Duncan Dam Project Water Use Plan
Monitoring Program Terms of Reference

- DDMMON-15 Lower Duncan River Protocol Development and Finalization

December 15, 2008
DUNCAN DAM
TERMS OF REFERENCE

1.0 OVERVIEW

This document presents Terms of Reference for monitoring program and physical works for the Duncan Dam Water Use Plan (Table 1). The monitoring programs will address key questions that affected decision making throughout the consultative process. They will assess expected outcomes of operational changes recommended in the Water Use Plan and will provide improved information for future operating decisions. The physical works programs will reduce ongoing erosion to a valuable wetland area, install a boat ramp, develop an action plan to minimize stranding of kokanee spawning in Duncan River side channels, and compensate for nutrient loss to Kootenay Lake.

This document provides detailed Terms of Reference for the following programs:

1) DDMMON-07 Lower Duncan River Water Quality Monitoring: A 2-year project with a 1-year contingency to collect temperature and total gas pressure concentration data in the Lower Duncan River and correlate changes in data with dam operations.

2) DDMMON-10 Duncan Reservoir Fish Habitat Use Monitoring: a multi-year program 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. The information collected in this program will be used in future water use planning processes to assess potential effects of operating alternatives.

3) DDMMON-15 Lower Duncan River Protocol Development and Finalization: a multi-year program to synthesize the results of the Adaptive Stranding Protocol and Development (ASDP) monitoring program studies (DDMMON#1, DDMMON#2, DDMMON#3 and DDMMON#16), identify data gaps as studies progress, provide the basis for recommending changes to the Lower Duncan River Stranding Protocol, and communicate to stakeholders at key decision points.

<table>
<thead>
<tr>
<th>Name of Monitoring Program or Physical Works</th>
<th>Order Clause Fulfilled</th>
<th>Submitted with this Package</th>
<th>Previously Submitted To CWR</th>
<th>Submission Date</th>
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<td>DDMMON-1 Lower Duncan River Ramping Rate Monitoring</td>
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### Name of Monitoring Program or Physical Works

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<td>DDMWORKS-3 Kootenay Lake Nutrient Loading Funding</td>
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15.0 DDMMON#15 – Lower Duncan River Stranding Protocol Development and Finalization

15.1 MONITORING PROGRAM RATIONALE

15.1.1 Background

Flow reductions on the lower Duncan River have occurred on an annual basis since the completion of the construction of the dam in 1967. Fish stranding on the lower Duncan River has also occurred from both natural flow variations (i.e., Lardeau River) and dam operations, however fish stranding resulting from flow changes, was raised as significant issue in 2002 by both fisheries agencies, the public and through the WUP process. Since 2002, several studies and programs have been implemented on the lower Duncan River to further understand the habitat utilization of fish and to further reduce the incidence of fish stranding as a result of operational changes from Duncan Dam.

Projects have included:

- the development of a Fish Stranding Corrective Action Plan (Higgins 2002);
- the completion of flow ramping assessments during the fall reduction period from 2004 to 2007 (Golder 2005, 2006, and 2007);
- assessments of several flow reduction events between 2002 and present (Table 15-1);
- an aerial assessment of the lower Duncan River to video tape potential stranding habitat;
- five seasonal assessments of fish habitat utilization to determine fish habitat presence by habitat type (AMEC, 2002, 2003a, 2003b, 2003c, 2003d);
- installation of a Data Collection Platform at the Water Survey of Canada Gauge Station (at Km 2.5 on the lower Duncan River, downstream of the confluence of the Lardeau River) for real time monitoring of downstream flows; and
- a fluvial geomorphological assessment of the lower Duncan River (Mike Miles and Associates 2002).

