Columbia River Project Water Use Plan

Columbia River White Sturgeon Management Plan Monitoring Program and Physical Works

Annual Report: 2013

Implementation Period: May 2012 to April 2013

- **CLBMON-19 Kinbasket Sturgeon Inventory and Habitat Use**
- **CLBMON-20 Mid Columbia River White Sturgeon Spawning Habitat Assessment**
- **CLBMON-21 Mid Columbia River Juvenile Sturgeon Detection and Habitat Program and Tracking of Existing Sonic Tagged Sturgeon**
- **CLBMON-23 Mid Columbia River Sturgeon Egg Mat Monitoring and Underwater Videography Feasibility**
- **CLBMON-24 Mid Columbia River Sturgeon Genetics**
- **CLBMON-25 Kinbasket Juvenile Sturgeon Detection and Habitat Use**
- **CLBMON-26 Kinbasket Sturgeon Recolonization Risk Assessment and Habitat Suitability**
- **CLBMON-27 Mid Columbia River Sturgeon Incubation and Rearing Study**
- **CLBMON-28 Lower Columbia River Adult Sturgeon Population Monitoring**
- **CLBMON-29 Lower Columbia River Juvenile Sturgeon Monitoring**
- **CLBMON-30 Lower Columbia River Opportunistic Assessment of High Flow Events**
- **CLBMON-54 Mid Columbia Effects of REV 5 Flow Changes on Incubation and Early Rearing Sturgeon**
- **CLBWORKS-24 Mid Columbia Experimental Aquaculture**
- **CLBWORKS-25 Mid Columbia Sturgeon Conservation Aquaculture**
- **CLBWORKS-26 Mid Columbia Sturgeon Upgrade Hatchery**
- **CLBWORKS-27 Lower Columbia Bentonite Addition Experiment**
- **CLBWORKS-28 Lower Columbia River Planning and Assessment of WSG Turbidity**
- **CLBWORKS-34 Lower Columbia Sturgeon Conservation Aquaculture Program**

Licences for Kinbasket storage (27068 and 39432), Mica diversion (39431), Revelstoke diversion and storage (47215), and Arrow storage (27066)

May 31, 2013

BC Hydro Columbia River Project Water Use Plan
Columbia River White Sturgeon Management Plan
Monitoring Programs and Physical Works Annual Report: 2013

1 Introduction

This document represents a summary of the status and the results of the Columbia River White Sturgeon Management Plan Water Use Plan (WUP) monitoring programs and physical works to April 30, 2013, as per the Columbia River Order under the *Water Act*, dated January 26, 2007. There are 12 monitoring programs and six physical works.

2 Status

The following table outlines the dates that TOR for the Columbia River White Sturgeon Management Plan WUP monitoring programs and physical works were submitted to and approved by the CWR.

BC Hydro will convene a multi-party panel five years after commencing the implementation of this WUP to evaluate the effectiveness of operations and physical works in meeting the stated objectives for Arrow Lakes Reservoir and the lower Columbia River. The outcomes from this process will be used to assess any potential need to review the Arrow Lakes Reservoir component of this WUP. If a replacement Non-Treaty Storage Agreement (NTSA) is negotiated within this 5-year period, it is also recommended that agreement provisions and implications be reported out through this panel. Signing of a new NTSA is not a trigger for panel evaluation or a review of this Water Use Plan recommendation to change operations.

