

## **Duncan Dam Project Water Use Plan**

### **Monitoring Programs and Physical Works Annual Report: 2017**

#### **Implementation Period: April 2016 to March 2017**

- DDMMON-1 Lower Duncan River Ramping Rate Monitoring
- DDMMON-2 Lower Duncan River Habitat Use Monitoring
- DDMMON-3 Lower Duncan River Hydraulic Model Development
- DDMMON-4 Lower Duncan River Kokanee Spawning Monitoring
- DDMMON-5 Upper Duncan River Bull Trout Migration Monitoring
- DDMMON-6 Lower Duncan Dam Bull Trout Passage Monitoring
- DDMMON-7 Lower Duncan River Water Quality Monitoring
- DDMMON-8 Duncan Watershed Riparian and Cottonwood Monitoring
- DDMMON-9 Lower Duncan River Mosquito Monitoring and Management Plan Development
- DDMMON-10 Duncan Reservoir Fish Habitat Use Monitoring
- DDMMON-11 Duncan Reservoir Burbot Monitoring
- DDMMON-12 Duncan Reservoir Archaeological Overview Assessment
- DDMMON-13 Duncan Reservoir Archaeological Site Erosion Monitoring
- DDMMON-14 Duncan Wildlife Use Monitoring
- DDMMON-15 Lower Duncan River Stranding Protocol Development and Finalization
- DDMMON-16 Lower Duncan River Fish Stranding Impact Monitoring
- DDMMON-17 Duncan Reservoir Kokanee Stock Assessment
- DDMWORKS-1 Lower Duncan River Argenta Slough Erosion Protection
- DDMWORKS-2 Duncan Reservoir Glacier Creek Boat Ramp Extension
- DDMWORKS-3 Plan to Address Nutrient Retention Caused by Duncan Dam Operations
- DDMWORKS-4 Action Plan to Minimize Stranding of Kokanee Spawning in Lower Duncan River Sidechannels

#### **For Conditional Water Licence for Duncan Dam and Reservoir 27027**

**April 26, 2017**

## **BC Hydro Duncan Dam Project Water Use Plan Monitoring Programs and Physical Works Annual Report: 2017**

### **1 Introduction**

This document represents a summary of the status and the results of the Duncan Dam Water Use Plan (WUP) monitoring programs and physical works to March 31, 2017, as per the Duncan Dam Order under the *Water Act*, dated December 21, 2007, and Clause 1 Amendment dated June 20, 2016. There are seventeen monitoring programs and four physical works.

### **2 Status**

The following table outlines the dates that Terms of Reference (TOR) for the Duncan Dam WUP monitoring programs and physical works were submitted to and approved by the Comptroller of Water Rights (CWR).

