

# Columbia River Project Water Use Plan

## Columbia River White Sturgeon Management Plan Monitoring Program and Physical Works

**Annual Report: 2023**

**Implementation Period: July 2022 to June 2023**

- 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)**

## **BC Hydro Columbia River Project Water Use Plan Columbia River White Sturgeon Management Plan Monitoring Programs and Physical Works Annual Report: 2023**

### **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, 2023, 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	Feb 03, 2023	Mar 17, 2023
CLBMON-23 Mid Columbia River Sturgeon Egg Mat Monitoring and Underwater Videography Feasibility	Schedule F.1.e	Jun 15, 2007	Jul 11, 2007	Mar 02, 2023	Mar 23, 2023
CLBMON-24 Mid Columbia River Sturgeon Genetics	Schedule F.1.f	Feb 10, 2021	Mar 04, 2021		
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	Mar 18, 2022	Apr 22, 2022
CLBMON-29 Lower Columbia River Juvenile Sturgeon Monitoring	Schedule F.1.i	May 12, 2008	Jun 25, 2008	Mar 18, 2022	Apr 22, 2022
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	Mar 02, 2023	Mar 23, 2023
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	Dec 17, 2021	Jan 25, 2022
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	Apr 11, 2023	Apr 14, 2023

### 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, 2023**

Columbia River Water Use Plan – Columbia River White Sturgeon Management Plan  
Monitoring Programs and Physical Works Annual Report: 2023

Monitoring Programs	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
	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	WLR YR17	WLR YR18	WLR YR19	WLR YR20	WLR YR21
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	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	u/w	■	■	■	■
CLBMON-23 Mid Columbia River Sturgeon Egg Mat Monitoring and Underwater Videography Feasibility	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	u/w	■	■	■	■
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		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	u/w	■	■	■	■
CLBMON-29 Lower Columbia River Juvenile Sturgeon Monitoring		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	u/w	■	■	■	■
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				x	✓	✓	✓F														
<b>Physical Works</b>																					
CLBWORKS-24 Mid Columbia Experimental Aquaculture		✓	✓	✓	✓	✓F															
CLBWORKS-25 Mid Columbia Sturgeon Conservation Aquaculture						✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	u/w	■	■	■	■
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		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	u/w	■	■	■	■

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.
- ☒ = Relief granted
- ☐ = 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:

[https://www.bchydro.com/toolbar/about/sustainability/environmental\\_responsibility/water-use-plans/southern-interior/columbia-river/columbia-sturgeon.html](https://www.bchydro.com/toolbar/about/sustainability/environmental_responsibility/water-use-plans/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. This project is 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 overall objective of this study 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, 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. Following Mid-Columbia River White Sturgeon Technical Forums in December 2018 and January 2023, and with the support of the participants, the program was extended to the Water Use Plan Ordered Review (WUPOR) to ensure management questions could be adequately addressed.

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 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. Low capture rates in MCR may be due to predation, slower growth, or a more challenging reservoir environment to sample. While captures of fish years after release 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. Since the 2018 Technical Forum, there has been an increase in sample size of recaptured juvenile white sturgeon. However, due to low recaptures of juveniles following release from the hatchery (<1%), factors influencing growth and survival remain uncertain and additional years of capture effort leading up to the WUPOR are important to implement.

The Year 16 report, dated July 2023, is attached.

#### **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. The study was supported for extension until the WUPOR by participants at the Mid Columbia River White Sturgeon Technical Forums in December 2018 and January 2023 and approved by the CWR in March 2023. This will provide a longer dataset to improve the confidence in the results but also allows for increased numbers of progeny collected at the Revelstoke spawning site to be incorporated into the conservation aquaculture program.

