

Peace Project Water Use Plan

Monitoring Program Terms of Reference

Peace Spill Protocol

- **GMSMON-3 Peace River Fish Stranding**

February 9, 2008

Terms of Reference for the Peace Project Water Use Plan Monitoring Programs Peace Spill Protocol

1.0 OVERVIEW

This document presents Terms of Reference for the effectiveness monitoring programs for the Peace Spill Protocol (Table 1). These programs will monitor and quantify the environmental effects of spills. Information collected through the Peace Spill Protocol will be used, if appropriate, in the revision of future spill strategies. This document provides detailed Terms of Reference for the following programs:

- 1) **GMSMON-3 Peace River Fish Stranding:** A conditional monitoring program to be implemented immediately following a spill event that will assess the magnitude of fish stranding in the Peace River.
- 2) **GMSMON-4 WAC Bennett Dam Entrainment Study:** A conditional monitoring program to be implemented for a spill event that will estimate the number of fish entrained through WAC Bennett Dam and the rate of mortality experienced by entrained fish. Formerly known as the GMS Entrainment Study. The original project title was misleading as the focus of the study is spillway entrainment and not turbine entrainment.
- 3) **GMSMON-6 Peace River Riparian Flooding:** A conditional 2-year monitoring program to be implemented in Years 9 and 10 of the Peace Project Water Use Plan should a spill event occur during the 10-period.
- 4) **GMSMON-7 Peace River Side Channel Fisheries:** A 10-year required program to provide baseline data on flow, fish use, and substrate changes in side channels as well as to assess the response of trial sites (a physical works project).
- 5) **GMSMON-8 Peace River Side Channel Response:** A conditional monitoring program to assess the response of side channels to spill events in terms of flow, fish use, and substrate.
- 6) **GMSMON-9 Peace River Spill Hydrology:** A conditional program to ensure the collection and reporting of hydrological data associated with a spill event.
- 7) **GMSMON-10 Peace River Spill Photos:** A conditional monitoring program that captures the Peace River at five different flows during a spill event.
- 8) **GMSMON-11 Peace River Spill TGP/Temp:** A conditional monitoring program that monitors TGP and temperature levels of the Peace River during a spill and two weeks following.
- 9) **GMSMON-12 Peace River Wildlife Survey:** A conditional monitoring program that assesses the impact of a spill event on ungulates, beavers, riparian birds, and toads.
- 10) **GMSMON-13 Williston Fish Index:** A study that will estimate the abundance of fish in the pelagic area of the Peace Arm of the Williston Reservoir to assist in assessing the impact of entrainment on fish populations during a spill.

Table 1 Peace Spill Protocol Monitoring Program Terms of Reference Submission Information

Name of Monitoring Program	Order Clause Fulfilled	Submitted with this Package	Previously Submitted To CWR	Ordered Submission Date
GMSMON-3 Peace River Fish Stranding	Schedule D 3(a)	Yes	No	February 2008
GMSMON-4 WAC Bennett Dam Entrainment	Schedule D 3(b)	Yes	No	February 2008
GMSMON-6 Peace River Riparian Flooding	Schedule D 3(c)	Yes	No	February 2008
GMSMON-7 Peace River Side Channel Fisheries	Schedule C 4(d)	Yes	No	August 2008
GMSMON-8 Peace River Side Channel Response	Schedule D 3(d)	Yes	No	February 2008
GMSMON-9 Peace River Spill Hydrology	Schedule D 3(e)	Yes	No	February 2008
GMSMON-10 Peace River Spill Photos	Schedule D 3(g)	Yes	No	February 2008
GMSMON-11 Peace River Spill TGP/Temp	Schedule D 3(f)	Yes	No	February 2008
GMSMON-12 Peace River Wildlife Survey	Schedule D 3(h)	Yes	No	February 2008
GMSMON-13 Williston Fish Index	Schedule D 3(i)	Yes	No	February 2008

Monitoring Program No. GSMON-3 Peace River Fish Stranding

1.0 MONITORING RATIONALE

1.1 Background

The Peace Water Use Plan Committee (hereafter known as the Committee) recommended monitoring of fish stranding impacts after a discharge event that exceeds generation capacity to determine the significance of spills on fish populations. The Committee acknowledged fish stranding as an expected outcome of a spill event but the magnitude of stranding is uncertain. Quantifying the impact of spills on fish abundance is important as over 28 fish species are found in the Peace River (BC Hydro 2003), some of which are of conservation concern. Stranding can occur in two forms: (i) as entrapment within an isolated pool and (ii) as bar stranding on gravel, cobble, and boulder bars (Higgins and Bradford 1996). A previous stranding assessment on the Peace River found that the highest risk areas for stranding were those areas with shallow slope and gravel bar areas associated with braided channels (BC Hydro 1997).