**Table 2-1: Dates of Duncan Dam WUP TOR Submissions and Approvals by the Comptroller of Water Rights**

Monitoring Program & Physical Works TOR	Order Clause	Original ToR Submission		Most Recent ToR Resubmission	
		Date Submitted	Date Approved	Date Submitted	Date Approved
DDMMON-1 Lower Duncan River Ramping Rate Monitoring	Clause 5(e)	Apr 03, 2008	Apr 30, 2008		
DDMMON-2 Lower Duncan River Habitat Use Monitoring	Clause 5(e)	Aug 07, 2008	Sep 9,2008		
DDMMON-3 Lower Duncan River Hydraulic Model Development	Clause 5(e)	Apr 03, 2008	Apr 30, 2008	Mar 31, 2014	Jul 28, 2014
DDMMON-4 Lower Duncan River Kokanee Spawning Monitoring	Clause 6(a)	Apr 03, 2008	Apr 30, 2008	Dec 19, 2008	Mar 17, 2009
DDMMON-5 Upper Duncan River Bull Trout Migration Monitoring	Clause 6(b)	Jan 23, 2008	Mar 05, 2008	Feb 22, 2010	Mar 18, 2010
DDMMON-6 Lower Duncan Dam Bull Trout Passage Monitoring	Clause 6(b)	Jan 23, 2008	Mar 05, 2008		
DDMMON-7 Lower Duncan River Water Quality Monitoring	Clause 6(c)	Dec 16, 2008	Mar 11, 2009		
DDMMON-8 Duncan Riparian Monitoring	Clause 6(d)	Aug 07, 2008	Sep 09, 2008	Nov 01, 2012	Nov 15, 2012
DDMMON-9 Lower Duncan River Mosquito Monitoring and Management Plan Development	Clause 6(e)	Aug 07, 2008	Sep 09, 2008	May 13, 2013	Jun 13, 2013
DDMMON-10 Duncan Reservoir Fish Habitat Use Monitoring	Clause 6(f)	Dec 16, 2008	Mar 11, 2009		
DDMMON-11 Duncan Reservoir Burbot Monitoring	Clause 6(g)	Apr 03, 2008	Apr 30, 2008	May 01, 2013	May 29, 2013
DDMMON-12 Duncan Reservoir Archaeological Overview Assessment	Clause 5(f)	Dec 04, 2009	Feb 05, 2010		
DDMMON-13 Duncan Reservoir Archaeological Site Erosion Monitoring	Clause 5(g)	Dec 04, 2009	Apr 07, 2010		
DDMMON-14 Duncan Wildlife Use Monitoring	Clause 6(h)	Aug 07, 2008	Sep 09, 2008		
DDMMON-15 Lower Duncan River Stranding Protocol Development and Finalization	Clause 5(e)	Dec 16, 2008	Mar 11, 2009	Jul 30, 2009	Aug 31, 2009
DDMMON-16 Lower Duncan River Fish stranding impact monitoring	Clause 5(e)	Jul 23, 2008	Sep 08, 2008		
DDMMON-17 Duncan Reservoir Kokanee Stock Assessment	Clause 6(f)	Dec 04, 2009	Apr 08, 2010		
DDMWORKS-1 Argenta Slough Erosion Protection	Clause 5(a)	Jan 23, 2008	Mar 18, 2008	Jul 30, 2014	Aug 19, 2014
DDMWORKS-2 Glacier Creek Boat Ramp	Clause 5(b)	Jan 23, 2008	Mar 18, 2008		
DDMWORKS-3 Plan to Address Nutrient Retention Caused by Duncan Dam Operations	Clause 5(d)	Jan 23, 2008	Mar 18, 2008		
DDMWORKS-4 Action Plan to Minimize Stranding of Kokanee Spawning in Lower Duncan River Sidechannels	Clause 5(c)	Dec 04, 2009	Apr 08, 2010	Dec 03, 2013	Jan 15, 2014

### 3 Schedule

The following table outlines the current schedule for the monitoring programs and physical works being delivered for the Duncan Dam WUP.

**Table 3-1: Monitoring Programs and Physical Works Schedule as of March 31, 2017**

Monitoring Programs	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
	WLR YR1	WLR YR2	WLR YR3	WLR YR4	WLR YR5	WLR YR6	WLR YR7	WLR YR8	WLR YR9	WLR YR10	WLR YR11 Final Review
DDMMON-1 Lower Duncan River Ramping Rate Monitoring	✓	✓								■	
DDMMON-2 Lower Duncan River Habitat Use Monitoring	✓	✓	✓	✓	✓F						
DDMMON-3 Lower Duncan River Hydraulic Model Development		✓	✓		✓					■	
DDMMON-4 Lower Duncan River Kokanee Spawning Monitoring	✓	✓	✓	✓	✓	✓	✓	✓	✓	■	
DDMMON-5 Upper Duncan River Bull Trout Migration Monitoring	✓	✓			✓	✓		✓		■	
DDMMON-6 Lower Duncan Dam Bull Trout Passage Monitoring	✓	✓	✓	x							
DDMMON-7 Lower Duncan River Water Quality Monitoring			✓	✓	✓F						
DDMMON-8 Duncan Riparian Monitoring		✓	✓		✓	✓	✓	✓	✓	■	■
DDMMON-9 Lower Duncan River Mosquito Monitoring and Management Plan Development		✓	✓	✓	✓		✓		✓		■
DDMMON-10 Duncan Reservoir Fish Habitat Use Monitoring		✓	✓	✓	✓		✓		✓		■
DDMMON-11 Duncan Reservoir Burbot Monitoring		✓	✓	✓			✓	✓	✓F		
DDMMON-12 Duncan Reservoir Archeological Overview Assessment			✓F								
DDMMON-13 Duncan Reservoir Archeological Site Erosion Monitoring				✓	✓	✓	✓	✓F			
DDMMON-14 Duncan Wildlife Use Monitoring		✓		✓			x			■	
DDMMON-15 Lower Duncan River Stranding Protocol Development and Finalization		✓	✓	✓	✓	✓	✓	✓	✓	■	■
DDMMON-16 Lower Duncan River Fish stranding impact monitoring	✓	✓	✓	✓	✓	✓	✓	✓	✓	■	
DDMMON-17 Duncan Reservoir Kokanee Stock Assessment									✓	■	■
<b>Physical Works</b>											
DDMWORKS-1 Argenta Slough Erosion Protection	✓	✓	x				x			■	
DDMWORKS-2 Glacier Creek Boat Ramp	x	✓									
DDMWORKS-3 Kootenay Lake Nutrient Loading Funding	✓	✓	✓	✓	✓	✓	✓	✓	✓	■	
DDMWORKS-4 Action Plan to minimize stranding of kokanee stranding in Lower Duncan River Sidechannels						✓	x	x	✓	■	

