

Columbia River Project Water Use Plan

Columbia River White Sturgeon Management Plan Monitoring Program and Physical Works

Annual Report: 2018

Implementation Period: July 2017 to June 2018

- **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 White Sturgeon Physical Works: Physical works options to address white sturgeon recruitment failure in the lower Columbia River**
- **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)

July 31, 2018

BC Hydro Columbia River Project Water Use Plan Columbia River White Sturgeon Management Plan Monitoring Programs and Physical Works Annual Report: 2018

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 June 30, 2018, 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 Terms of Reference (TOR) for the Columbia River White Sturgeon 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 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	Jul 16, 2018	Pending
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	Not currently scheduled			
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 White Sturgeon Physical Works	Conditional List 10.a	Mar 17, 2017	Sep 29, 2017	May 30, 2018	Jun 06, 2018
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 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: Monitoring Programs and Physical Works Schedule as of June 30, 2018

Monitoring Programs	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
	WLR YR1	WLR YR2	WLR YR3	WLR YR4	WLR YR5	WLR YR6	WLR YR7	WLR YR8	WLR YR9	WLR YR10	WLR YR11	WLR YR12	WLR YR13	WLR YR14	WLR YR15	WLR YR16
CLBMON-19 Kinbasket Sturgeon Inventory and Habitat Use		✓	✓	✓F												
CLBMON-20 Mid Columbia River Spawning Habitat Assessment				x	✓	✓	✓	✓F								
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				✓	✓	✓	✓F									
CLBMON-27 Mid Columbia River Sturgeon Incubation and Rearing Study			✓	✓	✓F											
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 REV5 Flow Changes on Incubation & Early Rearing Sturgeon				x	✓	✓	✓F									
Physical Works																
CLBWORKS-24 Mid Columbia Experimental Aquaculture		✓	✓	✓	✓	✓F										
CLBWORKS-25 Mid Columbia Sturgeon Conservation Aquaculture						✓	✓	✓	✓	✓	✓	■	■			
CLBWORKS-26 Mid Columbia Sturgeon Upgrade Hatchery		✓	✓F													
CLBWORKS-27 Lower Columbia White Sturgeon Physical Works	C*								del	del	✓	■	■			
CLBWORKS-28 Planning and Assessment of WSG Turbidity				✓	✓	✓F										
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
- del = Program is delayed
- x = Program started, but encountered operational or hydrological delays
- ✓F = All field work for this project is complete. No further field work is planned.
- = Proposed extension of work until WUPOR
- 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 Status of Monitoring Programs

5.1 CLBMON-19 Kinbasket Sturgeon Inventory and Habitat Use

This monitoring program was initiated in 2008 and was carried out over a three-year monitoring period ending in 2011. The primary management question of this program was whether White Sturgeon were present in the Kinbasket Reservoir. The final report from this work helped inform CLBMON-26 described below. The project was complete.

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

This monitoring program was initiated in 2010 and was carried out over a three-year period ending in 2014. The final report also incorporates additional work that expanded the modelling through BC Hydro's Revelstoke Unit 6 environment project, which has proved beneficial to the analysis being conducted under the Columbia WUP study.

This project was based primarily on advanced hydraulic modelling which was developed over a three-year period to validate with field sampling over a range of Revelstoke Dam Discharges and Arrow Lakes Reservoir (ALR) elevations. The work was implemented concurrently with CLBMON-54, due to similarities in management questions and methodology. The overall objective of these studies was to model the effects of Revelstoke Dam discharges and ALR levels on velocity/depth patterns in the White Sturgeon egg deposition/incubation and early rearing area. This objective was met and detailed results and modelling scenarios were presented in the report and discussed in the context of the programs' management questions and the biology of the species. This project is complete.

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

This monitoring program was initiated in 2007 and was scheduled to be carried out over ten years ending in 2017. Cost efficiencies have allowed for an additional year of monitoring with no additional budget. This will provide a longer dataset to improve confidence in the results which is important for a long lived species like White Sturgeon. Attached is the report for Year 11 dated July 2018, that covers capture efforts during 2017.