Based on the knowledge gained from the above mentioned lower Duncan River studies and the on going flow reduction management of the lower Columbia River system, "Strategy for Managing Fish Impacts Associated with Flow Reductions at Keenleyside Dam" (BC Hydro 2003), BC Hydro developed an interim strategy for managing flow reductions on the lower Duncan River entitled "Strategy for managing fish stranding impacts in the lower Duncan River Associated with Flow Reductions at Duncan Dam" (BC Hydro 2004). Since 2004, this strategy has been implemented for flow changes on the lower Duncan River. The protocol outlines, communication processes for flow reductions (both internal and external), specific flow reduction strategies (i.e. magnitude, timing, and duration of flow reductions), and monitoring/response assessment methods related to planned flow changes. The focus of the protocol, at the time of development, was to enable conservative flow change decisions in the absence of more comprehensive information, with the long term objective to develop flow reduction strategies (i.e., ramping rates, time of day) and or alternatively other mitigation efforts (if needed to minimize fish stranding).
On an annual basis there are approximately six flow reductions from Duncan Dam, that typically range from 1 to 4 kcf/s (daily maximum amount under the Columbia River Treaty). Stranding assessments are currently initiated when the planned flow reduction are >2 kcf/s and the conditions in the river are suitable to effectively conduct a stranding assessment. During the winter when ice formation and significant snow accumulations have occurred stranding assessment are rarely conducted. Since the initiation of the protocol, 23 stranding assessments have been conducted for operational flow changes on the lower Duncan River (Table 15-1). Of all the fish that were found isolated on the lower Duncan River between November 2002 and March 2006, sport fish represented 51% (Golder 2006). The dominant sport fish were Rainbow Trout (28.2%), Mountain Whitefish (13.6%), and Kokanee (8.2%), while non-sportfish represented the remaining 49% of the total, and included Longnose dace (23.4%), Slimy sculpin (9.5%), and sculpin species (9.4%).

Table 15-1: Summary of stranding assessments conducted on the lower Duncan River since 2002.

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of Stranding Assessments</th>
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<td>2002</td>
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<td>2008</td>
<td>4</td>
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<td>Total</td>
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In 2002, when fish stranding was recognized as a concern on the lower Duncan River, the Water Use Planning (WUP) process for Duncan Dam was also in the initial phases of the process. As a result, a key objective of the Duncan Dam Water Use Planning decision process was to maximize fish abundance and diversity in the Duncan River Watershed, and specifically reduce fish stranding risk and maximize habitat suitability in the lower Duncan River. Through the initial stages of the WUP process, several Duncan Dam flow management operations were modified or proposed for modification towards reaching these end objectives (Table 15-2) based life history timing, distribution timing, and habitat utilization knowledge and assumptions at the time.
Table 15-2: Duncan Dam Water Use Plan operating recommendations for lower Duncan River flows (as measured below the Lardeau River confluence).

<table>
<thead>
<tr>
<th>Annual Timing</th>
<th>Flow Target (Below Lardeau River confluence)</th>
<th>Rationale</th>
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<tr>
<td></td>
<td>Minimum</td>
<td>Maximum</td>
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</table>
| 1 August to 30 September | 73cms (a) 250cms (1 August)  
(b) 130 cms (30 September) | Instigate flow reduction to minimize kokanee spawning access to marginal habitats |
| 1 October to 21 October | 73cms                                       | 73cms Kokanee spawning flow                        |
| 22 October to 21 December | 73cms                                      | 110cms Whitefish spawning flow                     |
| 22 December to 9 April       | 73cms                                       | 250cms Ensure riparian productivity through reduced winter inundation |
| 10 April to 15 May          | 73cms                                       | 120cms Minimize stranding during Lardeau River freshet flows |
| 16 May to 31 July          | 73cms                                       | 400cms Control flooding on Duncan River           |

To confirm these assumptions and to conclude some of the uncertainties on how gate operations at Duncan Dam could best be managed; an adaptive management program was developed to be implemented over the WUP review period. This management program will include a group of monitoring studies and will be collectively referred to as the Adaptive Stranding Protocol Development (ASPD) program (Figure 15-1).

Figure 15-1: Overall structure of the Adaptive Stranding Protocol Development and the sources of information collection and interpretation.
This suite of monitoring programs will provide the rationale for the implementation of a final operating protocol for Duncan Dam release changes:

- DDMMON#1 – Lower Duncan River Ramping Rate Monitoring: experimental flow reductions during the fall period that assess the variables that affect the fish stranding risk;
- DDMMON#2 – Lower Duncan River Habitat Use Monitoring: identifying the timing and habitat use preferences of Duncan River fish populations;
- DDMMON#3 – Lower Duncan River Hydraulic Model Development: development of predictive tools to integrate habitat use with water flows at a range of operations to quantify operating impacts on habitat displacement; and
- DDMMON#16 – Lower Duncan River Fish Stranding Impact Monitoring: according to the methodology developed in DDMMON#15 (this document), conduct annual and opportunistic assessment of fish stranding risk and fish population response.