Legend:

- = Program to be undertaken/initiated in identified year
- u/w = Program is underway
- ✓ = Program completed for the year
- = Pending
- x = Program started, but encountered operational or hydrological delays
- ✓F = All field work for this project is complete. No further field work is planned.
- PCR = Project Completion Report submitted

## **4 Monitoring Programs and Physical Works Terms of Reference**

The monitoring programs and physical works being implemented under the Duncan Dam WUP are described in Terms of Reference. These Terms of Reference and the reports for work completed to date can be found here:

[http://www.bchydro.com/about/sustainability/conservation/water\\_use\\_planning/southern\\_interior/duncan\\_dam.html](http://www.bchydro.com/about/sustainability/conservation/water_use_planning/southern_interior/duncan_dam.html)

## **5 Status of Monitoring Programs**

### **5.1 DDMMON-1 Lower Duncan River Ramping Rate Monitoring**

The 2012 Annual Report provided a detailed summary of the work that is summarized below for completeness of this Annual Report.

Several ramping experiments were conducted in 2009 to support Clause 5e of the Order which requires the development of an adaptive protocol to minimize stranding of fish in the Lower Duncan River. In a subsequent stakeholder meeting, stakeholders agreed that ramping experiments were not the most effective way of answering the management questions. In lieu of ramping experiments, the stranding assessments in DDMMON-16 were modified as follows: day time flow reductions (to minimize night time stranding), a flow reduction rate of 10 cm/hr or less, and multiple smaller increment flow reductions.

BC Hydro will conduct a gap analysis in 2017 to ensure the management questions from DDMMON-1 were addressed through DDMMON-16 methods.

### **5.2 DDMMON-2 Lower Duncan River Habitat Use Monitoring**

This monitoring project was initiated in 2008 and completed in 2012. The objective of this monitoring project was to assess fish habitat use and life histories of Rainbow Trout, Mountain Whitefish, and Burbot within the Lower Duncan River mainstem and sidechannels.

### **5.3 DDMMON-3 Lower Duncan River Hydraulic Development**

This monitoring program was initiated in 2009. The objective of this monitoring program is to provide a comprehensive model of hydraulic and fish habitat values for the Lower Duncan River floodplain for the normal range of flow conditions affected by Duncan Dam operations.

This program includes a two-year development stage at the start of the review period, with model updates scheduled for Years 5 and 10 of the review period. The 2012 Annual Report provides an accurate summary of the project for the first two years of implementation.

The Year 5 (October 2013) model update captured changing conditions in the river; incorporated advancements in the hydraulic model; and reinforced the potential links between other monitoring programs in the Duncan Dam Project WUP.

The next update to the hydraulic model will occur in 2017.

#### **5.4 DDMMON-4 Lower Duncan River Kokanee Spawning Monitoring**

This monitoring program was initiated in 2008 and will be carried out every year over ten years.

Attached is the report for Year 7 (2014) dated September 2016, and Year 8 (2015) dated October 2016.

Similar to 2013, BC Hydro modified Duncan operations in two ways in 2016 to minimize dewatered redds. First, the fall reduction in Duncan Dam discharge occurred approximately six days earlier than normal in an attempt to avoid dewatering of redds deposited by early spawners. The second modification was to increase minimum flows through the kokanee spawning period from 73 cms to 100 cms. Observations and data from this trial flow are collected through this study and then utilized in DDMWORKS-4 Action Plan to Minimize Stranding of Kokanee Spawning in Lower Duncan River Sidechannels.

This program monitored spawning kokanee from September 14 to October 19, 2016. Peak spawning was estimated to have occurred on October 3, 2016.

The report for Year 9 (2016) is in draft and will be submitted with next year's annual report.

