

Peace Project Water Use Plan Spill Protocol and Archaeology Management Plan

Monitoring Programs and Physical Works Annual Report 2018

Implementation Period: September 2017 to August 2018

- **GMSMON-3 PCR Fish Stranding**
- **GMSMON-4 WACB Entrainment**
- **GMSMON-6 PCR Riparian Flooding**
- **GMSMON-8 PCR Side Channel Response**
- **GMSMON-9 PCR Spill Hydrology**
- **GMSMON-10 PCR Spill Photos**
- **GMSMON-11 PCR Spill TGP/Temperature**
- **GMSMON-12 PCR Wildlife Survey**
- **GMSMON-13 WLL Fish Index**
- **GMSMON-21A WLL Archaeological Overview Assessment**
- **GMSMON-21B WLL Erosion Monitoring of Archaeological Resources**
- **GMSWORKS-2 PCR Baseline TGP/Temperature**

For Water Licences 123018, 123019, 123020, 123021, 123025

September 28, 2018

BC Hydro Peace Project Water Use Plan Spill Protocol and Archaeology Management Plan Annual Report: 2018

1 Introduction

This document represents a summary of the status and the results of the Peace Project Spill Protocol and Archaeology Management Plan Water Use Plan (WUP) monitoring program and physical works projects to August 31, 2018, as per the Peace Order under the *Water Act*, dated August 9, 2007. This annual report includes those projects in Schedule D of the Order, as well as those under Clause 7 (Archaeological). There are eleven monitoring programs and one physical works.

2 Status

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

Table 2-1 Dates of Spill Protocol and Archaeology Management Plan WUP 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
GMSMON-3 PCR FISH STRANDING	Schedule D.3.a	Feb 07, 2008	Apr 02, 2008	Jul 24, 2015	Sep 8, 2015 CWR agrees to suspension
GMSMON-4 WACB ENTRAINMENT	Schedule D.3.b	Feb 07, 2008	Apr 02, 2008	Apr 29, 2013	May 22, 2013
GMSMON-6 PCR RIPARIAN FLOODING	Schedule D.3.c	Feb 07, 2008	Apr 02, 2008	Jul 24, 2015	Sep 8, 2015 CWR agrees to suspension
GMSMON-8 PCR SIDE CHANNEL RESPONSE	Schedule D.3.d	Feb 07, 2008	Apr 02, 2008	Jul 24, 2015	Sep 8, 2015 CWR agrees to suspension
GMSMON-9 PCR SPILL HYDROLOGY	Schedule D.3.e	Feb 07, 2008	Apr 02, 2008		
GMSMON-10 PCR SPILL PHOTOS	Schedule D.3.g	Feb 07, 2008	Apr 02, 2008	Jul 24, 2015	Sep 8, 2015 CWR agrees to suspension
GMSMON-11 PCR SPILL TGP/TEMP	Schedule D.3.f	Feb 07, 2008	Apr 02, 2008	Jul 24, 2015	Sep 8, 2015 CWR agrees to suspension
GMSMON-12 PCR WILDLIFE SURVEY	Schedule D.3.h	Feb 07, 2008	Apr 02, 2008	Jul 24, 2015	Sep 8, 2015 CWR agrees to suspension
GMSMON-13 WLL FISH INDEX	Schedule D.e.i	Feb 07, 2008	Apr 02, 2008		
GMSMON-21A WLL ARCHAEOLOGICAL OVERVIEW ASSESSMENT	Clause 7.a	May 09, 2008	Jun 02, 2008	Aug 07, 2009	Jan 20, 2010
GMSMON-21B WLL EROSION MONITORING OF ARCHAEOLOGICAL RESOURCES	Clause 7.b	May 09, 2008	Jun 02, 2008	Aug 07, 2009	Jan 20, 2010
GMSWORKS-2 PCR BASELINE TGP/TEMP	Schedule D.1	Feb 07, 2008	Apr 02, 2008	Jul 24, 2015	Sep 8, 2015 CWR agrees to suspension

3 Schedule

The following table outlines the current schedule for the monitoring programs and physical works being delivered for the Spill Protocol and Archaeology Management Plan WUP.