Table: 2-1: Dates of Columbia River White Sturgeon Management Plan 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
CLBMON-19 Kinbasket Sturgeon Inventory and Habitat Use	Schedule F.1.a	Feb 22, 2008	Apr 24, 2008		
CLBMON-20 Mid Columbia River White Sturgeon Spawning Habitat Assessment	Schedule F.1.b	Feb 22, 2008	Apr 24, 2008	Aug 21, 2009	Nov 10, 2009
CLBMON-21 Mid Columbia River Juvenile Sturgeon Detection and Habitat Program and Tracking of Existing Sonic Tagged Sturgeon	Schedule F.1.c, Schedule F.1.d	Jun 15, 2007	Jul 11, 2007		
CLBMON-23 Mid Columbia River Sturgeon Egg Mat Monitoring and Underwater Videography Feasibility	Schedule F.1.e	Jun 15, 2007	Jul 11, 2007	Apr 16, 2009	Apr 30, 2009
CLBMON-24 Mid Columbia River Sturgeon Genetics	Schedule F.1.f	Scheduled for 2015			
CLBMON-25 Kinbasket Juvenile Sturgeon Detection and Habitat Use	Conditional List 9.b	Conditional			
CLBMON-26 Kinbasket Sturgeon Recolonization Risk Assessment and Habitat Suitability	Clause 10.c Conditional List	Jan 07, 2009	Mar 19, 2009		
CLBMON-27 Mid Columbia River Sturgeon Incubation and Rearing Study	Schedule F.1.g	Jan 07, 2009	Mar 19, 2009		
CLBMON-28 Lower Columbia River Adult Sturgeon Population Monitoring	Schedule F.1.h	Feb 22, 2008	Apr 24, 2008		
CLBMON-29 Lower Columbia River Juvenile Sturgeon Monitoring	Schedule F.1.i	May 12, 2008	Jun 25, 2008		
CLBMON-30 Lower Columbia River Opportunistic Assessment of High Flow Events	Schedule F.1.j	Jan 07, 2009	Mar 19, 2009		
CLBMON-54 Mid Columbia Effects of REV 5 Flow Changes on Incubation and Early Rearing Sturgeon	Clause 2.e of the Amended Order	Aug 21, 2009	Oct 19, 2009		
CLBWORKS-24 Mid Columbia Experimental Aquaculture	Schedule F.3.a	Apr 17, 2008	May 12, 2008		
CLBWORKS-25 Mid Columbia Sturgeon Conservation Aquaculture	Schedule F.3.b	Apr 17, 2008	May 12, 2008		
CLBWORKS-26 Mid Columbia Sturgeon Upgrade Hatchery	Schedule F.3.c	Apr 17, 2008	May 12, 2008		
CLBWORKS-27 Lower Columbia Bentonite Addition Experiment	Conditional List 10.a	Conditional			
CLBWORKS-28 Lower Columbia River Planning and Assessment of WSG Turbidity	Schedule F.2.a	Mar 31, 2010	Jun 03, 2010		
CLBWORKS-34 Lower Columbia Sturgeon Conservation Aquaculture Program	Schedule F.3.b	Apr 17, 2008	May 12, 2008		

3 Schedule

The following table (Table 3-1) outlines the current schedule for the monitoring programs and physical works being delivered for the Columbia River White Sturgeon Management Plan WUP

.

Table 3-1: Table of WUP Schedule

Monitoring Programs	2007 WLR YR1	2008 WLR YR2	2009 WLR YR3	2010 WLR YR4	2011 WLR YR5	2012 WLR YR6	2013 WLR YR7	2014 WLR YR8	2015 WLR YR9	2016 WLR YR10	2017 WLR YR11	2018 WLR YR12	2019 WLR YR13 Final Review
CLBMON-19 Kinbasket Sturgeon Inventory and Habitat Use		✓	✓	✓									
CLBMON-20 Mid Columbia River Spawning Habitat Assessment				×	✓	✓							
CLBMON-21 Mid Columbia River Juvenile Sturgeon Detection and Habitat Program and Tracking of Existing Sonic Tagged Sturgeon	✓	✓	✓	✓	✓	✓	■	■	■	■			
CLBMON-23 Mid Columbia River Sturgeon Egg Mat Monitoring and Underwater Videography Feasibility	✓	✓	✓	✓	✓	✓	■	■	■	■			
CLBMON-24 Mid Columbia River Sturgeon Genetics									■				
CLBMON-25 Kinbasket Juvenile Sturgeon Detection and Habitat Use	C*												
CLBMON-26 Kinbasket Sturgeon Recolonization Risk Assessment and Habitat Suitability				✓	✓	✓							
CLBMON-27 Mid Columbia River Sturgeon Incubation and Rearing Study			✓	✓	✓								
CLBMON-28 Lower Columbia River Adult Sturgeon Population Monitoring		✓	✓	✓	✓	✓	■	■	■	■	■	■	■
CLBMON-29 Lower Columbia River Juvenile Sturgeon Monitoring		✓	✓	✓	✓	✓	■	■	■	■	■	■	■
CLBMON-30 Lower Columbia River Opportunistic Assessment of High Flow Events			✓	✓	✓	✓	■	■	■	■	■	■	
CLBMON-54 Mid Columbia Effects of REV 5 Flow Changes on Incubation & Early Rearing Sturgeon				×	✓	✓							
Physical Works													
CLBWORKS-24 Mid Columbia Experimental Aquaculture		✓	✓	✓	✓	✓							
CLBWORKS-25 Mid Columbia Sturgeon Conservation Aquaculture						✓	■	■	■	■	■		
CLBWORKS-26 Mid Columbia Sturgeon Upgrade Hatchery		✓	✓										
CLBWORKS-27 Lower Columbia Bentonite Addition Experiment	C*						■						
CLBWORKS-28 Planning and Assessment of WSG Turbidity				u/w	✓	✓	■						
CLBWORKS-34 Lower Columbia Sturgeon Aquaculture Program		✓	✓	✓	✓	✓	■	■	■	■	■	■	■