The Peace River Fish Stranding monitoring program addresses two management plans, the Peace Spill Protocol (PSP) and the Peace River Flood Pulse Plan, developed by the Committee. The PSP attempts to quantify the environmental effects of a spill. Information gained from these studies under this management plan will aid future decision-making related to spill risk strategies. This monitoring program will focus on the negative impact of fish loss through stranding. The Peace River Flood Pulse Plan was developed to improve downstream fisheries productivity and riparian habitat for flora and fauna by investigating the feasibility of periodic flood pulse events to maintain side channel and riparian habitat downstream of Peace Canyon (PCN) Dam. The results from this monitoring program may act as a weighting against the ecological merits of flood pulses. The monitoring programs within both of these management plans will be conducted opportunistically as no planned spill release is proposed. Spill events on the Peace system exceeding generation capacity of 70,000 cfs are rare, occurring only four times since 1968. Four additional spills events have occurred for other reasons during this period (BC Hydro 2003). These eight spills, in total, roughly equate to a spill occurring on average once every five years.

1.2 Management Questions

The key management question(s) are:

- 1) What is the magnitude of entrapment/stranding along the Peace River after a spill?
- 2) Which species and life stages are affected by stranding and is the level of stranding biologically significant to fish populations in the Peace River?
- 3) What areas of the Peace River have the highest risk of stranding?

1.3 Detailed Hypotheses about the Ecological Impacts

The primary hypotheses¹ to be tested are:

- H₁: Fish are isolated in pools after dam operations return to normal operating levels after a spill event
- H₂: Fish are stranded interstitially in gravel and on bars (e.g., gravel, cobble bars) once dam operations return to normal operating levels after a spill event
- H₃: The magnitude of stranding is biologically significant to the population abundance of a given fish species

In order to determine the impact of a spill on stranding, hypotheses will be tested using data collected at elevations above the elevation of the river at 70,000 cfs. The third hypothesis may not be directly testable by stranding data alone, but may have to be assessed based on available population abundance data (e.g., PCR Fish Index) and professional expert opinion.

1.4 Key Water Use Decision Affected

The key water use decisions affected by the results of the monitoring program are the revision of future spill strategies and the necessity of flood pulse events to maintain side channel and riparian habitat. In addition to the information from this monitoring program, other studies within the Peace Spill Protocol and the Peace River Flood Pulse Plan will influence these water use decisions. These decisions have important implications for power generating and ecological values. Results of the monitoring could affect power generation as well as fish, wildlife, and vegetation downstream of the Peace Canyon Dam.

2.0 MONITORING PROGRAM PROPOSAL

2.1 Objective and Scope

The objective of the monitoring program is to address the management questions identified in Section 1.2 by collecting the data necessary to draw inferences and to test the hypothesis outlined in Section 1.3. Specifically, fish stranding impacts in the Peace River will occur following each spill event where $Q_{out} > 70,629$ cfs (2000 cms) for two days or longer. The survey will occur immediately after the spill when total discharge has returned to within normal operating range. The study area is the stretch of the Peace River from the Peace Canyon Dam to the confluence of the Pine River. Fish stranding will be assessed at pre-selected index sites. Index sites will have some physical features that are indicative of potential stranding. The study area may be stratified to improve estimates. A previous stranding assessment stratified the area (Table 3-1) based on river length to be covered, number of high risk stranding sites suspected from aerial observations and map review, and professional expertise (BC Hydro 1997).

¹ For clarity, the hypotheses are stated as the alternate hypotheses. Analyses will test the null hypotheses of no effect or difference.

Table 3-1: Stratification scheme for a previous stranding assessment

Stratum	Area	Stratum Length (km)
1	Peace Canyon to Lynx Creek	14
2	Lynx Creek to Halfway River	31
3	Halfway River to Town of Taylor	57

2.2 Approach

This monitoring study will consist of an aerial survey and map review to plan the study design of the fish stranding assessment. Coordination of an aerial survey with other spill monitoring programs may be possible. A field survey will be conducted to enumerate stranding and mapping of stranding sites. Results of the study will provide a summary of the magnitude of stranding due to spill events and the implications for fish populations in the Peace River. This implementation of the monitoring program is conditional on meeting the study criterion, described above, in terms of total discharge and duration of spill event.

2.3 Methods

2.3.1 Task 1: Project Coordination

Project coordination will involve the general administrative and technical oversight of the monitoring program. This task will include but not be limited to: 1) budget management, 2) study team management, 3) logistic coordination, 4) technical oversight of field and analysis components, and 5) facilitation of data transfer among other investigators associated with the Peace Spill Protocol and Peace River Flood Pulse.

2.3.2 Task 2: Site Selection

Prior to the completion of the spill, a study review and aerial survey will be used to plan the survey design of the fish stranding assessment. The study review will consist of a map and literature review to identify potential sampling sites. Flow maps developed from the 1996 spill may assist in the selection of sites. If existing Peace River aerial photos are insufficient, then an aerial survey will be conducted over the study area to assist in site selection. The number of index sites (minimum of three) in each stratum will be dependent on the variability within each stratum and the characteristics of the index site to sufficiently represent the stranding potential. Survey sites will include only the area above the river channel elevation at 70,000 cfs, defined by the edge of terrestrial vegetation and/or flow maps. Site selection will be completed prior to the completion of the spill. This will enable the immediate commencement of the field survey.

