Columbia River Project Water Use Plan

Columbia River White Sturgeon Management Plan
Annual Report: 2007

- CLBMON-19 Kinbasket Reservoir White Sturgeon Inventory and Habitat Use Assessment
- 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 Feasibility Study
- CLBMON-24 Mid Columbia River Sturgeon Genetic
- CLBMON-25 Kinbasket Reservoir Juvenile Sturgeon Detection and Habitat Use Program
- CLBMON-26 Kinbasket Sturgeon Recolonization Risk
- CLBMON-27 Mid Columbia River Sturgeon Incubation and Rearing
- CLBMON-28 Lower Columbia Adult Sturgeon Population Monitoring
- CLBMON-29 Lower Columbia Juvenile Sturgeon Detection
- CLBMON-30 Lower Columbia Opportunistic Assessment of High Flow Events
- CLBMON-54 Mid Columbia River Effects of Flow Changes on Incubation and Early Rearing Sturgeon
- CLBWORKS-24 Mid Columbia River White Sturgeon Experimental Aquaculture
- CLBWORKS-25 Mid Columbia River White Sturgeon Conservation Aquaculture
- CLBWORKS-26 Mid Columbia River White Sturgeon Upgrade Hatchery
- CLBWORKS-27 Lower Columbia Bentonite Addition Experiment
- CLBWORKS-26 Lower Columbia Planning and Assessment of WSG Turbidity
- CLBWORKS-34 Lower Columbia River White Sturgeon Conservation

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

30 May 2008
1 Introduction

This document provides a summary of the status and results of monitoring programs and physical works being implemented under the Columbia River White Sturgeon Management Plan of the Columbia River Water Use Plan (WUP) to 30 April 2008, as per the Columbia River Order under the Water Act, dated 26 January 2007. There are 12 monitoring programs and 6 physical works included within this Management Plan:

- CLBMON-19 Kinbasket Reservoir White Sturgeon Inventory and Habitat Use Assessment
- 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
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2 Background

The water use planning process for BC Hydro’s Columbia River project was initiated in August 2000 and completed in June 2004. The conditions proposed in the WUP for the operation of the project reflect the June 2004 consensus recommendations of the Columbia River WUP Consultative Committee (CC).

In July 2006, the Columbia River Draft WUP was submitted to the Comptroller of Water Rights (CWR). The draft WUP was sent out to regulatory agencies, First Nations and interested stakeholders for review. In January 2007, the CWR approved the final WUP and issued an Order to BC Hydro to implement the conditions proposed in the Columbia River WUP and prepare the monitoring programs and physical works Terms of Reference (TOR).

An addendum to the Columbia River WUP was submitted to the CWR in July 2007 after an Environmental Assessment Certificate was issued for the Revelstoke Unit 5 Project. The addendum proposes additional terms and conditions for the Columbia River WUP, as recommended by the Revelstoke Unit 5 Core Committee in December 2006, to address incremental impacts of the operation of the fifth generating unit at Revelstoke Dam.

In August 2007, the CWR accepted the Columbia River Project WUP Addendum resulting from the Revelstoke Unit 5 Project, and issued amendments to the Columbia River Implementation Order to include the commitments made by BC Hydro to undertake additional monitoring programs and physical works associated with the Revelstoke Unit 5 Project.

The following table outlines the dates that TOR for the Columbia River White Sturgeon Management Plan have been submitted to and approved by the CWR.

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<tr>
<th>Monitoring Programs/ Physical Works TOR</th>
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As outlined in the Columbia River WUP, the Consultative Committee recommended a full review of the Columbia River Water Use Plan 13 years after implementation, unless results of the monitoring program suggest an earlier review is appropriate or significant risks are identified that could result in a recommendation to change operations.

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.

3 Schedule

The following table (Table 3-1) outlines the current schedule for the monitoring programs and physical works being delivered under the Columbia River White Sturgeon Management Plan of the Columbia River Water Use Plan.
Table 3-1: Schedule of Columbia River WUP Monitoring Programs and Physical Works Implementation under the Columbia River White Sturgeon Management Plan

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Legend:
- Program to be undertaken/initiated in identified year
- Project is underway
- Program completed for the year
- Program started, but encountered operational or hydrological delays
- Program is on the conditional list

4 Columbia River WUP Monitoring Programs - Columbia River White Sturgeon Management Plan

This section summarizes the status of the monitoring programs being implemented under the Columbia River White Sturgeon Management Plan of the Columbia River Water Use Plan, as per the Order under the Water Act, dated January 26, 2007.

