costs and Projects

Projects	Total	Complete	Pending Conditional Studies or Assessments	Issue/Delay	In Progress	Expenditures		
						CC Estimate	Actual and Forecast Total	Variance
Physical Works	3	2	-	-	1	\$3,350,000	\$1,020,006	\$-2,329,994

In addition to physical works, \$4,889 was spent on reports.

LOWER COLUMBIA RIVER FISH MANAGEMENT PLAN

The CC recommended an adaptive management plan to address fish stranding impacts and protect spawning and rearing of mountain whitefish and rainbow trout populations in the lower Columbia River. The plan includes eight monitoring studies to assess the effectiveness of water flow decisions on fish populations.

Table 11 Lower Columbia River Fish Management Plan Costs and Projects

Projects	Total	Complete	Pending Conditional Studies or Assessments	Issue/Delay	In Progress	Expenditures		
						CC Estimate	Actual and Forecast Total	Variance
Monitoring Studies	8	-	-	-	8	\$8,035,000	\$10,183,118	\$2,148,118

In addition to monitoring studies, \$8,978 was spent on reports.

DUNCAN DAM WUP

The consultation portion of the Water Use Planning process for BC Hydro’s Duncan Dam facility was initiated in August 2001 and completed in April 2004. The CC (12 active participating members) reached conditional consensus. The CWR accepted the recommendations from the CC. In December 2007 the CWR approved the final [Duncan Dam WUP](#) and issued an Order to BC Hydro to implement the conditions proposed in the WUP and prepare the monitoring programs and physical works ToRs. The Duncan Dam WUP was intended to be implemented over a 10-year period.

The Duncan Dam WUP considered operations at Duncan Dam and Duncan Reservoir. Duncan Dam, along with the Mica and Hugh Keenleyside dams, was constructed under the CRT and is operated in accordance with CRT operating plans. WUPs have some legal and regulatory constraints, as they cannot alter existing legal and constitutional rights and responsibilities or constrain future enactments. The Water Use Plan Guidelines identify the [CRT](#) as one of the international agreements (Canada and the U.S.) to be taken into account when preparing WUPs.

DUNCAN DAM AND DUNCAN RESERVOIR

Duncan Dam, an earth-fill dam was completed in 1967 and created the Duncan Reservoir. It is located immediately upstream of the confluence of the Duncan and Lardeau rivers, approximately eight km upstream of Kootenay Lake and 42 km north of the Village of Kaslo. Duncan Dam controls 10 per cent of the inflow into the Kootenay River system. Duncan Dam does not generate power. It is a storage facility that provides downstream flood control and power benefits. Duncan Dam created the 45 km-long Duncan Reservoir, which can store 1.4 million acre feet of water. Water levels in the Duncan Reservoir fluctuate up to 30 metres annually.

Water discharged from Duncan Reservoir flows into Kootenay Lake. The water level and water management of Kootenay Lake was originally established by Corra Linn Dam, built in 1931. Corra Linn Dam raised the lake elevation by approximately two metres and is governed by an International Joint Commission (IJC) Order. FortisBC and Columbia Power Corporation hold the storage licences on Kootenay Lake. BC Hydro manages water on the lower Kootenay River, but the hydroelectric facilities are not owned by BC Hydro and therefore were excluded from the WUPs.

DUNCAN DAM WUP IMPLEMENTATION

The table below provides a summary of activities, costs and implementation status of Duncan Dam WUP projects including delays and issues that have occurred. The WUPs were developed using adaptive management to account for realities that might result in delays and/or barriers to implementation. Enabling the adaptation of WUP project objectives and scope can more effectively achieve the overall WUP objectives.

Table 12 Duncan Dam WUP Projects and Costs

Projects	Total	Complete	Pending Conditional Studies or Assessments	Issue or Delay	In Progress	Expenditures		
						CC Estimate	Actual and Forecast Total	Variance
Monitoring Studies	17	1	-	1	14	\$5,593,500	\$9,131,835	\$3,538,335
Physical Works	4	1	-	2	2	\$1,391,000	1,871,706	\$480,706
Total	21	2	-	3	16	\$6,984,500	\$11,003,541	\$4,019,041

In addition to monitoring studies and physical works, \$25,300 was spent on reports.