The objective for DDMMON#15 monitoring program of the Adaptive Stranding Protocol (this document) is to review and integrate the results from studies DDMMON#1, #2, #3, and #16, to further develop and finalize an operating strategy that minimizes the risk and incidence of fish stranding.

Completing this physical works program will result in partial fulfillment of requirements ordered by British Columbia’s Comptroller of Water Rights, and will specifically address clause 5(e) of BC Hydro’s Duncan Dam Conditional Water License 27027, to submit plans for adaptive stranding protocol to manage fish stranding in the Lower Duncan River.

15.1.2 Management Questions

This monitoring program is proposed to address the following management question:

*What are the best operating strategies at Duncan Dam to reduce the number of fish stranded on the lower Duncan River?*

This question will be answered through the individual monitoring studies within the Adaptive Stranding Protocol and the appropriate management questions have been extracted from the individual monitoring studies as outlined below.

**DDMMON#1: LDR Ramping Rate Monitoring**

1. What is the relationship between fish stranding risk and:
   - Rate of river stage/total stage change?
   - Time of day (day/night)?
   - Substrate?
   - Cover?
   - Species?
   - Time of year (Spring, Fall, Winter)?
   - Habitat stability (“wetted history”)?

2. What operations are available to mitigate stranding risk through operations or habitat change?
DDMMON#2: LDR Habitat Use Monitoring
1. What are the typical life history timing, frequency distribution and relevant environmental cues for fish species of interest using the Duncan River mainstem and sidechannels?
2. What are the habitats and habitat preferences associated with the majority of fish from each species life history period?
3. What operations (flow releases, timing, and gate operations) would optimize habitats and minimize impacts for species life histories investigated herein?

DDMMON#3: LDR Hydraulic Model Development
1. Did the physical flow model developed prior to the DDM WUP accurately predict floodplain inundation levels and extend in the LDR mainstem and sidechannel areas?
2. Were the habitat-flow relationships for fish species of interest incorporated into DDM WUP performance measures accurate for the range of operations licensed for the LDR?
3. Given the criteria for operating recommendations made during the DDM WUP, would a more extensive and validated modeling effort result in revised recommendations? Will future model revisions result in revised recommendations?

DDMMON#16: LDR Fish Stranding Impact Monitoring
1. How effective are the operating measures implemented in terms of reducing the number of fish stranded as part of the Adaptive Stranding Protocol Development program?
2. What are the levels of impact to resident fish populations associated with fish stranding events on the Lower Duncan River?

15.1.3 Management Hypothesis
As the adaptive stranding protocol and the associated studies (#1, #2, #3, and #16) are implemented, data will be collected and analysis will be conducted for the various studies. The knowledge gained from this analysis and reporting will be critical in determining the most appropriate methodology and protocols for the stranding protocol (DDMMON#15).

DDMMON#1: LDR Ramping Rate Monitoring
H01: The number of stranded fish is independent of ramping rate (fast vs. slow) during fall flow reductions.
H02: The number of stranded fish is independent of time of day (daytime vs. nighttime) during fall flow reductions.
H03: The number of stranded fish is independent of wetted history and therefore has no implications on the operations of DDM.
H04: Stranding risk is independent of cover.
H05: Stranding risk is indistinguishable between species utilizing the LDR habitats in September.

**DDMMON#2: LDR Habitat Use Monitoring**

H01: The life history timing and distribution timing of species of interest in the lower Duncan River does not differ significantly from those defined for the DDM WUP.

H02: The habitat uses of species life histories of interest in the lower Duncan River are not significantly different than those assumed for the DDM WUP.

H03: Usable habitats identified in this study do not significantly differ from those predicted in the hydraulic model developed for the DDM WUP.

H04: The hydraulic modeling conducted in DDMMON#3 accurately predicts habitat availability according to monitoring indicators in this study.

H05: Duncan Dam WUP provisions do not restrict burbot passage in the Lower Duncan River.

**DDMMON#3: LDR Hydraulic Model Development**

H01: The quantity and quality of fish habitat for the Lower Duncan River floodplain over the range of flows influenced by Duncan Dam operations predicted by the existing HEC-RAS model (2003) does not significantly differ from those predicted in a more comprehensive and updated 2-dimensional flow model.

H02: Areas of habitat use predicted by the updated 2-D flow model do not accurately reflect those observed in habitat use studies included in the DDM WUP monitoring program (i.e., DDMMON#2).