#### **5.5 DDMMON-5 Upper Duncan River Bull Trout Migration Monitoring**

This monitoring program was initiated in 2008 and will be carried out periodically over ten years. The objective of the monitoring program is to determine the effectiveness of the adult bull trout transfer program at Duncan Dam for contributing to Kootenay Reservoir and/or Duncan Reservoir bull trout recruitment.

Implementation occurred in 2015, and the study will implement again in 2017. The first two years of the study included intensive reservoir and tributary sampling, as there was very little existing information on fish species and habitat use within the reservoir. The study results suggest that the management questions regarding inter-basin recruitment of Bull Trout can be addressed using otolith microchemistry. However, additional samples and refinements will be required to reduce uncertainty in predicted natal origins.

Attached is the Year 5 report (2015) dated February 9, 2017.

#### **5.6 DDMMON-6 Lower Duncan Dam Bull Trout Passage Monitoring**

This monitoring program was initiated in 2008 for three years.

The operation of the bull trout transfer program at Duncan Dam May to September each year allows the migration of bull trout from the Lower Duncan River to spawning locations in the Upper Duncan River system (upstream of Duncan Dam). Fish passage at Duncan Dam is facilitated through the installation of a weir immediately downstream of the flip bucket of the Low Level Operating Gate. In 2012, it was

concluded that the existing weir was an effective system for ensuring bull trout passage through the dam.

The second objective of this study was to evaluate alternative passage methods. In 2011, redesign and automation of the weir was proposed primarily for operational flexibility and safety reasons. As implementation of the improvements to update the weir is outside of the scope of the Duncan Dam Project WUP, BC Hydro is proceeding with design phases of the project under the regular capital planning process. Construction would occur in 2018 at the earliest and post-monitoring would be part of the capital project's scope.

### **5.7 DDMMON-7 Lower Duncan River Water Quality Monitoring**

This monitoring program was initiated in 2010 and was completed in 2012.

The objective of this monitoring program is to determine if a relationship exists between water quality parameters (TGP levels and water temperature) and Duncan Dam operations and decide how each of the water quality parameters affect fish species downstream of Duncan Dam using the total gas pressure as a performance measure (there is no performance measure for water temperature).

### **5.8 DDMMON-8 Duncan Watershed Riparian and Cottonwood Monitoring**

This project has been divided into two discrete monitoring components based on their locations in the Duncan River watershed.

#### **5.8.1 DDMMON-8-1 Lower Duncan River Riparian Cottonwood Monitoring**

This monitoring program was initiated in 2009 and, with the exception of 2011, will be carried out every year over a ten year period. Attached is the report for Year 7 dated March 31, 2017.

The aim of the study is to provide site-specific data to guide the flow management regime and to improve the understanding of the relationships between flow regime, physical environmental conditions, and riparian vegetation.

Results to date suggest that cottonwood establishment and survival are linked to water inundation, river stage during the growing season, deposition and erosion, establishment elevation, and the growing-season weather. All of these factors, excluding weather, are influenced by river regulation. The past seven years of results show a strong trend suggesting that river flow regime does affect establishment and survival along the Lower Duncan River. Hypothesis testing will occur in 2018.

#### **5.8.2 DDMMON-8-2 Duncan Reservoir Riparian Monitoring**

This monitoring program was initiated in 2009, implemented in 2012 and 2015, and will next be carried out in 2018. The most recent DDMMON-8-2 report was included in last year's Duncan Annual Report.

This long-term monitoring program is being implemented to assess the effects of Alternative S73 through observation of riparian distribution and abundance and testing of hypotheses underlying the approach taken in the WUP.

A summary of 2015 results showed a significant decrease in vegetation cover by area and an increase in bare ground area. Weather may be an important factor but there were no two sampling years with similar spring weather. Future sampling may indicate the level of spring weather effects on vegetation communities, and especially annual plant communities. Hypotheses testing results in 2018 will define how much each factor tested contributes to the change in vegetation cover.

### **5.9 DDMMON-9 Lower Duncan River Mosquito Monitoring and Management Plan Development**

This monitoring program was initiated in 2009 and will be carried out periodically over ten years. The report for Year 6 (2016) is in draft and will be submitted with next year's annual report.