This monitoring program was designed to ensure consistent annual monitoring based on the outcome of the Mid Columbia White Sturgeon Management Plan 2012 Midterm Review, which was reviewed again in 2018. A key result from the program has been the collection of both wild-origin eggs and larvae that were transferred to the hatchery program in each year 2018-2022. Since the inception of the aquaculture program in 2001, wild White Sturgeon from Arrow Reservoir had not been represented in supplemental progeny that were released until eggs were transferred starting in 2018. Wild-origin juveniles from the Revelstoke spawning site are being reared to a larger size (700 g) threshold for release to hopefully improve survival in the wild. Of note, spawning has been detected in the Mid Columbia River near Revelstoke in 16 of 21 years where monitoring has occurred (13 of 16 WUP years). An outcome of the 2023 Technical Forum was a recommendation to relocate the streamside incubation facility, used in the Lower Columbia River for on-site egg incubation and larval rearing, to an area adjacent to the Revelstoke spawning area to improve survival of progeny collected at the site prior to transferring to the hatchery. Permits have been obtained for the relocation and the trailer will be moved during the summer of 2023.

The Year 16 report, dated June 2023, is attached.

#### **5.5 CLBMON-24 Mid Columbia River Sturgeon Genetics**

The purpose of this program was to analyze samples collected from monitoring under CLBMON-23 to estimate numbers of spawning adults contributing to progeny collected at the Revelstoke spawning area. However, challenges in collecting sufficient genetic samples delayed this program. In 2018, monitoring was successful in collecting a larger number of progenies from spawning events. In 2019, 2020, and 2021, further samples were obtained from spawning events which, combined with the ones collected in earlier years (2007-2017), were sufficient for analysis. This is timely as other pertinent genetic questions exist in the lower Columbia River and work to analyze both sets of samples can occur concurrently to ensure efficient use of resources.

The TOR for this program was approved on March 4, 2021, and this study is underway, being delivered in partnership with other recovery team members that have genetic samples from the population (US partners) and experts in White Sturgeon genetics. Results are expected later in 2023, with a report to be provided with next years annual report. A TOR resubmission for final reporting will be submitted to the CWR by October 31, 2023.

#### **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 2012 Mid Columbia White Sturgeon Management Plan Midterm Review to focus on questions related to sturgeon recovery in the Arrow Lakes Reservoir before conducting concurrent work in Kinbasket. This conditional study, if implemented, would focus on identifying any unresolved questions rising from CLBMON-26, described below.

At the 2018 Mid Columbia River White Sturgeon Technical Forum, participants agreed that CLBMON-26 is complete; hence no need for further work under CLBMON-25 while the Arrow Lakes Reservoir programs are being evaluated. A review of the feasibility of utilizing Kinbasket Reservoir as a recovery area for juvenile White Sturgeon will be conducted during the Columbia River Water Use Plan Order Review. For this reason, the CWR granted relief on May 13, 2020 from implementing CLBMON-25.

#### **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.

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

At the 2018 Mid Columbia River White Sturgeon Technical Forum, participants agreed that this study is complete. Further evaluation of Kinbasket as a recovery area will only occur if Arrow efforts are unsuccessful.

#### **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 was initially carried out over 12 years. Cost efficiencies during implementation will allow for additional years of monitoring with no additional request for budget; therefore, the juvenile monitoring

study was approved by the CWR on April 22, 2022 for extension until 2027 and covers monitoring of the habitat restoration physical works under CLBWORKS-27.

An important aspect of this program in recent years is the initiation of a systematic stock assessment that 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; a secondary objective is to estimate survival of hatchery released juvenile in this reach. At the conclusion of 2022, 20 sessions have been completed and preliminary data analyses have estimated a wild population abundance of approximately 1,000 individuals in the Canadian section of the upper Columbia River. An updated population model is in development, with results expected for next years annual report, that will shed more light on trends in abundance and survival since the onset of the program.

Another key objective of this program is to monitor spawning activity at the known spawning locations in the lower Columbia River to identify the timing, frequency, and duration of spawning. As part of this work, wild-origin progeny is collected and transferred to the hatchery to serve as progeny for the conservation aquaculture program. 2022 represented another successful year where spawn monitoring was completed at multiple locations, and sufficient numbers of wild-origin progeny were transferred to the hatchery to meet the release target of 200 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. Cost efficiencies will allow for additional years of monitoring with no additional request for budget; therefore, the stock assessment was approved for extension until 2027 to further refine population abundance estimates, identify natural recruitment, and better define movements of both wild and hatchery-origin fish.