H03: The transient nature of the Lower Duncan River floodplain morphology does not significantly change the flow-habitat relationships that are predicted by the 2-D flow model.

H04: Fish stranding risk predicted by the 2-D model of the Lower Duncan River floodplain for operating scenarios evaluated and/or considered in the Adaptive Stranding Protocol Development plan provides a reasonable surrogate for empirical observations made prior to and during the DDM WUP monitoring review period (i.e., the two approaches do not differ).

**DDMMON#16: LDR Stranding Impact Monitoring**

H01: Fish stranding observed at index sites along the Lower Duncan River floodplain are representative of overall stranding.

H02: Fish populations in the Lower Duncan River are not significantly impacted by fish stranding events.

**15.1.4 Key Water Use Decision Affected**

A key operating decision affected by this monitoring program is to further develop the existing protocol (“Strategy for Managing Fish Stranding Impact in the Lower Duncan River Associated with Flow Reductions at Duncan Dam”) for flow reductions from Duncan Dam that effectively minimizes the incidence of fish stranding on the lower Duncan River.
The strategy defined in this monitoring program will be developed in consultation with BC Hydro and regulatory agencies for implementation either during the review period or following its conclusion.

15.2 MONITORING PROGRAM PROPOSAL

15.2.1 Objectives and Scope
The end 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. Only the timing and rate of changes to Duncan Dam flow releases are to be considered in the protocol (ramping rates): revisions to flow targets and prescriptions will be reviewed as part of any future water planning process.

15.2.2 Approach
This monitoring program will serve to coordinate and integrate the information collected in the Adaptive Stranding Protocol Development (ASPD) program studies, seek regulatory and stakeholder approval and communicate results on an annual basis. The following tasks are anticipated as part of this monitoring program:

- **Annual ASPD Review and Reporting (Years 2 to 11):** As knowledge is gained through DDMMON #1, #2, #3, #16 and from the concurrent Columbia River ramping and fish stranding monitoring studies, any information that will ultimately aid in reaching the end objective of reducing the number of fish stranded on the LDR will be captured in the annual review and reporting for consideration for protocol refinement, implementation and finalization in Years 4, 5 and 11 respectively.

- **ASPD Refinement and Implementation (Years 4 and 5):** a review of all studies completed to date will be conducted, towards adapting the ASPD to minimize fish stranding impacts where applicable to the protocol based on the knowledge and experience gained (i.e., ramping rate protocols, time of day, magnitude of reductions and habitat utilization) from the studies DDMMON#1, #2, #3, and #16.

- **Finalize Stranding Protocol (Year 11 – after the review period):** finalize the stranding protocol based on data and analyses of studies DDMMON#1, #2, #3, and #16.

15.2.3 Methods
As discussed in the Approach section, there is an expectation that this study will serve to ensure that all ASPD studies and activities are consistent with their study objectives. Furthermore, by the end of the review period, it is anticipated that all data requirements will be met and a final operating strategy for minimizing fish stranding impacts will be successfully developed and implemented. In addition to the tasks outlined below, it is the responsibility of this study program’s lead biologist that shortcomings of any ASDP study be communicated with BC Hydro and with respective study leads at the earliest possible point in the review period to ensure study objectives are met.
15.2.3.1 Annual ASPD Review and Reporting (Years 2 to 11)

In 2004, BC Hydro drafted the “Strategy for Managing Fish Stranding Impacts Associated with Flow Reductions at Duncan Dam” (the Strategy) with the approval of DFO and MOE representatives. The strategy outlined communication, operating and fish stranding response protocols to be implemented while the ASPD was being studied and defined.

Starting in Year 2 of the review period, the Strategy will be reviewed annually and recommendations consistent with both the approach of the ASPD and the results of studies completed to date (including those initiated prior to ASPD implementation) will be captured in an annual report. The recommendations will then be considered in comprehensive reviews in Years 4 and 5, resulting in potential updates to the Strategy’s protocols for operations and fish stranding response according to respective ASPD program study recommendations (see the next section).

Each annual report will be consistent in formatting and structure, will provide updates on the ASPD program status, will rationalize any recommendations with references to key information and will ensure that all information being provided is consistent with the objectives stated herein. It is therefore important that communication with leads from the ASPD program studies be maintained throughout the review period. Reviews of annual reports will be scheduled and finalized with representatives from BC Hydro, MOE and DFO. First Nations comments will also be solicited through a process to be defined at that time. Any operational changes will be integrated into Duncan Dam’s Local Operating Order.