Legend:
- ■ = Program to be undertaken/initiated in identified year
- u/w = Project is underway
- ✓ = Program completed for the year
- × = Program started, but encountered operational or hydrological delays
- C* = Program is on the conditional list

4 Monitoring Programs and Physical Works Terms of Reference

The Monitoring Programs and Physical Works being implemented under the Columbia River White Sturgeon 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:

http://www.bchydro.com/toolbar/about/sustainability/conservation/water_use_planning/southern_interior/columbia_river/columbia-sturgeon.html

5 Summary of Monitoring Programs

5.1 CLBMON-19 Kinbasket Sturgeon Inventory and Habitat Use

5.1.1 Status

This monitoring program was initiated in 2008 and was carried out over a 3 year monitoring period ending in 2011. The final report from this work helped inform CLBMON26, described below.

5.2 CLBMON-20 Mid Columbia River White Sturgeon Spawning Habitat Assessment

5.2.1 Status

This monitoring program was initiated in 2010 and will be carried out over a three-year period ending at the end of 2013. No report is attached. The expected final report (due August of 2013) will be submitted in next year's report.

This project is based primarily on advanced hydraulic modelling which has taken a three-year period to validate with field sampling over a range of Revelstoke Dam Discharges and Arrow Lakes Reservoir elevations. The modelling results have been extremely informative to date and the model was used to determine any incremental effects of the increased discharge from the addition of Revelstoke Unit 6 on sturgeon spawning habitat. The work is going to be an important piece of literature demonstrating the usefulness of such techniques in describing both hydraulic properties of critical fish habitat and possible mitigation options Below is an abstract of the work that will be presented at the World Sturgeon Symposium in 2013:

Use of a 3D numerical model to assess effects of hydroelectric facility expansions on white sturgeon (*Acipenser transmontanus*) spawning habitats

In the Columbia River, dam construction and resultant river regulation have separated formerly contiguous populations of White Sturgeon and dramatically altered the historical hydrograph. White Sturgeon in the Canadian portion of the Columbia River are experiencing partial or complete recruitment failure and have been designated as Endangered. The mechanisms that result in recruitment failure are poorly understood but multiple competing hypotheses exist and include changes to spawning habitats, turbidity levels, temperature regimes, and discharge. The effects of discharge on spawning and early rearing habitats have been studied in many systems. However, measuring the effects of discharge on near-bottom habitats in large, deep, and high velocity rivers was problematic due to limitations in technology. Improvements in remote sensing methods and advances in numerical model development have allowed researchers to accurately describe how discharge

affects the near-bottom river environment. Recent hydroelectric expansions in the Canadian portion of the Columbia River have used high resolution numerical models to assess the effects of altered discharge regimes on near-bottom velocities, current patterns, and substrate composition in critical White Sturgeon habitats located downstream from these facilities. We describe the development of a 3D numerical model, the inputs to the model, and how the data were collected. The models were powerful enough to describe detailed hydraulic patterns in the study areas, which facilitated the development of flow mitigation options and helped obtain regulatory approvals for two major hydroelectric expansion projects in the upper Columbia River.

5.3 CLBMON-21 Mid Columbia River Juvenile Sturgeon Detection and Habitat Program and Tracking of Existing Sonic Tagged Sturgeon

5.3.1 Status

This monitoring program was initiated in 2007 and will be carried out over 10 years ending in 2016. Attached is the report for Year 6 dated June 2013.

The program used new advancements in telemetry (acoustic positing system) to address questions regarding habitat use at different reservoir elevations that were not feasible to address using more indirect means (direct capture). However, despite the success of addressing that specific question (see report), significant uncertainty remains regarding the growth and survival capacity for juvenile sturgeon released from the hatchery program. This program will focus for the final four years on addressing these questions.