This monitoring program was designed to monitor the success (growth and survival) of hatchery-origin white sturgeon released into the MCR and Arrow Reservoir. The monitoring program has been successful in addressing general habitat use in the

MCR through the use of telemetry on a subset of individuals. However, there has been limited success in evaluating growth and survival of fish released from the aquaculture program despite significant capture efforts expended as part of this program. To date, only 37 individuals have been captured, precluding any quantitative evaluation of survival. Low capture rates in MCR may be due to predation, slower growth, or a more challenging reservoir environment to sample. The majority of the captures (78%) have been captured within 1.5 years following release from the hatchery with only a single individual captured more than 5 years following the date they were released (10 years at large). While this suggests some capacity for survival, the program has yet to produce sufficient data to estimate survival or year class abundance which is required to address the management questions.

To address survival following release, the size of hatchery-origin juveniles has been increased over time: 75 grams in the initial Years 1-5; 150 grams in Years 6-8; and 300 grams in Years 8-10. Additional years of monitoring are required to evaluate survival of the recent, and largest, year classes (2015-2018). A request for additional funding was submitted in July of 2018 with rationale to extend the monitoring in order to obtain a sufficient sample size to address the management questions. This request includes five more years of study or until the WUPOR is required, whichever comes first.

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

This monitoring program was initiated in 2007 and was initially planned for ten years ending in 2016 and cost efficiencies have allowed for 2 additional years of monitoring with no additional budget, ending in 2018. This will provide a longer dataset to improve the confidence in the results which is important for a long lived species like White Sturgeon. Attached is the report for Year 11 dated June 2018.

This monitoring program was designed to ensure consistent annual monitoring based on the outcome of the Mid Columbia White Sturgeon Management Plan midterm review which occurred in 2012. Of note, spawning has been detected at this location in 9 of 15 years where monitoring has occurred (7 of 11 WUP years). There has been no significant change to the delivery or implementation of this program. One key focus for the remaining years of the program is to bank tissue samples (from captured larvae) for genetic analysis under CLBMON-24 towards the end of the WUP. To date, very few tissue samples have been obtained as a result of low larval capture numbers.

5.5 CLBMON-24 Mid Columbia River Sturgeon Genetics

The purpose of this program was to analyze historical adult samples and samples collected from monitoring under CLBMON-23. However, it is unlikely that sufficient genetic samples will be collected before the end of the WUP term. More pertinent genetic questions exist in the lower Columbia River related to recovery goals for that segment of the population.

Options for this program will be discussed at the technical review in December of 2018 and outcomes from these discussions will be drafted into a submission to the CWR outlining recommended next steps for this program in 2019.

5.6 CLBMON-25 Kinbasket Juvenile Sturgeon Detection and Habitat Use

This is a conditional study that was originally intended to be implemented if juvenile White Sturgeon were experimentally released into Kinbasket. 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. This conditional study, if implemented, could focus on identifying any unresolved questions rising from CLBMON-26, described below.

Options for this program will be discussed at the technical review in December of 2018 and outcomes from these discussions will be drafted into a submission to the CWR outlining recommended next steps for this program in 2019.

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

This monitoring program was initiated in 2010 and was carried out over a three-year period ending in 2014. The final report detailing a conservation aquaculture strategy for this program is in draft form and will be reviewed by recovery initiative partners prior to finalization.

CLBMON-26 was designed in two phases. Phase one was an ecological risk assessment and forms the basis of the early reports. At the Mid Columbia White Sturgeon Management Plan midterm review in 2012 a decision was made to prepare a conservation aquaculture strategy that, even though not implemented, would help inform future discussions around the use of Kinbasket reservoir as a failsafe or recovery area for White Sturgeon.

Options for this program will be discussed at the technical review in December of 2018 and outcomes from these discussions will be drafted into a submission to the CWR outlining recommended next steps for this program in 2019.

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

This monitoring program was initiated in 2009 and was carried out over three years ending in 2012. The primary purpose of this study was to investigate aspects of the relationship between temperature and early life history survival and recruitment. This project is complete.