Delayed Projects:

Lower Duncan Dam Bull Trout Passage Monitoring: This project will determine effectiveness of the existing weir, which acts as a fish ladder for bull trout, and, if necessary, make recommendations for weir design and operations. Due to resource constraints on capital funding, work in 2011 was limited to

scoping and feasibility of structural design. Post-monitoring will recommence for three years in 2016 after the implementation of a new weir.

Argenta Slough Erosion Protection: The results of the 2010 [Argenta Slough Erosion Protection Assessment](#) (Assessment) were discussed in 2013 with the regulators (Department of Fisheries and Oceans, Canadian Wildlife Service, and Ministry of Forests, Lands and Natural Resource Operations). The regulators did not support proceeding with the physical works outlined in the Assessment due to excessive costs and the likelihood of significant environmental damage to the slough resulting from construction access to the bank. BC Hydro will recommence erosion monitoring in 2013 and evaluate alternatives.

Glacier Creek Boat Ramp: See Appendix 1: Columbia and Duncan Boat Ramp Projects Update.

SUMMARY FINDINGS ON THE COLUMBIA RIVER AND DUNCAN DAM WUPS

The Columbia River and Duncan Dam WUP consultation and approval processes, from initiation to final approval, took many years, and implementation and review are ongoing. The consultative process and approved recommendations represent the initiation of an enormous multi-generational undertaking.

This review has found that the Columbia River and Duncan Dam WUP processes in the Columbia Basin have, to a great extent, delivered on the WUP goals of balancing various water-use interests. However, very few of the projects outlined in the WUP ToR have been completed to-date, consistent with the approved plans. Therefore, little can be definitively reported about the effectiveness of the overall WUPs. Several projects have been completed, such as upgrading the Columbia River sturgeon hatchery, boat ramp feasibility, environmental review studies, and debris removal work.

The costs of implementing the recommendations have been much higher than anticipated, and will likely need to be considered during WUP reviews. A total of 80 monitoring studies and 37 physical work projects have been approved by the Province in the Columbia River and Duncan Dam WUPs, with almost \$95 million approved for the Columbia River WUP and approximately \$11 million for the Duncan Dam WUP projects. To-date, more than \$43 million has been spent on Columbia River WUP projects and \$5 million has been spent on Duncan Dam WUP projects.

As of May 2013, the Columbia River WUP, 11 per cent of projects are complete, 75 per cent are in progress, six per cent are delayed and seven per cent are pending. For the Duncan Dam WUP, ten per cent of projects are completed, 76 per cent are in progress and 14 per cent are delayed.

CONSULTATIVE COMMITTEE ALIGNMENT FINDINGS

Upon review of the original CC recommendations through to implementation, the majority of the CC recommendations have been implemented. The CWR accepted and approved well over 95 per cent of all recommendations from the CCs. However, there have been some cases where the CWR did not order the recommendations. For example, the Bulldog Creek boat ramp was not ordered as the community indicated work should be focused on Valemount Marina works. Additionally, much of the archeology site restoration was not ordered as these activities were outside the scope of the CWR's authority under the *Water Act*.

It is noted that in many cases the ToR for particular activities were altered from the original CC recommendations. These changes included changes to budget and scope of activities to address implementation issues faced in the field. As an indication of the magnitude of the change, approximately one-third of all initial ToR had to be revised and re-approved by the Water Comptroller.

As noted earlier, project scope and ToR changes were expected at the commencement of the WUP process. WUPs embed adaptive management practices to allow project refinement as new information becomes available. The continual revisions of ToR ensure the WUP obligations are delivered efficiently and effectively.

A detailed analysis of the CC recommendations and implementation of each recommendation to-date could occur during the full WUP review, which will evaluate the success and monitoring of the project activities.