5.4 CLBMON-23 Mid Columbia River Sturgeon Egg Mat Monitoring and Underwater Videography Feasibility

5.4.1 Status

This monitoring program was initiated in 2007 and will be carried out over 10 years ending in 2016. Attached is the report for Year 6 dated April 2013.

Project is setup with consistent monitoring based on the outcome of the Mid-Columbia White Sturgeon Management Plan midterm review which occurred in 2012. No significant change to the delivery or implementation of this program.

5.5 CLBMON-24 Mid Columbia River Sturgeon Genetics

5.5.1 Status

This monitoring program is not planned to be initiated until 2016 due to the additional collection of genetic samples prior to project implementation. The program will analyze historical adult samples and samples collected from monitoring under CLBMON-23.

5.6 CLBMON-25 Kinbasket Juvenile Sturgeon Detection and Habitat Use

5.6.1 Status

This is a conditional study and will be implemented, if necessary, following the outcomes of a technical review in 2015. A decision was made at the Mid-Columbia

White Sturgeon Management Plan midterm review in 2012 to focus on questions related to sturgeon recovery in the Arrow Lakes Reservoir before conducting concurrent work in Kinbasket.

5.7 CLBMON-26 Kinbasket Sturgeon Recolonization Risk Assessment and Habitat Suitability

5.7.1 Status

This monitoring program was initiated in 2010 and will be carried out over three years ending in 2013-2014. Attached is the report for Year 2 dated May 2013.

Phase 1, the ecological risk assessment was finalized and forms the basis of the report attached. At the Mid-Columbia White Sturgeon Management Plan midterm review in 2012 a decision was made to complete a conservation aquaculture strategy that, even though not implemented, would help inform future discussions. A conservation aquaculture strategy will be developed and finalized this year (due Winter 2014) and included in the annual report submission next year.

5.8 CLBMON-27 Mid Columbia River Sturgeon Incubation and Rearing Study

5.8.1 Status

This monitoring program was initiated in 2009 and was carried out over three years ending in 2012. A final program report and publication is in final review (due later 2013) and will be included in next year's submission.

5.9 CLBMON-28 Lower Columbia River Adult Sturgeon Population Monitoring

5.9.1 Status

This monitoring program was initiated in 2008 and will be carried out over 12 years. Attached are the reports for Years 2, 3 and 4. An additional report is being finalized for Year 5 (due Fall 2013) and will be included in next year's submission. Significant progress has been made addressing questions regarding reproductive ecology in the lower Columbia River using molecular methods. Results from this work are helping to inform new recovery goals, such as ways to improve genetic diversity in supplemental progeny stocked on an annual basis. Below is an abstract from the work that is being presented at the World Sturgeon Symposium in 2013.

Pedigree analyses provide estimates of the effective number of breeding adults and number of spawning events for White Sturgeon in the Upper Columbia River, Canada.

The White Sturgeon population in the Upper Columbia River has been undergoing recruitment failure for several decades and uncertainty exists regarding the number of adults contributing to annual spawning events. Molecular techniques allow for the examination of levels of recruitment to the egg or larval stage and/or reproductive success of adult fish. We estimated the number of spawning adults (Nb) and effective breeding number (Ne) from collected eggs and larvae in each of two years using a pedigree analysis based on genotypic data from 12 microsatellite loci. We also produced a timetable of white sturgeon larval development that incorporated variation due to family and temperature to improve estimates of fertilization dates for wild caught larvae. The total annual number (mean ± SD) of contributing adults and

breeding adult effective size among spawning areas (n=2) was 109.0 ± 8.5 (Nb) and 71.5 ± 12.0 (Ne), respectively. Genetically derived estimates of numbers of spawning adults were concordant with empirical estimates of the number of available breeders annually based on sex ratios and maturation stages of adults captured during broodstock programs. Further, genetic data determined egg mats (vs. drift nets) captured offspring that better represented the total spawning population with the majority of Nb represented by progeny at the egg stage. However, these results were influenced by lower sampling effort due to the hydrology of the spawning area. We also used inferred adult contributions to pedigreed larvae produced within and among events to validate the inferred timing of different spawning events based on developmentally staged eggs which is commonly used as a surrogate measure of adult spawning events. Low estimates of the number of spawning adults and inferred reproductive skew based on pedigree analysis revealed that effective breeding numbers are considerably lower than the number of breeders (Ne:Nb = 0.64 ± 0.17; mean ± SD) suggesting that the genetic diversity of progeny during this early life stage is low and effective population size is likewise small. Results from this work help to describe the reproductive ecology of this population and can be used to revise ongoing recovery strategies (e.g., conservation aquaculture programs).