The Year 15 data report, dated July 2023, is attached.

#### **5.10 CLBMON-29 Lower Columbia River Juvenile Sturgeon Monitoring**

This monitoring program was initiated in 2008 and was carried out over 12 years. Cost efficiencies during implementation will allow for additional years of monitoring with no additional request for budget; therefore, the juvenile monitoring study was approved by the CWR on April 22, 2022 for extension until 2027.

Work under this program to describe survival, growth, and habitat use of hatchery-origin White Sturgeon following release from the aquaculture program into the river has been very successful and informs management decisions related to stocking targets. Monitoring results have found there are >5,000 hatchery origin White Sturgeon at large in the lower Columbia River, extending the estimated extirpation of the population by several decades. Recent work has described the reproductive structure of the hatchery-origin population. Results suggest that a small proportion of males have reached maturity and may be contributing to spawning events. Further, significant progress was made in 2022 describing habitat use of hatchery-origin sturgeon under varying environmental conditions (temperature and discharge) in collaboration with US partners.

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 progenies are captured in the wild



and transferred to the hatchery for rearing and release to increase genetic diversity in the conservation aquaculture program. Genetic analyses are ongoing to confirm levels of genetic diversity represented in this approach, with results expected for next years report.

The Year 13-15 report which covers some larger analyses of juvenile growth between January 2020 and December 2022, is attached.

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

This monitoring program was initiated in 2009 and carried out over ten years, with data collection extending a few additional years under companion programs (CLBMON-28 and 29). The program focused on assembly of long-term datasets, followed by larger analyses to evaluate how sturgeon habitat use and movements are influenced by environmental variables. A key component was to use acoustic transmitters to assess the effects of higher flow years on White Sturgeon movements, spawning site selection, and habitat use. Those tags were deployed in a structured manner from 2009-2013. With a life span of 10 years, the tags applied most recently are just starting to cease operation and the data being incorporated. A large relational database was developed to manage all data types required for the analysis including life history information (e.g., capture and biological information), environmental covariates (e.g., flows or habitat), animal movements (e.g., telemetry), and other important program components (e.g., hatchery programs).

The analyses of these datasets began in 2019 but are not complete given more time than expected to develop databases, models, and find qualified personnel. In addition to more complex analysis, routine biological monitoring to identify possible recruitment from high flow years has been ongoing under CLBMON-29. A report is being drafted outlining the results of this program, with the final report expected for next year's annual report.

#### **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 overall objective of CLBMON-54 was to examine the effects of the additional (5<sup>th</sup>) 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 five 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. This project is complete.

### **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 carried out over six years. The project was supported for extension until the WUPOR by participants at the 2018 and 2023 Mid Columbia River White Sturgeon Technical Forums and approved by the CWR in March 2023.

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.

Attached is the report (which is combined with the Year 15 report for CLBWORKS-34) for Year 11 dated July 2023.

## **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 based on a 2009 decision 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.**

This project was initiated in 2018. Workshops were held in May 2019 and February 2020 to evaluate the suitability of current conditions at the known White Sturgeon spawning areas in the Lower Columbia River and to identify restoration options at spawning areas based on biological and technical feasibility. A final restoration alternative was selected for consideration in Phase Two of this program, and a design was completed and approved. The final report for Phase Two is attached.

The Terms of Reference for Phase Three Construction was approved on January 25, 2022. Construction was initiated in late September 2022 and, following winter weather, river flow, and methodology related delays, was complete by April 30, 2023.

The area will be monitored for spawning activity via regular annual spawn monitoring under CLBMON-28 over the next four years. Physical monitoring will be via bathymetric surveys at regular intervals and annual gabion basket temperature data collection. The construction report is in draft and will be submitted with the next annual report.

## **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 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 was carried out over 12 years ending in 2019. Cost efficiencies allowed for additional years of this physical works with no additional request for budget; therefore, the LCR sturgeon aquaculture program was extended until 2022. Continuation of the program will be discussed at the Upper Columbia White Sturgeon Recovery Initiative (UCWSRI) annual meeting later in the fall.