As described in the following table, several studies will be underway when this program starts, but Years 3 and 4 in particular will be important towards refining the Strategy for implementation for the duration of the review period. This aspect of the ASPD is detailed in the next section.

Table 15-3: Summary of the timing of the WLR monitoring studies in the Adaptive Stranding Protocol Development for the Lower Duncan River.

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15.2.3.2 ASPD Refinement and Implementation (Years 4 and 5)

Two sub-tasks are to be completed in Years 4 and 5 to meet the objectives of the ASPD program:

- Literature review and ASPD program results summary; and
- ASPD Refinement and Implementation.

**Literature Review and ASPD Results Summary**

Since 2002, stranding assessments have been conducted annually following flow reductions on the lower Duncan River. From these assessments, knowledge has been gained regarding, identification of stranding sites, the incidence of stranding by species, risk periods, and habitat utilization on the lower Duncan River. During 2002 and 2003, additional information was collected on habitat utilization (AMEC 2003, 2004a, 2004b, 2005a, 2005b) and diurnal habitat use. The seasonal habitat use information also contributed to the development of the lower Duncan River Flow Ramping Assessment that has been conducted annually from 2004 to 2007 (Golder 2005, 2006, and 2007).

Table 15-4 is a summary of the studies that were completed prior to the implementation of the WUP monitoring studies that relate specifically to the Adaptive Management Stranding Protocol of the Lower Duncan River.

Table 15-4: Summary of studies conducted prior to the WUP monitoring studies that relate directly to the ASDP.

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<td>Experimental Flow Ramping Assessments</td>
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The lead biologist for the study program will conduct a review of grey and published literature, with specific attention to the results of studies associated with the Adaptive Stranding Protocol Development program, to address the following data gaps:

- Habitat mapping for the Lower Duncan River: areas of high fish habitat value and areas that have high fish stranding risk/potential will be identified for each fish species life history of interest, summarized according to species use, habitat characteristics and applicable flow range, and annotated on a map of the area;

- Recruitment bio-standards: for each species life history of interest, natural survival indices (e.g., parr to adult survival) will be researched and assigned with appropriate confidence intervals and caveats/considerations, with emphasis on local fisheries information and professional opinions; and

- Standing stock estimates: based on data collected in DDMMON#2 – Lower Duncan River Habitat Use Monitoring, and prior studies of stock abundance in the Lower Duncan River, identify sampling locations, historic species life history densities, and methodologies for annual stock assessment studies.

Suggested literature and data sources for the lower Duncan River will include but will not be limited to:

- Stranding assessment data (from 2002 to 2007) and DDMMON#16.
• Review of habitat utilization data and reports (2003 and 2005) and DDMMON#2.
• Review of flow ramping assessment data (2004 to 2007) and DDMMON#1.
• Review of the results from the lower Duncan River Hydraulic Model Development study (DDMMON#3).

The review will also include personal communications with each monitoring study’s lead biologist to ensure (a) that the recommendations are being summarized in the appropriate context, and (b) to communicate data gaps identified in the review, to ensure that they are addressed in future study. The budget also includes a provision for a two-day field visit to the Lower Duncan River in each of Years 4 and 5 to put into context the recommendations to be developed out of the literature review.

Each year’s report (Years 4 and 5) will also contain all study logistics information including:
• Data collection forms: forms will be developed for index stranding assessments, expanded stranding assessments and standing stock assessments;
• Methodology and schedule for sampling: any amendments to these terms of reference and site specific (in consideration of historic/WUP operations and local fish life history timing) task scheduling will be summarized in this report; and
• Contact and permitting information: a summary of all contacts related to the study including regulatory, contract, and subject matter experts.

The literature review in Year 4 will outline the data gaps to be identified in future years, and the Year 5 report will finalize the review for ASPD refinement and implementation.

**ASPD Refinement and Implementation**

Following the literature review in Year 5, the Strategy document will be refined to consider the following components:

• Flow reduction protocols (time of day, ramping rates, magnitude of reductions): in consultation with respective ASPD study leads and BC Hydro dam operators, all recommendations for revising the existing Duncan Dam operating protocols will be summarized to specify the time of day, flow threshold and time of year flow ramping requirements. All refinements will be consistent with all other aspects of Water Use Plan recommendations: where specific recommendations for flow targets are made, they may be considered at the end of the review period.