Table 3-1: Monitoring Programs and Physical Works Schedule as of August 31, 2018

Monitoring Programs and Physical Works	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
	WLR YR1	WLR YR2	WLR YR3	WLR YR4	WLR YR5	WLR YR6	WLR YR7	WLR YR8	WLR YR9	WLR YR10	WLR YR11	WLR YR12
GMSMON-3: PCR Fish Stranding ¹					✓							
GMSMON-4: WACB Entrainment					✓							■
GMSMON-6: PCR Riparian Flooding ¹					✓							
GMSMON-8: PCR Side Channel Response ¹					✓							
GMSMON-9: PCR Spill Hydrology			✓		✓							■
GMSMON-10: PCR Spill Photos ¹					✓							
GMSMON-11: PCR Spill TGP/Temperature ²					✓							■
GMSMON-12: PCR Wildlife Survey ¹		✓			✓							
GMSMON-13: WLR Fish Index	✓	✓F										
GMSMON-21A: WLL Archaeological Overview Assessment		✓	✓F									
GMSMON-21B: WLL Erosion Monitoring of Archaeological Resources		Del	✓	✓	✓	x	✓	✓	✓	✓	u/w	■
GMSWORKS-2: PCR Baseline TGP/Temperature	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	u/w	

Legend	■	=	Project to be undertaken/initiated in identified year
	■	=	Opportunistic Program may be undertaken in identified year
	u/w	=	Project is under way
	x	=	Project not undertaken as planned for this year
	Del	=	Project is delayed for the year
	✓	=	Project is completed for the year
	✓F	=	All field work for this project is complete. No further field work is planned.

Footnotes:

1. Projects suspended as per CWR due to Site C.
2. Project partially suspended as per CWR due to Site C

4 Monitoring Programs and Physical Works Terms of Reference

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

https://www.bchydro.com/about/sustainability/conservation/water_use_planning/northern_interior/peace_river/spill-protocol-management-plan.html

5 Status of Monitoring Programs and Physical Works under Schedule D: Protocols in the event of Spills

5.1 GMSMON-3 Peace River Fish Stranding

The purpose of this project was to inform future spill strategies by assessing stranding downstream of Peace Canyon Dam (PCN). This opportunistic project is implemented in the event of a spill, and was last triggered in 2012. However, as the area for this project is located in the future Site C inundation zone and the outcome of the project will not be applicable to a reservoir environment, this project was suspended as per the CWR letter of September 8, 2015.

5.2 GMSMON-4 WAC Bennett Dam Entrainment

The purpose of this project was to estimate fish entrainment through WAC Bennett Dam (GMS) and mortality rates of entrained fish. This opportunistic project is implemented in the event of a spill, and was last triggered in 2012. The CWR approved additional budget (letter dated May 22, 2013) to allow for additional study in the event of a future spill.

5.3 GMSMON-6 Peace River Riparian Flooding

The objective of this project was to inform revision of future spill strategies by assessing riparian flooding downstream of PCN. This opportunistic project is implemented in the event of a spill, and was last triggered in 2012. However, as the area for this project is located in the future Site C inundation zone and the outcome of the project will not be applicable to a reservoir environment, this project was suspended as per the CWR letter of September 8, 2015.

5.4 GMSMON-8 Peace River Side Channel Response

The purpose of this project was to inform future spill strategies by measuring effects to side channel fish, downstream of PCN. This opportunistic project is implemented in the event of a spill, and was last triggered in 2012. The sites monitored were based on the site selection process embedded in GMSWORKS-3 (Peace River Trial Side Channels). However, as the sites for the project are located in the future Site C inundation zone and the outcome of the project will not be applicable to a reservoir environment, this project was suspended as per the CWR letter of September 8, 2015.

5.5 GMSMON-9 Peace River Spill Hydrology

The purpose of this opportunistic work was collection and reporting of hydrological data required for reporting of companion spill projects (GMSMON-3, 4, 6, and 8

through 12). Assessment of the pre-spill data requirements were completed in June 2009. This project was triggered and completed in 2012.

A review of the results of GMSMON-9 against the project purpose was completed in 2018 to determine if additional years of study and data from a future spill are required. The goal of the GMSMON-9 program was to evaluate data requirements for spill event monitoring programs and to supply data in the event of a spill. We plan to seek relief from further implementation of this program as data requirements are identified, and can be obtained from current, existing BC Hydro sources.

5.6 GMSMON-10 Peace River Spill Photos

The objective of this project was to document PCN spill flow effect on the Peace River inundation of shoreline and riparian areas. Digital photography was acquired in 2012. However, as the area of the project is located in the future Site C inundation zone and the outcome of the project will not be applicable to a reservoir environment, this project was suspended as per the CWR letter of September 8, 2015.