5.9 CLBMON-28 Lower Columbia River Adult Sturgeon Population Monitoring

This monitoring program was initiated in 2008 and will be carried out over 12 years. Attached is the report covering Year 10 dated July 2018.

One important aspect of this program in recent years is the initiation of a systematic stock assessment that was started in 2013 to estimate the number of White Sturgeon in the transboundary reach of the Columbia River. This study represents the first systematic population estimate for the entire transboundary reach and a secondary objective is to estimate survival of hatchery released juvenile in this reach. At the conclusion of 2017, all ten sessions have been completed and preliminary data analyses have estimated a wild population abundance of 1,071 (629-1,512) individuals. This project has been identified as critical by recovery initiative partners as it is providing data that are important for recovery of White Sturgeon in the Columbia. It is expected that the stock assessment will continue in future years to

further refine population abundance estimates, identify natural recruitment, and better define movements of both wild and hatchery-origin fish.

5.10 CLBMON-29 Lower Columbia River Juvenile Sturgeon Monitoring

This monitoring program was initiated in 2008 and will be carried out over 12 years. Attached is a report for Year 10 dated July 2018.

For approximately the last 40 years, recruitment of White Sturgeon in the Transboundary Recovery Area (TRA) of the Columbia River (Hugh L. Keenleyside Dam (HLK) to Grand Coulee Dam (GCD) in WA, USA) has not occurred at a rate sufficient to maintain the population. In response to this, the Upper Columbia White Sturgeon Recovery Initiative (UCWSRI) was formed in 2000, and developed a Recovery Plan, a key component of which is the supplementation of the existing White Sturgeon population through broodstock collections, hatchery rearing, and stocking of juvenile White Sturgeon.

Over 150,000 hatchery-origin juvenile White Sturgeon have been released into the TRA from 2002 to spring 2018 (yearly releases ranging from 76 in 2016 to 21,603 in 2005). These juveniles are being monitored annually by various agencies (i.e., Washington Department of Fish and Wildlife (WDFW)) and BC Hydro under this program. There are an estimated 5,725 (5,022-6,428) hatchery-origin individuals in Canada from analyses conducted using the stock assessment data. These juveniles have extended the estimated extirpation of this population by several decades and are now reaching a size and stage of maturity where they will start entering the adult population. A recent review of White Sturgeon capture data has identified high variability in maternal family representation of hatchery-origin juveniles in both the Canadian and U.S. portions of the Transboundary Reach of the Columbia River. Unequal family representation presents a substantial genetic risk to the long term viability of the White Sturgeon population in the Transboundary Reach, and the UCWSRI TWG are working on conservation measures to address this issue.

Larval monitoring under this program has been successful in identifying larvae distributing from the Hugh L. Keenleyside (HLK)/Arrow Lakes Hydro (ALH) spawning area, downstream of Kinnaird, and from the Waneta spawning site downstream into the US portion of the lower Columbia River. These progeny are captured in the wild and transferred to the hatchery for rearing and release in an attempt to increase genetic diversity in the conservation aquaculture program.

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

This monitoring program was initiated in 2009 and will be carried out over ten years. Work is ongoing, including analyses of long-term movements related to flows and environmental variables. These results will be presented when available, likely in 2018.

A long-term data set is required to address the effects of higher flow years on White Sturgeon movements, spawning site selection, and habitat use. Importantly, both 2011 and 2012 were years of high (>200 kcfs) sustained flows (>4 weeks), where Columbia River discharge at the international borders reached levels that could not be achieved operationally. These years serve as the test years in the long-term database being developed with the expectation that natural recruitment of wild juveniles would be detected through the CLBMON-29 juvenile monitoring program.