4.1 CLBMON-19 Kinbasket Sturgeon Inventory and Habitat Use

4.1.1 Overview

The Kinbasket Sturgeon Inventory and Habitat Use study is a 3-year investigation into the status and habitat use of white sturgeon in Kinbasket Reservoir and the Columbia River upstream. The study is descriptive in nature, and will include surveys at key locations to capture adult and/or juvenile sturgeon and record habitat characteristics important to the white sturgeon life cycle.

The primary objectives of this monitoring program are to assess:
- the presence of white sturgeon in Kinbasket Reservoir,
• whether natural recruitment has occurred, and
• the habitat associations of white sturgeon in Kinbasket Reservoir.

Information obtained through this monitoring program will feed into a subsequent or concurrent evaluation of Kinbasket Reservoir as a recovery/failsafe area for white sturgeon included as part of the Mid Columbia River White Sturgeon Monitoring Plan.

4.1.2 Status

This monitoring program is being initiated in June 2008 and will be carried out over 3 consecutive years. A contract was awarded to CCRIFC in association with the Okanagan Nation Alliance (ONA) and Westslope. The first program report is expected in January 2009.

4.1.3 Interpretation of Data

At this time, there are no data to interpret for this monitoring program.

4.2 CLBMON-20 Mid Columbia River Spawning Habitat Assessment

4.2.1 Overview

As part of the monitoring plan recommended for the Arrow Lakes Reservoir sturgeon population, the WUP Consultative Committee identified the need to better understand spawning habitat capability in the mid Columbia River, and how dam and reservoir operations influence the quality and quantity of this habitat. It was recommended that detailed hydrometric surveys be undertaken in the mid Columbia River in locations of known white sturgeon spawning and other locales, as appropriate, to validate assumptions used to decide on and set white sturgeon spawning flow treatments, and determine spawning habitat objectives for sturgeon for future rehabilitation activities.

The Mid Columbia River White Sturgeon Spawning Habitat Assessment is being conducted over a 2-year period to:

1) Assess hydraulic and substrate conditions in locations of known sturgeon spawning immediately below Revelstoke Dam.
2) Relate hydraulic conditions to discharge from the dam and water elevation of Arrow Lakes Reservoir.
3) Assess operations of the dam and the reservoir in providing suitable spawning conditions and incubation for white sturgeon.
4) Provide recommendations for selection of a water allocation schedule for white sturgeon spawning in the mid Columbia River.

The scope of the program is limited to empirical measurement of hydraulics, observations of substrate conditions, post-measurement analysis, and professional judgment. The study will be undertaken over a 2-year period (one year pre-REV5 and one year post-REV5) to allow collection of data over a range of dam discharges and reservoir elevations.
4.2.2 Status

This monitoring program will be carried out over two years (2009, 2011). Contract award is scheduled for July 2009. The first program report is expected in February 2010.

4.2.3 Interpretation of Data

At this time, there are no data to interpret for this monitoring program.

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

4.3.1 Overview

This study is being conducted to better understand juvenile white sturgeon habitat capabilities in the mid Columbia River, and the potential for either building a self-sustaining or failsafe population in the Arrow Lakes Reservoir. This monitoring program will be conducted over a 10-year period, including pre- and post-flow treatment conditions, to evaluate juvenile survival and the availability and suitability of juvenile habitat downstream of Revelstoke Dam to the downstream end of the Revelstoke Reach (roughly located along a line from Arrowhead to Shelter Bay). Sampling may need to be undertaken in other areas of Arrow Lakes Reservoir depending on study results. This work is to be undertaken primarily through a program to recapture marked fish and assessments of the patterns of habitat use by sampling for and tracking juveniles released from the existing conservation aquaculture program. Once the habitats occupied by these fish are located, they will be described to define juvenile habitat parameters, and the reach will be surveyed to assess the availability of such habitat. A comparison of the juvenile habitat within the reach, with juvenile habitat utilized by other white sturgeon populations in the upper Columbia River and elsewhere, will contribute to testing the hypothesis that juvenile habitat limitations are critically limiting the survival of juvenile white sturgeon and that juvenile rearing habitat for sturgeon spawned in the mid Columbia area is critically limited.