5.7 GMSMON-11 Peace River Spill TGP and Temperature

The purpose of this project is to determine the PCN spill effects to Peace River temperature and total dissolved gas pressure levels. A portion of this study, downstream of Peace Canyon Dam, is within the future inundation zone of Site C and was suspended as per the CWR letter of September 8, 2015. If triggered by a spill, the remaining upstream portion of the project (from the forebay of GMS to the tailrace of PCN) will continue to assess spill effects to Peace River temperature and total dissolved gas pressure levels.

5.8 GMSMON-12 Peace River Wildlife Stranding Survey

The purpose of this project was to determine the effects on wildlife below PCN resulting from spill effects. The pre-spill research component was conducted in May 2010. This opportunistic project is implemented in the event of a spill, and was last triggered in 2012. However, as the area of the project is located in the future Site C inundation zone and the outcome of the project will not be applicable to a reservoir environment, this project was suspended as per the CWR letter of September 8, 2015.

5.9 GMSMON-13 WLL Fish Index

The objective of this project was to assess the fish species composition, abundance, and distribution in the pelagic area of the Peace Arm of Williston Reservoir, to assist in assessing the impact of entrainment on fish populations during a spill. This project was a one-time survey completed in 2008.

A key assumption in this project was that the inter-variability in the index estimates and composition in the Williston Reservoir was not very large, and therefore, this index survey would serve as a pre-spill baseline collected under normal operating conditions. However, the composition of Williston Reservoir has changed over the past ~20 years, shifting from primarily Lake Whitefish in the pelagic zone to primarily Kokanee. This shift was first observed in early 2000, was continuing in 2012, and is likely still occurring as of 2018. As a result, any spill that occurs at W.A.C. Bennett Dam will require an updated index survey to reflect the current species composition and assessment of specific age classes and species in the reservoir and forebay.

A TOR addendum seeking approval to complete the additional index survey will be submitted to the CWR office by May 31, 2019.

5.10 GMSWORKS-2 Peace River Baseline TGP and Temperature

The purpose of this project is to collect baseline total gas pressure (TGP) and water temperature data in the vicinity of GMS and PCN. Temperature and TGP readings are downloaded quarterly and will continue until 2019.

The Year 8 report (January 2016 to December 2016) is attached. The Year 9 report (January 2017 to December 2017) is in draft and under review. It will be submitted with the 2019 Annual Report.

6 Status of Monitoring Programs under Order Clause 7

6.1 GMSMON-21A Heritage and Culture Information Plan: Archaeological Overview Assessment

The purpose of this project, undertaken in 2009, was a one-year archaeological overview assessment of the drawdown zones of the Williston and Dinosaur Reservoirs and the Peace River. The intent was to gather information on the number, location, elevation, condition, use, susceptibility to erosion and relative importance of heritage sites in the area, and to provide baseline information for GMSMON-21B (see section 6.2 below). This project is complete.

6.2 GMSMON-21B Peace River Erosion Monitoring – Archaeological Resources

The objective of this project is to collect quantitative measures of the magnitude, severity, rate of change and estimated duration of erosion effects caused by reservoir operations on selected heritage sites within the Williston and Dinosaur Reservoirs and the Peace River. This non-intrusive monitoring project commenced in the spring of 2010. A review of this project has been completed, and a schedule extension will be proposed. A TOR addendum seeking approval for the schedule extension will be submitted to the CWR office by January 31, 2018.

The Year 6 monitoring report (May 2016 to December 2016) is attached. The Year 7 monitoring report (May 2017 to December 2017) is under review and will be submitted with the 2019 Annual Report.

7 Monitoring Programs and Physical Works Costs

The following table summarizes the Spill Protocol and Archaeology Management Plan WUP monitoring programs and physical works costs approved by the CWR and the Actual Costs to August 31, 2018.