Some results to date include:

- Twenty-two species of mosquitoes have been observed throughout the spring and summer period in the lower Duncan River floodplain. Two species are defined as nuisance mosquitoes that emerge in large numbers and are aggressive human biters.
- Initial Duncan Floodplain flooding during the spring (largely driven by unregulated inflows) represents the largest opportunity for nuisance mosquito production, and reflooding later in the summer (largely driven by regulated discharges from Duncan Dam) can increase production, depending on the difference between summer and spring peak river flows (regulated + unregulated).
- Different vegetation support different levels of nuisance mosquito breeding; regulation of summer flows can influence the flooding of key vegetation types like grasslands. Other factors outside of BC Hydro control, such as precipitation and warmer temperatures, will increase the productivity of nuisance mosquito populations in any given period of the spring and summer.

### **5.10 DDMMON-10 Duncan Reservoir Fish Habitat Use Monitoring**

This monitoring program was initiated in 2009 and will be carried out periodically over ten years. Implementation occurred in 2016 and reporting is in progress. Implementation will resume in 2018.

The objective of the monitoring program is to monitor habitat use of reservoir fish species of interest (rainbow trout, kokanee, bull trout and burbot), reservoir water quality variables, and spawning timing data on a seasonal basis.

In 2010, rainbow trout were considered to have been adequately addressed and were dropped from the monitoring program. This was based on the lack of available habitat, low water temperatures, and limited rainbow trout presence. It was determined that it was unlikely that Duncan Lake and its tributaries supported large



numbers of rainbow trout prior to dam construction, and therefore rainbow trout are no longer considered a key species with respect to reservoir management.

In 2014, the program focused on spawning activities of kokanee and bull trout with the intention to provide a solid spawning escapement and location dataset for use in future programs. The results gained will be used as an index where reservoir operation impacts can be investigated.

#### **5.11 DDMMON-11 Duncan Reservoir Burbot Monitoring**

This monitoring program was initiated in 2009. In 2013, after three years of attempting to monitor adult Burbot spawning with little success and to capture juvenile Burbot with no success, this program changed its methods from direct biological monitoring to a physical modelling approach.

This program mapped potential Burbot habitat and monitored temperature in the upper Duncan Reservoir drawdown zone. The Burbot habitat mapping and modelling occurred in August 2015 and associated temperature monitoring was completed in 2016.

Attached is the Year 5 (2015-2016) dated August 5, 2016; this is the final report for this study.

#### **5.12 DDMMON-12 Duncan Reservoir Archaeological Overview Assessment**

The key objective addressed by this monitoring program was to collect information on cultural resource potential or sensitivity within portions of the drawdown zone of the Duncan reservoir and, based on this research, identify cultural site locations suitable for long-term erosion monitoring under DDMMON-13.

This study was initiated in 2010 and was completed in 2011.

#### **5.13 DDMMON-13 Duncan Reservoir Archaeological Site Erosion Monitoring**

The purpose of this study was to monitor the rate of erosion at two archaeological sites on Duncan Reservoir. This study was initiated in 2011, carried out every year for five years, and concluded in 2015.

Based on the data collected over five years, it appears that the two archaeological sites are subject to both erosion and deposition, with erosion being the dominant process. Deposition appears to occur during years with relatively quiet or calm weather, while erosion appears to occur under stormy weather. The ground surfaces at both sites have, over the five years of monitoring, lowered in average elevation by approximately 1 cm. Artifacts observed within the monitoring areas have generally lowered, in keeping with this drop in the ground surface elevation, and shifted away laterally, from their original recorded location by typically less than 10 cm.

The information from this study will be used by BC Hydro's Reservoir Archaeology Program to assess the impacts of normal reservoir operations on these two archaeological sites and to better understand erosion within the Duncan drawdown

zone as a whole. The study information is also expected to assist future decision makers and the development of an Archaeological Management Plan.

#### **5.14 DDMMON-14 Duncan Wildlife Use Monitoring**

This monitoring program was initiated in 2009 and implemented in 2011. The 2014 field season was cancelled because, based on an external review of this study, the TOR needed to be revised.

The TOR is under external review by First Nations and regulatory agencies (Ministry of Forests, Lands and Natural Resource Operations, and Canadian Wildlife Services). We will submit the revised Terms of Reference for DDMMON-14 once we have received approval from all stakeholders.

#### **5.15 DDMMON-15 Lower Duncan River Stranding Protocol Development and Finalization**

This monitoring program was initiated in 2009 and will be carried out every year for ten years.

The regulatory agencies (Fisheries and Oceans Canada and the Ministry of Forests, Lands and Natural Resource Operations) will be updated in 2017 on any recommended changes to the Adaptive Stranding Protocol (ASP).