IMPLEMENTATION FINDINGS

Implementation of each activity has proceeded at pace. Most activities seem to be on track to reach their stated objectives, although in some cases information is limited regarding the progress of each recommendation. There have been some delays in programs due to hydrological (high inflows) and operational issues, but these have been the exception and have been addressed through adaptive management practices. For example, the Kinbasket Reservoir Re-Vegetation project has been delayed due to poor growth and hydrology issues associated with high inflows and outages during Mica 5 & 6 installation. The Edgewood boat ramp has also faced a delay, due to issues associated with a final location for the boat ramp. In these types of cases, BC Hydro works with the CWR and the local community to identify an approach to enable the delivery on the WUP project(s).

Most of the ordered WUP activities are still in the early stages of implementation. In particular, the Columbia River WUP expenditures are largely focused on monitoring activities, with around 70 per cent of the 2011 Columbia WUP budget allocated to monitoring. These monitoring studies are primarily focused on addressing uncertainties during the WUP consultation project related to the potential impacts of operational changes.

ESTIMATED COSTS VERSUS ACTUAL IMPLEMENTATION COSTS

As discussed above, the actual cost of implementing the WUPs has been much greater than was originally estimated by each CC. These higher costs could result in a longer implementation timeframe and possibly a re-evaluation of trade-offs or changes to project scope to address high costs. Overall, a better understanding of the actual costs may raise questions regarding trade-offs and whether new cost information would result in the same assumptions made during the initial WUP process when the costs of those trade-offs were not well understood.

The estimated cost for the Duncan Dam WUP has been approximately \$5 million less than expected. In contrast, some projects in the Columbia River WUP have been up to 600 per cent higher than the original CC estimated cost.

CONCLUSION

Overall, the WUP process, from CC recommendations to current implementation of the WUPs, are mostly on-track, with the exception of the substantial increase in actual costs compared to estimated costs and boat ramp construction. Most of the CC recommendations have been adopted by the CWR. BC Hydro's implementation of the CWR orders related to WUP projects are also for the most part on track. Where projects are not progressing in a timely fashion, adaptive management approaches have been undertaken to refine and proceed with projects and activities. Only the costs associated with WUP implementation and boat ramp timelines have been far off initial estimates, and this has led in some part to a need to adjust the scope and timing of project implementation.

As to the overall effectiveness of the WUPs, the Duncan Dam and Columbia River WUPs are only halfway through implementation and much more information and review is still required before any definitive conclusions can be reached. The Arrow Lakes Reservoir "soft constraints" review in 2014, related to the effects of the "soft constraints," should provide some indication of effectiveness to-date.

This information was compiled by the CWR office at the Ministry of Forest Lands and Natural Resource Operations.

APPENDIX 1

Please note that these tables outline the status as of May 2013 for the approval/construction etc., for each ramp. As construction progresses and ramps move forward to design and approval, details may change. Further changes will occur on an ongoing basis as all ToR are submitted and approved by the CWR.

Arrow Lakes Reservoir Boat Ramp Obligations Update

Arrow Lakes Reservoir Boat Ramps	Clause M Requirement	CC Recommendation (2004)	2007 WUP Order Requirement	CWR Approval	Current Status (as of May 2013)
Fauquier	Yes, to Elevation 424.66 m	Yes, but no recommended elevation	Feasibility study	Yes, extend ramp to Elevation 419.5 m	Ramp constructed to El 423.5 m. If dewatering of ramp occurs during recreational window, BC Hydro will undertake additional work to ensure access to the reservoir is maintained.
Edgewood	Yes, to El 425.7 m	Yes, extend to El 423.7 m	Feasibility study	Yes, construct new ramp to 425.7 m; ramp to be extended to 423.7 m when reservoir conditions allow	Work to begin in 2013. ToR for extension of ramp to be submitted for approval by CWR in a year when appropriate reservoir conditions are forecasted.
McDonald Creek	Yes, to El 426.0 m	Yes, extend to El 434.9 m	Feasibility study	Yes, build and extend ramp to El 419.7 m	Ramp constructed to El 425.8 m. If dewatering of ramp occurs during recreational window, BC Hydro will undertake additional work to ensure access to the reservoir is maintained.
Burton	Yes, to El 431.0 m	Yes, construct new ramp to El 423.7 m	Feasibility study	Yes, construct new ramp to El 419.5 m	Ramp is currently constructed to El 433 m. BC Hydro expects extension to be completed in spring 2013.
Anderson Point	No	No	Feasibility study for up to two sites between Renata and Syringa Creek Park	Yes, construct new ramp at Anderson to El 425 m; may require extension to El 421 m in future	Construction underway if dewatering of ramp occurs during recreational window, BC Hydro will undertake additional work to ensure access to the reservoir is maintained.