One of the key management questions is relating spawning site selection and years of higher flows, to determine if additional sites are used in those years. This has proved challenging due to the logistics associated with sampling equipment at higher flows (e.g., 2012 flow year) and a relatively small dataset on spawning locations outside of the primary site at Waneta. Spawning (documented through egg and larval captures) had only been identified to occur at the Waneta area prior to the monitoring studies under the Columbia River Water Use Plan being implemented. Results from recent WUP work reveal that spawning occurs downstream of HLK and ALH in some years, though it is not known if this site is used annually for spawning and continues to be the focus of additional monitoring. Spawning also occurs on an annual basis in the Kinnaird area, as egg and larval captures have been collected from 2007-2017. However, the main geographical boundaries and how they may change in years of higher flows, remains uncertain. A comprehensive analysis that will include telemetry data from other recovery team partners is being developed to determine if annual changes in environmental variables influence sturgeon habitat use or movements to spawning areas.

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

This monitoring program was initiated in 2010 and was carried out over a three-year period ending in 2014. The final report incorporates additional work that expanded the modelling through BC Hydro's Revelstoke Unit 6 environment project, which has proved beneficial to the analysis being conducted under this Columbia WUP study. This project is complete.

This project was based primarily on advanced hydraulic modelling which was developed over a three-year period to validate with field sampling over a range of Revelstoke Dam Discharges and Arrow Lakes Reservoir elevations. The work was implemented concurrently with CLBMON-20, due to similarities in management questions and methodology. The overall objective of CLBMON-54 was to examine the effects of the additional (5th) generating unit at Revelstoke Dam on the spawning and early life stage habitat at the known spawning area. Results of this work demonstrated that the additional flows of Revelstoke unit 5 were only slightly beneficial to the conditions experienced at the spawning location and more suitable early life stage habitat exists in the area than previously known. Suitable spawning parameters (depths and flows) existed over most operational scenarios tested.

6 Status of Physical Works

6.1 CLBWORKS-24 Mid Columbia Experimental Aquaculture

This physical works was initiated in 2007 and was carried out over five years ending in 2012. The purpose of this program was to provide larvae and juveniles for release into the Mid Columbia to evaluate survival, habitat use, and impacts of Arrow operations on juvenile habitat availability and suitability (CLBMON-21). This project is complete and CLBWORKS-25 has been initiated to continue conservation aquaculture in the Mid-Columbia.

6.2 CLBWORKS-25 Mid Columbia Sturgeon Conservation Aquaculture

This physical works was initiated in 2012 and initially to be carried out over six year. An additional year of work is implementation will be completed, within the existing TOR budget and methods. Attached is the report for Year 6 dated July 2018.

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

Options for this program will be discussed at the technical review in December of 2018 and outcomes from these discussions will be drafted into a submission to the CWR outlining recommended next steps for this program in 2019.

6.3 CLBWORKS-26 Mid Columbia Sturgeon Upgrade Hatchery

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. This project is complete.

6.4 CLBWORKS-27 Lower Columbia White Sturgeon Physical Works: Physical works options to address white sturgeon recruitment failure in the lower Columbia River.

The Terms of Reference for this project was approved June 6, 2018

This project is being implemented in summer of 2018. Future updates will be provided as work progresses.

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

This physical works was initiated in 2011 and was carried out over two years ending in 2013. This study has helped to inform development of Terms of Reference and associated physical works options under CLBWORKS-27 by investigating likely causes of recruitment failure as they relate to physical and environmental conditions in the lower Columbia River. This work has been peer reviewed by several technical experts and also serves as an important study discussing historical recruitment patterns for this population. This project is complete.

6.6 CLBWORKS-34 Lower Columbia Sturgeon Conservation Aquaculture Program

This physical works was initiated in 2008 and will be carried out over 12 years ending in 2019. Attached is the report for Year 10 dated May 2018.

Starting in 2014, this program started piloting the use of wild eggs and larvae as supplemental progeny in the hatchery program. This was based on the results of genetic work conducted under CLBMON-28 which suggested that more wild adults could be represented in supplemental hatchery progeny using this method compared to the traditional broodstock program. A pilot program was initiated to investigate this as a conservation aquaculture option going forward. A small streamside trailer was established on the banks of the Columbia River near the Waneta spawning grounds. Results from the 2014 pilot year for the streamside facility were successful,

with over 1,000 wild origin juveniles released into the LCR. The program was then fully adopted in 2015 and the traditional broodstock program has been suspended for the lower Columbia going forward. Wild-origin progeny have been successfully collected, reared, and released annually from 2015-2018. Additional discussions are occurring at the UCWSRI TWG to determine long-term population goals and how this aquaculture program can meet those targets while augmenting genetic diversity through techniques like the culture of wild origin progeny.