5.10 CLBMON-29 Lower Columbia River Juvenile Sturgeon Monitoring

5.10.1 Status

This monitoring program was initiated in 2008 and will be carried out over 12 years. Attached is the report for Years 2 and 3 dated May 2013. Two additional reports are in finalization (due winter 2014) and will be included in next year's submission.

Significant progress has been made in understanding juvenile white sturgeon ecology in the lower Columbia River in the past year. Below are two abstracts for work from this program being presented at the World Sturgeon Symposium in 2013.

Influence of site fidelity on growth and diet of juvenile White Sturgeon in the upper Columbia River, Canada.

Juvenile age classes are lacking for many populations of sturgeon worldwide due to recruitment failure. Accordingly, conservation aquaculture has become a critical component of recovery programs, including for White Sturgeon in the lower Columbia River, Canada. Hatchery reared juveniles (n=122,555) have been released annually at varying ages and in varying numbers since 2001. We evaluated growth, habitat use and described diet following release into the wild. Monitoring was conducted over a 9 year period using a combination of methods including setlines, gill nets, and angling. Results from monitoring to date suggest that though the majority of available habitats are utilized by juvenile sturgeon, site fidelity to a specific location was high. Growth rates differed significantly depending on the age of the individual and the habitats used. Younger juveniles (<4 years) grew faster in length (14 cm/year) while older juveniles grew faster in weight (0.6 kg/year). Growth was significantly higher in sections of the river characterized by deeper slower water and smaller substrate. Prey diversity in the diet was high and was influenced more by the habitats used then by fish size or age. Results from this work demonstrate the success of a conservation aquaculture program for an imperiled species and are important for future recovery efforts.

The effects of growth rate, age, and habitat use on age estimates made from pectoral fin rays of juvenile White Sturgeon.

Knowledge of the age of juvenile sturgeon collected in the wild is important when evaluating mechanisms influencing recruitment. However, few studies have quantified factors influencing the accuracy of ages estimated from pectoral fin ray sections. To determine the accuracy of age estimates for juvenile white sturgeon, we collected both pectoral fin rays from equal numbers of known age hatchery released fish (ages 4-11) in the lower Columbia River, Canada. We selected individuals within each age class from three size categories and two different habitats. Multiple sections from each fin ray were aged blindly by six readers. We found that mean (± 1 SD) aging error across all age classes evaluated overestimated true age by 1.09 ± 0.81 years. Aging error decreased with increasing age and was highest at the youngest ages examined (3-6 years). Error was explained significantly by reader, with the mean difference in age estimates between readers being 1.39 years (range 0 to 3.5 years). Fish size only explained a marginal amount of the variation observed and while growth rate differed by habitats used, ageing error did not reflect this. Low confidence in ages estimated from pectoral fin rays of white sturgeon continues to complicate recovery as this structure represents the only nonlethal method to age sturgeon.

5.11 CLBMON-30 Lower Columbia River Opportunistic Assessment of High Flow Events

5.11.1 Status

This monitoring program was initiated in 2009 and will be carried out over 10 years. No report is attached. Long term data are required to address the management questions related to flows. A report addressing the management questions using the data collected in the first several years of monitoring is in preparation (due Winter 2014) and will be included in next year's submission.

5.12 CLBMON-54 Mid Columbia Effects of REV 5 Flow Changes on Incubation and Early Rearing Sturgeon

5.12.1 Status

This monitoring program was initiated in 2010 and will be carried out over a three year period ending at the end of 2013. No report is attached. The expected final report (due August of 2013) will be submitted in next year's report.

This program is implemented concurrently with CLBMON-20 and has a similar update to the one provided above.

6 Summary of Physical Works

6.1 CLBWORKS-24 Mid Columbia Experimental Aquaculture

6.1.1 Status

This physical works was initiated in 2007 and was carried out over 5 years ending in 2012. Attached is the report for Year 5 dated May 2013.

6.2 CLBWORKS-25 Mid Columbia Sturgeon Conservation Aquaculture

6.2.1 Status

This physical works was initiated in 2012 and will be carried out over five years ending in 2017. Attached is the report for Year 1 dated May 2013.