Centennial Park	No	CC recommended ramp access in Revelstoke	Feasibility study	Construction costs and maintenance were approved March 3, 2008; subsequent work put in abeyance	The ramp is considered unsafe and there are no appropriate alternate sites nearby. Liability lies with the City of Revelstoke. BC Hydro proposes to deactivate the ramp if the city is not willing to fund and maintain it.
Shelter Bay	Yes, to El 423.7 m	No, this was a low priority ramp for the CC	No	BC Hydro to keep CWR apprised of ramp status	Ramp constructed by BC Hydro to El 423 m. Maintained by Provincial Park as per MOU. Ramp is in need of structural repair and ancillary upgrades.
Nakusp	Yes, to El 420.5 m	Yes, construct new ramp; but no recommended elevation	No	BC Hydro to keep CWR apprised of ramp status	Planned for construction to El 428 m in spring 2013. Extension of the ramp to 421.17 is planned for 2014.
Syringa Creek	Yes, to El 422.0 m	No	No	BC Hydro to keep CWR apprised of ramp status	Ramp constructed elevation to be confirmed by BC Hydro; maintenance ongoing.

Kinbasket Lake Reservoir Boat Ramp Obligations

Kinbasket Reservoir Boat Ramps	Clause M Requirement	CC Recommendation	2007 WUP Order Requirement	CWR Approval	Current Status (as of May 2013)
Bulldog Creek	No	Yes, construct ramp to El 723.9 m	Feasibility study	No, ramp was not determined to be feasible	n/a
Valemount	Yes	Yes, extend ramp to El 730.0 m	Feasibility study	Yes, extend to El 727.0 m	Ramp constructed to El 727.59 m; annual maintenance ongoing.
Nixon Creek	Yes	Yes, extend ramp to El 713.2 m	Feasibility study	Maintenance of existing ramp was approved	Ramp exists to El 713.2 m; BC Hydro to do annual maintenance to allow its use.
Bush Harbour	Yes	Yes, extend ramp to El 727.0 m	Feasibility study	Yes, extend ramp to El 724.0 m	Ramp constructed to El 730.0 m; scheduled for completion down to 724.6 m in 2013.

Sprague Bay	No	No	No	n/a	BC Hydro intends to maintain existing ramp.
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Revelstoke Reservoir Boat Ramp Obligations

Revelstoke Reservoir Boat Ramps	Clause M Requirement	CC Recommendation	2007 WUP Order Requirement	Approved by CWR	Current Status (as of May 2013)
Martha Creek	Yes	No	No	Approved under agreement of February 15, 1988	Ramp exists; clause (o) requires BC Hydro to maintain facility as needed to meet current standards.
Downie Creek	Yes	No	No	Approved under agreement of February 15, 1988	Ramp exists; clause (o) requires BC Hydro to maintain facility as needed to meet current standards.
Columbia View	Yes	No	No	Approved under agreement of February 15, 1988	Ramp exists; clause (o) requires BC Hydro to maintain facility as needed to meet current standards.
Mica	No	No	No	n/a	BC Hydro intends to maintain existing ramp mainly to allow access for dam maintenance.

Duncan Lake Reservoir Boat Ramp Obligations

Duncan Reservoir Boat Ramps	Clause M Requirement	CC Recommendation	2007 WUP Order Requirement	Approved by CWR	Current Status (as of May 2013)
Glacier Creek	Yes	Yes, extend ramp with funding cap of \$126,000; but no elevation recommended	Extend and maintain ramp	Yes, extend ramp; but no elevation recommended	Extension complete; elevation to be determined by BC Hydro; BC Hydro has MOU with the RDCK on maintenance.