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 June 30, 2018.

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	\$17,096	\$10,303	\$3,432	\$13,736	\$3,360		
C05M19A KIN: Sturgeon Invent	\$591,767	\$548,372	\$4,850	\$553,222	\$38,545	Project Complete	
C05M19A KIN: Sturgeon Invent - OR DM	\$47,474	\$33,419	\$4,850	\$38,269	\$9,205		
C05M19A KIN: Sturgeon Invent - OR Imp	\$544,293	\$514,953		\$514,953	\$29,340		
C05M20A MID COL White Sturge - ONR	\$65,316	\$41,194		\$41,194	\$24,122	Project Complete	
C05M20A MID COL White Sturge - ONR Imp	\$65,316	\$41,194		\$41,194	\$24,122		
C05M20A MID COL White Sturge - OR	\$313,123	\$193,150	\$4,850	\$198,000	\$115,123	Project Complete	
C05M20A MID COL White Sturge - OR DM	\$37,623	\$24,819	\$4,850	\$29,669	\$7,954		
C05M20A MID COL White Sturge - OR Imp	\$275,500	\$168,331		\$168,331	\$107,169		
C05M21A MID COL Juvenile Stu	\$1,761,966	\$1,668,075	\$56,076	\$1,724,151	\$37,815	TOR submitted for approval	
C05M21A MID COL Juvenile Stu - OR DM	\$167,316	\$91,257	\$38,244	\$129,501	\$37,815		
C05M21A MID COL Juvenile Stu - OR Imp	\$1,594,650	\$1,576,818	\$17,832	\$1,594,650	\$0		
C05M23A MID COL Sturgeon Egg	\$1,504,542	\$1,211,693	\$292,849	\$1,504,542	\$0		
C05M23A MID COL Sturgeon Egg - OR DM	\$155,990	\$89,205	\$26,089	\$115,295	\$40,695		
C05M23A MID COL Sturgeon Egg - OR Imp	\$1,348,552	\$1,122,488	\$266,759	\$1,389,247	(\$40,695)		
C05M24A MID COL Sturgeon Gen	\$0	\$3,042		\$3,042	(\$3,042)	A TOR will be submitted if the works proceeds.	
C05M24A MID COL Sturgeon Gen - OR DM	\$0	\$3,042		\$3,042	(\$3,042)		
C05M24A MID COL Sturgeon Gen - OR Imp	\$0			\$0	\$0		
C05M25A KIN: Juv Sturg Detect	\$0	\$1,563		\$1,563	(\$1,563)	A TOR will be submitted if the works proceeds.	
C05M25A KIN: Juv Sturg Detect - OR DM	\$0	\$1,563		\$1,563	(\$1,563)		
C05M25A KIN: Juv Sturg Detect - OR Imp	\$0			\$0	\$0		
C05M26A KIN: Sturg Recoloniz	\$325,523	\$266,280	\$24,850	\$291,130	\$34,393	Project nearing completion, only reporting costs remain	
C05M26A KIN: Sturg Recoloniz - OR DM	\$51,455	\$26,260	\$4,850	\$31,111	\$20,344		
C05M26A KIN: Sturg Recoloniz - OR Imp	\$274,068	\$240,020	\$20,000	\$260,020	\$14,048		
C05M27A MID COL Sturg Incub	\$375,879	\$360,581	\$4,850	\$365,432	\$10,447	Project Complete	
C05M27A MID COL Sturg Incub - OR DM	\$56,570	\$35,893	\$4,850	\$40,744	\$15,826		
C05M27A MID COL Sturg Incub - OR Imp	\$319,309	\$324,688		\$324,688	(\$5,379)		
C05M28A LC: Adult Sturg	\$3,483,799	\$1,772,656	\$476,252	\$2,248,908	\$1,234,891	Project may be extended within budget. A TOR resubmission will be sent	