The Year 10 report is in progress and will be submitted in the 2018 annual report.

#### **5.16 DDMMON-16 Lower Duncan River Fish Stranding Impact Monitoring**

The objective of this monitoring program is to finalize a flow reduction protocol, including stranding response procedures (e.g., fish salvaging), flow reduction procedures at Duncan Dam, internal and external correspondence procedures, stranding assessment methodology, and reporting requirements.

This monitoring program was initiated in 2008 and will be carried out every year for ten years. Attached is the report for Year 7 (April 2014 to April 2015) dated January 5, 2017. The Year 8 report is in progress and will be submitted in the 2018 annual report.

#### **5.17 DDMMON-17 Duncan Reservoir Kokanee Stock Assessment**

The program will improve understanding of the effects of reservoir operation on kokanee populations, and will lead to a better understanding of the implications of entrainment on kokanee populations to assist in future decisions regarding the operation of Duncan Reservoir.

This monitoring program will be carried out every year for three years. The first year of study was completed in 2016. The data report will be included with next year's Annual Report.

## **6 Status of Physical Works**

### **6.1 DDMWORKS-1 Argenta Slough Erosion Protection**

The regulatory agencies (Fisheries and Oceans Canada and Ministry of Forests, Lands and Natural Resources) do not support proceeding with any proposed physical works to armour the eroding bend in Lower Duncan River. Regulators agreed to continue erosion monitoring and the creation of an ecological inventory of the areas of the slough that are threatened by a breach.

Attached is the Ecological Inventory dated January 17, 2017. Results of the Ecological Inventory will be presented to regulators in 2017.

### **6.2 DDMWORKS-2 Glacier Creek Boat Ramp Extension**

The ramp was completed in May 2009. The Regional District of Central Kootenay (RDCK) is maintaining the ramp. BC Hydro conducted an inspection of the ramp this past summer (2016). Minor recommendations to maintain breakwater will be communicated to the RDCK in accordance to BC Hydro's agreement with them.

### **6.3 DDMWORKS-3 Plan to Address Nutrient Retention Caused by Duncan Dam Operations**

Payments are made annually to the amount of 17.5% of the previous year's fertilization cost as per the letter of agreement between BC Hydro and the Fish and Wildlife Compensation Program (FWCP). In 2016, the payment was \$168,772.

### **6.4 DDMWORKS-4 Action Plan to Minimize Stranding of Kokanee Spawning in Lower Duncan River Sidechannels**

The regulatory agencies (Fisheries and Oceans Canada and Ministry of Forests, Lands and Natural Resources) rejected physical works given issues with logistics, annual maintenance and potential secondary effects on other resources in the area.

As an alternate method to mitigate kokanee stranding, an opportunistic alteration to the flow regime was realized from September 2013 to February 2014. The results from the 2013 DDMMON-4 report were inconclusive about the benefits from the experimental flows because of changes in methodology and difficulties in conducting field studies during the brief peak spawning period.

BC Hydro undertook another opportunistic alteration to the flow regime which occurred from September to October 2016. Observations and data were collected under DDMMON-4 and shared with DDMWORKS-4. The results of this modified operation will be shared with regulatory agencies and First Nations. Replication of the flow experiment if operations allow will be pursued in 2017. The report will be submitted with next year's Annual Report.

## **7 Monitoring Programs and Physical Works Costs**

The following table summarizes the Duncan Dam WUP monitoring programs and physical works costs approved by the CWR and the Actual Costs to March 31, 2017.