This program is a continuation of CLBWORKS-24. The two projects overlapped in 2013. One primary goal of CLBWORKS-25 is to release juvenile sturgeon of a larger body size compared to historical values in order to help address questions of survival under CLBMON-21.

6.3 CLBWORKS-26 Mid Columbia Sturgeon Upgrade Hatchery

6.3.1 Status

This physical works was initiated in 2008 and ended in 2010 with the construction of temporary rearing facilities that could be located on the banks of the Columbia River (e.g., Revelstoke). Currently, the facilities are under operation at the Kootenay Trout hatchery pending a decision in 2009 to not relocate them to the banks of the Columbia without more certainty in how streamside rearing would fit within recovery goals.

6.4 CLBWORKS-27 Lower Columbia Bentonite Addition Experiment

6.4.1 Status

This physical works is planned for implementation in 2014. Terms of reference will be developed and finalized in late 2013 and early 2014 and follow the outcomes of CLBWORKS-28 below.

6.5 CLBWORKS-28 Lower Columbia River Planning and Assessment of WSG Turbidity

6.5.1 Status

This physical works was initiated in 2011 and will be carried out over two years ending in 2013. Attached is the report for Year 1 dated May 2013.

This study will inform development of Terms of Reference and associated physical works options under CLBWORKS-27.

6.6 CLBWORKS-34 Lower Columbia Sturgeon Conservation Aquaculture Program

6.6.1 Status

This physical works was initiated in 2008 and will be carried out over 12 years ending in 2019. Attached is the report for Year 5 dated May 2013.

7 Monitoring Programs and Physical Works Costs

The following table summarizes the Columbia River White Sturgeon Management Plan WUP monitoring programs and physical works costs approved by the Comptroller and the Actual Costs to April 30, 2013.