C05M28A LC: Adult Sturg - OR DM	\$422,141	\$132,100	\$31,325	\$163,425	\$258,716		
C05M28A LC: Adult Sturg - OR Imp	\$3,061,658	\$1,640,556	\$444,927	\$2,085,483	\$976,175		
C05M29A LC: Juv Sturgeon	\$3,120,256	\$1,772,518	\$457,972	\$2,230,490	\$889,766	Project may be extended within budget. A TOR resubmission will be sent	
C05M29A LC: Juv Sturgeon - OR DM	\$218,003	\$122,850	\$21,427	\$144,277	\$73,726		
C05M29A LC: Juv Sturgeon - OR Imp	\$2,902,253	\$1,649,668	\$436,545	\$2,086,213	\$816,040		
C05M30A LC: Opportunist	\$526,741	\$293,481	\$94,110	\$387,591	\$139,150	Efficiencies found during implementation	
C05M30A LC: Opportunist - OR DM	\$131,917	\$60,187	\$14,783	\$74,970	\$56,947		
C05M30A LC: Opportunist - OR Imp	\$394,824	\$233,293	\$79,327	\$312,621	\$82,203		
C05M54A MCR Effect of Flow	\$328,107	\$197,128	\$4,850	\$201,979	\$126,128	Project Complete	
C05M54A MCR Effect of Flow - ONR DM	\$38,208	\$18,727	\$4,850	\$23,578	\$14,630		
C05M54A MCR Effect of Flow - ONR Imp	\$289,899	\$178,401		\$178,401	\$111,498		
C05W24A MID COL Expersturg	\$1,783,845	\$1,783,846		\$1,783,846	\$0	Project Complete	
C05W24A MID COL Expersturg - OR DM	\$50,606	\$23,510		\$23,510	\$27,096		
C05W24A MID COL Expersturg - OR Imp	\$1,733,239	\$1,760,335		\$1,760,335	(\$27,096)		
C05W25A MID COL Consr Sturg	\$3,159,806	\$1,775,002	\$411,723	\$2,186,725	\$973,081	Efficiencies found during implementation	
C05W25A MID COL Consr Sturg - OR DM	\$83,368	\$26,427	\$21,328	\$47,754	\$35,614		
C05W25A MID COL Consr Sturg - OR Imp	\$3,076,438	\$1,748,575	\$390,396	\$2,138,970	\$937,468		
C05W26A MID COL Upgrd Sturg	\$585,560	\$532,938	\$4,850	\$537,788	\$47,772	Project Complete	
C05W26A MID COL Upgrd Sturg - OR DM	\$9,018	\$6,743	\$4,850	\$11,594	(\$2,576)		
C05W26A MID COL Upgrd Sturg - OR Imp	\$576,542	\$526,194		\$526,194	\$50,348		
C05W27A LC Recruitment Failure	\$682,179	\$68,678	\$562,983	\$631,661	\$50,518		
C05W27A LC Recruitment Failure - OR DM	\$164,199	\$38,690	\$125,509	\$164,199	(\$0)		
C05W27A LC Recruitment Failure - OR Imp	\$517,980	\$29,988	\$437,474	\$467,462	\$50,518		
C05W28A LC Pln Wsg Tur	\$182,520	\$77,139	\$4,850	\$81,990	\$100,530	Project Complete	
C05W28A LC Pln Wsg Tur - OR DM	\$33,304	\$16,053	\$4,850	\$20,903	\$12,401		
C05W28A LC Pln Wsg Tur - OR Imp	\$149,216	\$61,086		\$61,086	\$88,130		
C05W34A LC Sturg Aqua	\$2,773,383	\$1,761,351	\$298,401	\$2,059,752	\$713,631		
C05W34A LC Sturg Aqua - OR DM	\$152,467	\$55,607	\$10,423	\$66,030	\$86,437		
C05W34A LC Sturg Aqua - OR Imp	\$2,620,916	\$1,705,745	\$287,978	\$1,993,723	\$627,193		

OR - Ordered Remissible
ONR - Ordered Non-Remissible