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 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 was suspended for the lower Columbia going forward. Wild-origin progeny have been successfully collected, reared, and released annually from 2015-2023. Additional discussions are occurring at the UCWSRI Technical Working Group 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.

Attached is the report (which is combined with the Year 11 report for CLBWORKS-25) for Year 15 dated July 2023.

## **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, 2023.

**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
<b>CLB MP5 White Sturgeon Annual Report</b>	\$27,409	\$16,180	\$9,131	\$25,312	\$2,097		
<b>C05M19A KIN: Sturgeon Invent - OR</b>	\$591,767	\$548,372		\$548,372	\$43,395	Project complete	
C05M19A KIN: Sturgeon Invent - OR DM	\$47,474	\$33,419		\$33,419	\$14,055		
C05M19A KIN: Sturgeon Invent - OR Imp	\$544,293	\$514,953		\$514,953	\$29,340		
<b>C05M20A MID COL White Sturge - ONR</b>	\$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		
<b>C05M20A MID COL White Sturge - OR</b>	\$313,123	\$193,150		\$193,150	\$119,973	Project complete	
C05M20A MID COL White Sturge - OR DM	\$37,623	\$24,819		\$24,819	\$12,804		
C05M20A MID COL White Sturge - OR Imp	\$275,500	\$168,331		\$168,331	\$107,169		
<b>C05M21A MID COL Juvenile Stu</b>	\$3,075,067	\$2,323,014	\$684,283	\$3,007,297	\$67,770	Efficiencies found during project implementation	
C05M21A MID COL Juvenile Stu - OR DM	\$169,512	\$118,989	\$31,014	\$150,002	\$19,510		
C05M21A MID COL Juvenile Stu - OR Imp	\$2,905,555	\$2,204,026	\$653,269	\$2,857,295	\$48,260		
<b>C05M23A MID COL Sturgeon Egg</b>	\$2,152,013	\$1,655,260	\$393,755	\$2,049,015	\$102,998	Efficiencies found during project implementation	
C05M23A MID COL Sturgeon Egg - OR DM	\$198,590	\$129,565	\$42,429	\$171,994	\$26,596		
C05M23A MID COL Sturgeon Egg - OR Imp	\$1,953,423	\$1,525,696	\$351,326	\$1,877,021	\$76,402		
<b>C05M24A MID COL Sturgeon Gen</b>	\$94,561	\$91,566	\$8,240	\$99,806	(\$5,245)	Resubmit TOR by Oct 31, 2023	
C05M24A MID COL Sturgeon Gen - OR DM	\$24,413	\$10,135	\$8,240	\$18,375	\$6,038		
C05M24A MID COL Sturgeon Gen - OR Imp	\$70,148	\$81,431		\$81,431	(\$11,283)		
<b>C05M25A KIN: Juv Sturg Detect - ONR</b>		\$1,562		\$1,562	(\$1,562)	Relief granted	
C05M25A KIN: Juv Sturg Detect-ONR DM OS		\$1,562		\$1,562	(\$1,562)		
C05M25A KIN: Juv Sturg Detect-ONR Imp OS							
<b>C05M26A KIN: Sturg Recoloniz</b>	\$325,523	\$266,280	\$4,188	\$270,468	\$55,055	Project complete, remaining budget for completion reporting	
C05M26A KIN: Sturg Recoloniz - OR DM	\$51,455	\$26,260	\$4,188	\$30,448	\$21,007		
C05M26A KIN: Sturg Recoloniz - OR Imp	\$274,068	\$240,020		\$240,020	\$34,048		
<b>C05M27A MID COL Sturg Incub</b>	\$375,879	\$361,272	\$4,188	\$365,460	\$10,419	Project complete, remaining budget for completion reporting	
C05M27A MID COL Sturg Incub - OR DM	\$56,570	\$36,585	\$4,188	\$40,772	\$15,798		