Table 7-1: Columbia River White Sturgeon 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
CLB MP5 White Sturgeon Annual Report	$15,870	$4,551	$11,319	$15,870	$0	On Track	No Corrective Action
CLBMON-19 KIN STURGEON INVENTORY & HABITAT	$591,767	$548,372	$0	$548,372	$43,395	Project Complete	No Corrective Action
C05M19A KIN: Sturgeon Invent - OR DM	$47,474	$33,419	$0	$33,419	$14,055		
C05M19A KIN: Sturgeon Invent - OR Imp	$544,293	$514,953	$0	$514,953	$29,340		
CLBMON-20 OR MID COL WHITE STURGEON SPAWNING HABITAT	$378,439	$183,497	$48,418	$231,915	$146,524	Efficiencies found during project implementation	No Corrective Action
C05M20A MID COL White Sturge - OR DM	$37,623	$22,822	$2,864	$25,687	$11,936		
C05M20A MID COL White Sturge - OR Imp	$275,500	$130,909	$37,817	$168,726			
C05M20A MID COL White Sturge - ONR Imp	$65,316	$29,766	$7,737	$37,503	$27,813		
CLBMON-21 MID COL JUVENILE STURGEON DETECTION & HABITAT USE STUDY & TRACKING OF EXISTING TAGGED ADULTS	$1,761,966	$978,093	$662,011	$1,640,104	$121,862	On Track	No Corrective Action
C05M21A MID COL Juvenile Stu - OR DM	$167,316	$53,589	$49,496	$103,085	$64,231		
C05M21A MID COL Juvenile Stu - OR Imp	$1,594,650	$924,504	$612,515	$1,537,019	$57,631		
CLBMON-23 MID COL STURGEON EGG SUBSTRATE	$1,504,542	$784,168	$632,627	$1,416,796	$87,746	On Track	No Corrective Action
C05M23A MID COL Sturgeon Egg - OR DM	$155,990	$58,438	$48,147	$106,586	$49,404		
C05M23A MID COL Sturgeon Egg - OR Imp	$1,348,552	$725,730	$584,480	$1,310,210	$38,342		
CLBMON-26 KIN STURGEON RECOLONIZATION RISK	$325,523	$248,534	$41,967	$290,502	$35,021	On Track	No Corrective Action
C05M26A KIN: Sturg Recoloniz - OR DM	$51,455	$24,004	$4,354	$28,358	$23,097		
C05M26A KIN: Sturg Recoloniz - OR Imp	$274,068	$224,531	$37,613	$262,144	$11,924		
CLBMON-27 MID COL JUVENILE STURGEON INCUBATION & REARING	$375,879	$360,581	$0	$360,581	$15,298	Project complete, minor reporting costs remain	No Corrective Action
C05M27A MID COL Sturg Incub - OR DM	$56,570	$35,893	$0	$35,893	$20,677		
C05M27A MID COL Sturg Incub - OR Imp	$319,309	$324,688	$0	$324,688	($5,379)		
CLBMON-28 LOW COL ADULT STURGEON POPULATION MONITORING	$3,483,799	$920,257	$2,053,928	$2,974,185	$509,614	On Track	No Corrective Action
C05M28A LC: Adult Sturg - OR DM	$422,141	$86,114	$166,614	$252,728	$169,413		
C05M28A LC: Adult Sturg - OR Imp	$3,061,658	$834,144	$1,887,314	$2,721,458	$340,200		
CLBMON-29 LOW COL JUVENILE STURGEON DETECTION	$3,120,256	$884,473	$2,066,892	$2,951,364	$168,892	On Track	No Corrective Action
C05M29A LC:Juv Sturgeon - OR DM	$218,003	$78,623	$110,083	$188,706	$29,297		
C05M29A LC:Juv Sturgeon - OR Imp	$2,902,253	$805,850	$1,956,809	$2,762,659	$139,594		
CLBMON-30 LOW COL OPPORTUNISTIC ASSESSMENT OF HIGH FLOW EVENTS	$526,741	$115,166	$273,214	$388,380	$138,361	On Track	No Corrective Action
C05M30A LC: Opportunist - OR DM	$131,917	$36,053	$66,493	$102,546	$29,371		
C05M30A LC: Opportunist - OR Imp	$394,824	$79,113	$206,721	$285,834	$108,990		
CLBMON-54 MCR EFFECTS OF FLOW CHANGES ON INCUBATION AND EARLY REARING STURGEON	$328,107	$154,863	$43,210	$198,073	$130,034	Efficiencies found during project implementation	No Corrective Action
C05M54A MCR Effect of Flow - ONR DM	$38,208	$18,076	$3,559	$21,635	$16,573		
C05M54A MCR Effect of Flow - ONR Imp	$289,899	$136,787	$39,651	$176,438	$113,461		
CLBWORKS-24 MID COL STURGEON EXPERIMENTAL AQUACULTURE	$1,783,845	$1,783,845	$0	$1,783,845	($0)	Project Complete	No Corrective Action
C05W24A MID COL Expersturg - OR DM	$50,606	$23,510	$0	$23,510	$27,096		
C05W24A MID COL Expersturg - OR Imp	$1,733,239	$1,760,335	$0	$1,760,335	($27,096)		
CLBWORKS-25 MID COL STURGEON CONSERVATION AQUACULTURE	$3,159,806	$438,331	$2,565,271	$3,003,601	$156,205	On track	No Corrective Action
C05W25A MID COL Consr Sturg - OR DM	$83,368	$7,407	$36,882	$44,289	$39,079		
C05W25A MID COL Consr Sturg - OR Imp	$3,076,438	$430,923	$2,528,389	$2,959,312	$117,126		
CLBWORKS-26 MID COL STURGEON UPGRADE HATCHERY	$585,560	$532,938	$0	$532,938	$52,622	Project complete	No Corrective Action
C05W26A MID COL Upgrd Sturg - OR DM	$9,018	$6,743	$0	$6,743	$2,275		
C05W26A MID COL Upgrd Sturg - OR Imp	$576,542	$526,194	$0	$526,194	$50,348		
CLBWORKS-28 LOW COL PLANNING & ASSESSMENT OF WSG TURBIDITY	$182,520	$77,139	$0	$77,139	$105,381	Efficiencies found during project implementation	No Corrective Action
C05W28A LC Pln Wsg Tur - OR DM	$33,304	$16,053	$0	$16,053	$17,251		
C05W28A LC Pln Wsg Tur - OR Imp	$149,216	$61,086	$0	$61,087	$88,130		
CLBWORKS-34 LOW COL STURGEON AQUACULTURE PROGRAM	$2,773,383	$1,001,982	$1,605,441	$2,607,422	$165,961	On Track	No Corrective Action
C05W34A LC Sturg Aqua - OR DM	$152,467	$26,035	$58,197	$84,231	$68,236		
C05W34A LC Sturg Aqua - OR Imp	$2,620,916	$975,947	$1,547,244	$2,523,191	$97,725		

OR - Ordered Remissible
ONR - Ordered Non-Remissible

* Red values in parentheses denote overage.