• Communication protocols (both internal and external): where appropriate and practical, the communication protocols outlined in the Strategy will be revised to suit both the applicability of the protocol and the regulatory requirements that are dictated. All changes will consider historic practice to ensure all relevant information is provided. The communication protocol will also include a reporting template that will clearly outline the performance measures to be updated for each stranding assessment, including a database (developed in DDMMON#16) of results to track ASPD performance by time of year, species and age class.

• Field sampling procedures (e.g., sequence of activities, data collected, specific sampling methodologies, risk ratings to sites): it is anticipated that the data collected in the ASPD studies will dictate a refined approach to fish stranding surveys (e.g., site selection, habitat parameters, study team). These refinements
will be developed in consultation with study leads for DDMMON#16 to refine the stock assessment and index stranding surveys.

As in the previous section, these refinements will be reported through the annual reporting process, reviewed by BC Hydro and regulatory agencies and updated in the Year 5 annual report.

15.2.3.3 Finalize Stranding Protocol (Year 11)

An annual review of the results from the monitoring studies that are included in the Adaptive Stranding Protocol will continue as part of the annual ASPD reporting through the later part of the WLR review period (Table 15-4). DDMMON#16 (Stranding Assessments) will be conducted annually throughout the WLR review period and will provide annual indication of the stranding impacts associated with ongoing operational flow reductions on the lower Duncan River. DDMMON#3 (Hydraulic Modeling) will also be updated in the latter part of the review period (Years 5 and 10). Based on the Adaptive Stranding Protocol monitoring program results, a comprehensive review of the results and conclusions of the monitoring studies and the implications to existing stranding protocols and procedures will be conducted. This comprehensive review will be carried out in Year 11 to determine if any modifications are required to the interim protocol document developed in Years 4 and 5. Changes to the protocol will be instituted with final consultation with BC Hydro, agencies (DFO and MOE) and First Nations. The changes will be consistent with annual reporting templates as described previously.

15.2.4 Interpretation of Monitoring Program Results

The results from the various studies in the ASPD will be integrated towards the development of a recommended operating regime (specific to Duncan Dam’s flow releases and change operations) that minimize fish stranding. Annual reporting will be reviewed by BC Hydro and regulating agencies (DFO, MOE) to approve implementation of recommendations. The recommendations will cover operating, communication, impact assessment (performance measures), and reporting protocols, such that BC Hydro in implementing these measures is duly diligent in its approach to this issue.

Data from the stranding assessments (DDMMON#16), e.g., the number of fish stranded per flow reduction event, will be provided throughout the WUP review period. This performance measure will be reported to stakeholders and to the Comptroller of Water Rights as an indication that this monitoring task has been completed and as an indication of the effectiveness of the lower Duncan River Fish Stranding Protocol.

15.2.5 Schedule

This program will start early in Year 2 of the review period. Timing for annual reporting will consider the inputs required for reporting, as well as the need for certain studies, in particular DDMMON#16, to implement study recommendations. The review of the protocol will be conducted during Years 4 and 5, with finalization of the protocol in Year 11 (Table 15-4). DDMMON#1 will be conducted in the first two years of the WLR review period and will contribute to the interim review of the stranding protocol in Years 4 and 5 (Table 15-4). DDMMON#2 will also be conducted during the early stages of the WLR review period (Years 2 to 5) and will contribute to
both the interim protocol (Years 4 and 5) and the final protocol document in Year 11 (Table 15-4).

- Year 2: Contract start in spring, annual draft report due in August; Final reports due in October upon review from both BC Hydro and fisheries agencies;
- Years 3 to 11: Annual draft reports due in March; Final annual reports due May, upon review from both BC Hydro and fisheries agencies;
- Years 4 and 5: Literature reviews due in January with draft reports in March; Final reports due in May upon review from BC Hydro and fisheries agencies.
- Year 11: Draft of review-period end report due in May of Year 11, with the final in July upon review from BC Hydro and fisheries agencies.

**15.2.6 Budget**

The total budget approved by the WUP CC in 2004 was $195K. The cost of this monitoring program in 2004 is estimated to cost $114K. The total inflated cost for this program, assuming implementation in 2009 (Year 2) is $136K. The difference in cost between that approved and that estimated here is primarily due to the way in which ASDP studies were divided in this implementation package, reducing the analytical requirements for this program.

**15.3 REFERENCES**