C05M27A MID COL Sturg Incub - OR Imp	\$319,309	\$324,688		\$324,688	(\$5,379)		
<b>C05M28A LC: Adult Sturg</b>	\$3,483,799	\$2,310,520	\$904,300	\$3,214,820	\$268,979	Efficiencies found during project implementation	
C05M28A LC: Adult Sturg - OR DM	\$422,141	\$174,782	\$46,846	\$221,628	\$200,513		
C05M28A LC: Adult Sturg - OR Imp	\$3,061,658	\$2,135,737	\$857,455	\$2,993,192	\$68,466		
<b>C05M29A LC: Juv Sturgeon</b>	\$3,120,256	\$2,488,193	\$605,393	\$3,093,586	\$26,670	Efficiencies found during project implementation	
C05M29A LC: Juv Sturgeon - OR DM	\$218,003	\$162,074	\$47,019	\$209,093	\$8,910		
C05M29A LC: Juv Sturgeon - OR Imp	\$2,902,253	\$2,326,118	\$558,374	\$2,884,493	\$17,760		
<b>C05M30A LC: Opportunist</b>	\$526,741	\$437,525		\$437,525	\$89,216	Efficiencies found during project implementation	
C05M30A LC: Opportunist - OR DM	\$131,917	\$79,930		\$79,930	\$51,987		
C05M30A LC: Opportunist - OR Imp	\$394,824	\$357,595		\$357,595	\$37,229		
<b>C05M54A MCR Effect of Flow</b>	\$328,107	\$197,128		\$198,778	\$129,329	Project complete	
C05M54A MCR Effect of Flow - ONR DM	\$38,208	\$18,727	\$1,650	\$20,377	\$17,831		
C05M54A MCR Effect of Flow - ONR Imp	\$289,899	\$178,401		\$178,401	\$111,498		
<b>C05W24A MID COL Expersturg</b>	\$1,783,845	\$1,783,948		\$1,783,948	(\$103)	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)		
<b>C05W25A MID COL Consr Sturg</b>	\$3,627,837	\$2,676,508	\$567,766	\$3,244,273	\$383,564	Efficiencies found during project implementation	
C05W25A MID COL Consr Sturg - OR DM	\$91,124	\$49,785	\$28,736	\$78,521	\$12,603		
C05W25A MID COL Consr Sturg - OR Imp	\$3,536,713	\$2,626,723	\$539,030	\$3,165,753	\$370,960		
<b>C05W26A MID COL Upgrd Sturg</b>	\$585,560	\$532,938		\$532,938	\$52,622	Project complete	
C05W26A MID COL Upgrd Sturg - OR DM	\$9,018	\$6,743		\$6,743	\$2,275		
C05W26A MID COL Upgrd Sturg - OR Imp	\$576,542	\$526,194		\$526,194	\$50,348		
<b>C05W27A LC Recruitment Failure</b>	\$6,442,707	\$2,497,497	\$3,366,386	\$5,863,884	\$578,823	Efficiencies found during project implementation	
C05W27A LC Recruitment Failure - OR DM	\$579,664	\$413,828	\$224,232	\$638,060	(\$58,396)		
C05W27A LC Recruitment Failure - OR Imp	\$5,863,043	\$2,083,669	\$3,142,154	\$5,225,824	\$637,219		
<b>C05W28A LC Pin Wsg Tur</b>	\$182,520	\$77,554		\$77,554	\$104,966	Project complete	
C05W28A LC Pin Wsg Tur - OR DM	\$33,304	\$16,468		\$16,468	\$16,836		
C05W28A LC Pin Wsg Tur - OR Imp	\$149,216	\$61,086		\$61,086	\$88,130		
<b>C05W34A LC Sturg Aqua</b>	\$3,284,934	\$2,436,300	\$569,401	\$3,005,700	\$279,234	Efficiencies found during project implementation	
C05W34A LC Sturg Aqua - OR DM	\$131,454	\$81,077	\$30,371	\$111,448	\$20,006		
C05W34A LC Sturg Aqua - OR Imp	\$3,153,480	\$2,355,222	\$539,030	\$2,894,252	\$259,228		
<b>OR - Ordered Remissible</b>							
<b>ONR - Ordered Non-Remissible</b>							

\* Red values in parentheses denote overage.