Table 7-1: Duncan Dam WUP Monitoring Programs and Physical Works Costs

Monitoring Programs	Costs approved by CWR	Life to Date Actuals (LTD)	Estimated to Complete (Forecast)	Total Forecast (LTD and Forecast)	Variance Total to Approved	Explanation	Corrective Action
<b>DDM Prepare Annual Report</b>	\$25,300	\$13,052	\$4,885	\$17,937	\$7,363		
<b>DDMM01A Ramping Rate</b>	\$247,883	\$125,967	\$6,055	\$132,022	\$115,861	Efficiencies found during project implementation.	
DDMM01A Ramping Rate - ONR DM	\$34,639	\$17,643	\$6,055	\$23,698	\$10,941		
DDMM01A Ramping Rate - ONR Imp	\$213,244	\$108,324		\$108,324	\$104,920		
<b>DDMM02A Low Duncan HabitatUse</b>	\$566,815	\$502,057		\$502,057	\$64,758	Project Complete - completion report outstanding.	
DDMM02A Low Duncan HabitatUse - ONR DM	\$84,707	\$40,585		\$40,585	\$44,122		
DDMM02A Low Duncan HabitatUse - ONR Imp	\$482,108	\$461,472		\$461,472	\$20,636		
<b>DDMM03A Low Duncan Hydraulic</b>	\$674,088	\$573,780	\$98,228	\$672,007	\$2,081		
DDMM03A Low Duncan Hydraulic - ONR DM	\$88,037	\$83,570	\$4,467	\$88,037	\$0		
DDMM03A Low Duncan Hydraulic - ONR Imp	\$586,051	\$490,210	\$93,761	\$583,971	\$2,080		
<b>DDMM04A Low Duncan Kokanee Sp</b>	\$1,462,700	\$927,908	\$146,953	\$1,074,861	\$387,839	Efficiencies found during project implementation.	
DDMM04A Low Duncan Kokanee Sp - ONR DM	\$148,850	\$69,766	\$12,243	\$82,010	\$66,840		
DDMM04A Low Duncan Kokanee Sp - ONR Imp	\$1,313,850	\$858,141	\$134,710	\$992,851	\$320,999		
<b>DDMM05A Up Duncan Bull Study</b>	\$436,738	\$320,174	\$86,597	\$406,770	\$29,968	Efficiencies found during project implementation.	
DDMM05A Up Duncan Bull Study - ONR DM	\$88,738	\$54,564	\$13,249	\$67,812	\$20,926		
DDMM05A Up Duncan Bull Study - ONR Imp	\$348,000	\$265,610	\$73,348	\$338,958	\$9,042		
<b>DDMM06A Low Duncan Bull Pass</b>	\$280,970	\$93,135		\$93,135	\$187,835	Project Complete - completion report outstanding.	
DDMM06A Low Duncan Bull Pass - ONR DM	\$78,970	\$27,205		\$27,205	\$51,765		
DDMM06A Low Duncan Bull Pass - ONR Imp	\$202,000	\$65,930		\$65,930	\$136,070		
<b>DDMM07A Low Duncan Water Qual</b>	\$154,827	\$106,203		\$106,203	\$48,624	Project Complete - completion report outstanding.	
DDMM07A Low Duncan Water Qual - ONR DM	\$43,003	\$22,166		\$22,166	\$20,837		
DDMM07A Low Duncan Water Qual - ONR Imp	\$111,824	\$84,037		\$84,037	\$27,787		
<b>DDMM08A Low Duncan Riparian</b>	\$1,457,738	\$902,011	\$555,726	\$1,457,737	\$1		
DDMM08A Low Duncan Riparian - ONR DM	\$192,758	\$103,069	\$89,688	\$192,757	\$1		
DDMM08A Low Duncan Riparian - ONR Imp	\$1,264,980	\$798,942	\$466,038	\$1,264,980	\$0		
<b>DDMM09A LDR Mosquito Mon</b>	\$730,574	\$548,308	\$182,265	\$730,573	\$1		
DDMM09A LDR Mosquito Mon - ONR DM	\$122,310	\$106,597	\$15,713	\$122,310	\$0		
DDMM09A LDR Mosquito Mon - ONR Imp	\$608,264	\$441,711	\$166,552	\$608,263	\$1		
<b>DDMM10A Res Seasonal Habitat</b>	\$791,362	\$652,193	\$87,408	\$739,600	\$51,762	Efficiencies found during project implementation.	
DDMM10A Res Seasonal Habitat - ONR DM	\$117,205	\$67,282	\$8,828	\$76,110	\$41,095		
DDMM10A Res Seasonal Habitat - ONR Imp	\$674,157	\$584,911	\$78,580	\$663,491	\$10,666		
<b>DDMM11A Duncan Burbot</b>	\$829,768	\$649,329		\$649,329	\$180,439	Project Complete - completion report outstanding.	