Survey sites will be given a unique site identifier, photographed from three viewpoints for future comparison, and surveyed with GPS for mapping. A map to scale will be developed to summarize site locations and descriptions.

Each index site should have some of the following characteristics:

- Shallow slope;
- Large area of small to medium sized porous substrate;

- Undercut bank or pothole;
- Overbank cover;
- Large boulder or debris cover; and/or
- Sidechannel

Effort among strata will be equally allocated unless information collected from the map and literature review can provide a more informative survey design. The process for site selection will be documented.

2.3.3 Task 3: Field Survey

The start of the ground survey will occur on the day of or the day following the return of the dam facilities to normal operating levels (Q_{out} to $\leq 70,000$ cfs) and be completed in one day. Completion of the survey in a single day will minimize any fish mortality that occurs from stranding and warming of water in entrapments, as well as minimize predation. This will provide for a more accurate estimate of stranding.

Areas of isolated pools and dewatered area will be measured at each index site. A site survey data sheet will include but is not limited to the following data fields:

- Crew, date, time, and location;
- Stratum ID, site ID, and photo-numbers
- Total survey area
- Predominant weather
- Operating conditions (e.g., discharge, rampdown schedule, river stage collected from BC Hydro)
- Temperature of air, mainstem, and if applicable, isolated pool
- Transect ID, length, and width
- Quadrant #
- Interstitial or pool
- Sampling gear type for each pool
- Fish condition: live with no injury, live with injury, (including comments noting if individual was salvaged), or dead
- Species and life stage
- Presence/absence of vegetation
- Estimate of transect/quadrant slope
- Substrate composition (dominant, subdominant)
- Total number of pools present

Number and width of transects at each site will be based on total area of site and time considerations. Transect will run perpendicular from the water's edge and may be placed systematically unless the 'population' of stranded fish is suspected have some underlying pattern or trend in the distribution. If a trend is suspected then transects should be placed randomly. Isolated pools at sites will be surveyed using appropriate equipment based on conditions (e.g., seine net or backpack electrofisher) to determine presence of fish in each pool. Captured fish should be immediately placed in a bucket of water, or transferred to the main channel where possible. Capture and handling of fish will follow RIC standards (RIC 1997).

Data collection is not exclusive to this method if an alternative cost-effective method is determined.

2.3.4 Task 4: Data Entry and Analysis

The proponent will enter, check and store all data collected during the index study into Microsoft Access database. Stranding risk is defined as the number of observed fish stranded/isolated per meter of habitat dewatered at index sites and will be summarized as the main reporting metric. Data will be analyzed to assess stranding risk based on habitat type for the species and life stages observed. Overall, the analysis will identify stranding rate for type (and indicator of stranding risk) and extent of areas that are of high stranding risk.

2.3.5 Task 5: Reporting

Following completion of the field survey, a summary report will be prepared that will include the following:

- a) an executive summary of the annual report;
- b) field methods, including the process of site selection, maps that indicate survey locations and photos;
- c) extent of overall fish stranding observed;
- d) extent of stranding by habitat/environmental features and by site, presented in tabular and graphical form;
- e) environmental data including figures of discharge and river stage;
- f) summary of data gaps and recommendations for improving the program as a monitoring tool.

All reports will follow the standard format that is being developed for Water Use Plan (WUP) monitoring programs. This includes providing a version of the report in Microsoft Word and Adobe Acrobat (*.pdf) and all maps, figures, and photos either as embedded objects in the Word file or as separate files.

2.4 Interpretation of Monitoring Program Results

If fish are observed stranded in isolated pools and interstitially on river bars, then spill strategies may require review to mitigate the negative impacts on fish populations in the Peace River. In particular, if the magnitude of stranding is deemed biologically significant to fish populations then this will further support the need to assess spill strategies. The degree of fish stranding may also discount or support the feasibility of flood pulse events of certain magnitudes. Alternatively, a fish salvage protocol may be proposed if a change in spill strategy that minimizes stranding is not feasible.

2.5 Schedule

Monitoring as part of the PCR Fish Stranding program is conditional on the occurrence of a spill event where $Q_{out} > 70,629$ cfs (or 2000 cms) for two days or longer. The monitoring program will be implemented for each spill that meets this criterion. If a spill occurs, study planning (design and site selection) will be completed prior to the completion of the spill. In the two days following a return to normal operating levels, a field survey will be completed to assess stranding.

2.6 Budget

The estimated cost for the monitoring program per spill event is \$108,639. Table 3-2 summarizes the budget estimated in 2007 dollars.

Table 3-2 Estimated costs for Peace River Fish Stranding monitoring program

Sub-total		\$91,875
Inflation	2%	\$11,591
Contingency	5%	\$5,173
Total		\$108,639

2.7 References

BC Hydro. 1997. 1996 Spillway discharge environmental overview and report: Peace River generating facilities. Strategic Fisheries Report No. SFP96-PR-04.

BC Hydro. 2003. Consultative committee report: Peace River water use plan. Prepared by the Peace River water use plan consultative committee.

Resources Inventory Committee. 1997. Fish collection methods and standards. Version 4. <http://ilmbwww.gov.bc.ca/risc/pubs/aquatic/index.htm>