Table 7-1: Spill Protocol and Archaeology Management Plan 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
GMSM03A PCR Fish Stranding	\$225,156	\$144,306	\$1,895	\$146,202	\$78,954	Project suspended due to Site C	
GMSM03A PCR Fish Stranding - OR DM	\$12,272	\$13,703	\$1,895	\$15,598	(\$3,326)		
GMSM03A PCR Fish Stranding - OR Imp	\$212,884	\$130,604		\$130,604	\$82,280		
GMSM04A GMS Entrainment	\$468,168	\$263,926	\$774	\$264,700	\$203,468	Opportunistic study - only implemented in the event of a spill	
GMSM04A GMS Entrainment - OR DM	\$45,505	\$34,637	\$774	\$35,411	\$10,094		
GMSM04A GMS Entrainment - OR Imp	\$422,663	\$229,289		\$229,289	\$193,374		
GMSM06A PCR Riparian Flooding	\$226,273	\$4,332	\$1,024	\$5,355	\$220,918	Project suspended due to Site C	
GMSM06A PCR Riparian Flooding - OR DM	\$31,213	\$4,332	\$1,024	\$5,355	\$25,858		
GMSM06A PCR Riparian Flooding - OR Imp	\$195,060		\$0	\$0	\$195,060		
GMSM08A PCR Side Channel Resp	\$138,752	\$58,464	\$586	\$59,050	\$79,702	Project suspended due to Site C	
GMSM08A PCR Side Channel Resp - OR DM	\$9,652	\$8,066	\$586	\$8,652	\$1,000		
GMSM08A PCR Side Channel Resp - OR Imp	\$129,100	\$50,398		\$50,398	\$78,702		
GMSM09A PCR Spill Hydrology	\$68,979	\$47,737	\$681	\$48,418	\$20,561		
GMSM09A PCR Spill Hydrology - OR DM	\$18,979	\$21,049	\$681	\$21,731	(\$2,752)		
GMSM09A PCR Spill Hydrology - OR Imp	\$50,000	\$26,687		\$26,687	\$23,313		
GMSM10A PCR Spill Photos	\$297,996	\$125,083	\$193	\$125,277	\$172,719	Project suspended due to Site C	
GMSM10A PCR Spill Photos - OR DM	\$10,951	\$12,286	\$193	\$12,479	(\$1,528)		
GMSM10A PCR Spill Photos - OR Imp	\$287,045	\$112,798		\$112,798	\$174,247		
GMSM11A PCR Spill TGP/Temp	\$77,856	\$38,181	\$309	\$38,491	\$39,365	Opportunistic study - only implemented in the event of a spill	
GMSM11A PCR Spill TGP/Temp - OR DM	\$15,371	\$14,036	\$309	\$14,345	\$1,026		
GMSM11A PCR Spill TGP/Temp - OR Imp	\$62,485	\$24,145		\$24,145	\$38,340		
GMSM12A PCR Wildlife Survey	\$339,669	\$141,639	\$1,041	\$142,680	\$196,989	Project suspended due to Site C	
GMSM12A PCR Wildlife Survey - OR DM	\$18,231	\$17,801	\$1,041	\$18,842	(\$611)		
GMSM12A PCR Wildlife Survey - OR Imp	\$321,438	\$123,838		\$123,838	\$197,600		
GMSM13A WLL Fish Index	\$124,909	\$80,943		\$80,943	\$43,966		
GMSM13A WLL Fish Index - OR DM	\$14,296	\$19,437		\$19,437	(\$5,141)		
GMSM13A WLL Fish Index - OR Imp	\$110,613	\$61,506		\$61,506	\$49,107		
GMSM21A WLL Arch Overview	\$113,614	\$113,343		\$113,343	\$271	Project complete	
GMSM21A WLL Arch Overview - OR DM	\$16,186	\$20,123		\$20,123	(\$3,937)		
GMSM21A WLL Arch Overview - OR Imp	\$97,428	\$93,220		\$93,220	\$4,208		
GMSM21B B WLL Arch Monitor	\$705,659	\$420,650	\$194,621	\$615,270	\$90,389	Additional year of study required	TOR addendum
GMSM21B B WLL Arch Monitor - OR DM	\$119,954	\$29,690	\$7,741	\$37,431	\$82,523		
GMSM21B B WLL Arch Monitor - OR Imp	\$585,705	\$390,960	\$186,880	\$577,840	\$7,865		
GMSW02A Baseline TGP Temp	\$254,554	\$215,131	\$8,653	\$223,784	\$30,770		
GMSW02A Baseline TGP Temp - OR DM	\$77,340	\$33,699	\$2,476	\$36,175	\$41,165		
GMSW02A Baseline TGP Temp - OR Imp	\$177,214	\$181,431	\$6,178	\$187,609	(\$10,395)		

OR - Ordered Remissible
ONR - Ordered Non-Remissible

* Red values in parentheses denote overage.