DDMM11A Duncan Burbot - ONR DM	\$173,632	\$61,190		\$61,190	\$112,442		
DDMM11A Duncan Burbot - ONR Imp	\$656,136	\$588,140		\$588,140	\$67,996		
<b>DDMM12A Duncan Arch Assess</b>	\$68,632	\$71,521		\$71,521	(\$2,889)	Project Complete - completion report outstanding.	
DDMM12A Duncan Arch Assess - ONR DM	\$21,870	\$26,992		\$26,992	(\$5,122)		
DDMM12A Duncan Arch Assess - ONR Imp	\$46,762	\$44,529		\$44,529	\$2,233		
<b>DDMM13A Duncan Arch Monitor</b>	\$306,185	\$245,646		\$245,646	\$60,539	Project Complete - completion report outstanding.	
DDMM13A Duncan Arch Monitor - ONR DM	\$79,579	\$66,740		\$66,740	\$12,839		
DDMM13A Duncan Arch Monitor - ONR Imp	\$226,606	\$178,906		\$178,906	\$47,700		
<b>DDMM14A DuncanResRiparianWLD</b>	\$450,955	\$246,488	\$201,873	\$448,361	\$2,594	Project halted as hypothesis testing was inappropriate and methods required revision.	Terms of Reference Submission pending.
DDMM14A DuncanResRiparianWLD - ONR DM	\$97,167	\$88,750	\$5,822	\$94,573	\$2,594		
DDMM14A DuncanResRiparianWLD - ONR Imp	\$353,788	\$157,738	\$196,050	\$353,788			
<b>DDMM15A LDR StrandingProtocol</b>	\$257,049	\$139,538	\$75,689	\$215,228	\$41,821	Efficiencies found during project implementation.	
DDMM15A LDR StrandingProtocol - ONR DM	\$71,421	\$36,990	\$16,570	\$53,560	\$17,861		
DDMM15A LDR StrandingProtocol - ONR Imp	\$185,628	\$102,548	\$59,119	\$161,667	\$23,961		
<b>DDMM16A LDR Stranding Assess</b>	\$1,002,995	\$768,841	\$198,939	\$967,780	\$35,215	Efficiencies found during project implementation.	
DDMM16A LDR Stranding Assess - ONR DM	\$144,330	\$55,657	\$29,279	\$84,935	\$59,395		
DDMM16A LDR Stranding Assess - ONR Imp	\$858,665	\$713,185	\$169,660	\$882,845	(\$24,180)		
<b>DDMM17A Duncan Res KoK Mon</b>	\$248,583	\$37,150	\$146,682	\$183,832	\$64,751	Efficiencies found during project implementation.	
DDMM17A Duncan Res KoK Mon - ONR DM	\$49,281	\$5,008	\$12,735	\$17,743	\$31,538		
DDMM17A Duncan Res KoK Mon - ONR Imp	\$199,302	\$32,142	\$133,947	\$166,089	\$33,213		
<b>DDMW01A Argenta Slough Eros</b>	\$270,861	\$194,919	\$75,491	\$270,410	\$451	Efficiencies found during project implementation.	
DDMW01A Argenta Slough Eros - ONR DM	\$47,561	\$48,358	\$5,209	\$53,566	(\$6,005)		
DDMW01A Argenta Slough Eros - ONR Imp	\$223,300	\$146,561	\$70,282	\$216,844	\$6,456		
<b>DDMW02A Glacier Creek Boat</b>	\$197,339	\$124,363		\$124,363	\$72,976	Project Complete - completion report outstanding.	
DDMW02A Glacier Creek Boat - ONR DM	\$71,139	\$37,787		\$37,787	\$33,352		
DDMW02A Glacier Creek Boat - ONR Imp	\$126,200	\$86,576		\$86,576	\$39,624		
<b>DDMW03A Plan Nutrient Reten</b>	\$1,496,979	\$1,223,294	\$145,700	\$1,368,994	\$127,985	Efficiencies found during project implementation.	
DDMW03A Plan Nutrient Reten - ONR DM	\$40,979	\$3,236		\$3,236	\$37,743		
DDMW03A Plan Nutrient Reten - ONR Imp	\$1,456,000	\$1,220,059	\$145,700	\$1,365,759	\$90,241		
<b>DDMW04A Action Plan Kokanee</b>	\$241,650	\$45,042	\$65,239	\$110,281	\$131,369	Efficiencies found during project implementation.	
DDMW04A Action Plan Kokanee - ONR DM	\$90,342	\$25,290	\$7,967	\$33,256	\$57,086		
DDMW04A Action Plan Kokanee - ONR Imp	\$151,308	\$19,753	\$57,272	\$77,025	\$74,283		

OR - Ordered Remissible  
ONR - Ordered Non-Remissible

\* Red values in parentheses denote overage.