A second component of the monitoring program is the tracking of existing sonic tagged adult sturgeon for the duration of the life of their tags. This work is expected to provide improved knowledge of the timing of movements of adult fish into staging and spawning areas near Revelstoke Dam. These timing data will assist other adult sturgeon monitoring projects, including spawn monitoring and testing of techniques for identifying spawning behaviour and events, as well as the description of spawning habitat conditions under varying flow conditions. Since most of the adult tags are being tracked with the same equipment used to monitor tagged juvenile sturgeon, this monitoring component is included as part of the juvenile monitoring program.

4.3.2 Status

The first year of this monitoring program was initiated in April 2007 through a contract to Golder Associates Ltd. (Castlegar). The 2007-08 data report is complete and appended to this annual report.
4.3.3 Interpretation of Data

Prior to the release of 4000 sub-yearling juvenile white sturgeon (including 50 with sonic tags) in the mid Columbia River in early May 2007, a series of 18 VR2W receivers was deployed from the Revelstoke Dam to Beaton Flats/Galena Bay. Seven VR2W download and maintenance sessions were conducted from May 2007 to March 2008, in addition to five mobile tracking sessions for both sonic tagged juveniles and adults. The general movement pattern exhibited by sonic-tagged juvenile white sturgeon was a rapid downstream movement after release until lower velocity habitats were encountered. Movements then generally became less rapid and fish often spent longer periods of time in specific areas. Gill net sampling and habitat measurements were undertaken in the fall and winter in conjunction with mobile tracking in an effort to capture juvenile white sturgeon to assess growth, survival, and habitat use; however, weather and adverse site conditions hampered success of capture and in some cases curtailed sampling effort.

Of the six remaining active coded pingers on adult sturgeon, five were detected by the VR2W array. The furthest upstream detection of a sonic-tagged adult was about 3 km above Tank Creek in August, with the fish subsequently moving back downstream to Beaton Flats. None of the sonic tagged adults exhibited typical spawning movements (i.e., moving to the Big Eddy/golf course area in late July and August) and the movements detected were likely feeding related.

Year 2 of this study will continue in 2008-09.

4.4 CLBMON-23 Mid Columbia River Sturgeon Egg Mat Monitoring & Underwater Videography Feasibility Study

4.4.1 Overview

Annual sturgeon spawn monitoring below Revelstoke Dam is required to document spawning events, timing, frequency, egg deposition, and habitat conditions. Due to the low numbers of aging sturgeon in Arrow Lakes Reservoir, it is likely that spawning events do not occur every year and events will gradually decline in frequency over time. To date, spawn monitoring has occurred when tagged fish have been located close to the spawning site. However, the deployment of additional tags is considered undesirable, as it would require additional capture and stress of the few remaining adults. As an alternative, the feasibility of using underwater videography (or potentially other remote sensing methods) is being examined as a less-intrusive means to assess staging of spawners and record actual spawning events to detect presence of adults in the spawning area. Conducting spawn monitoring with substrate mats will also allow for the collection and on-site incubation of eggs for rearing and release in the mid Columbia River as part of the aquaculture program.

The fundamental management questions to be addressed through this study are:

1. Where are the primary white sturgeon incubation sites below Revelstoke Dam?

2. How do dam and reservoir operations affect egg and larvae survival in this area? Specifically, do significant numbers of eggs become dewatered as a result of operations?
3. Can underwater videography or other remote sensing methods be used to effectively monitor staging and spawning of white sturgeon?

4. What is the most effective method for monitoring spawning of white sturgeon?

5. Can modifications be made to operation of Revelstoke Dam and Arrow Lakes Reservoir to protect or enhance white sturgeon incubation habitat?

4.4.2 Status

The first year of the egg mat monitoring program was initiated in July 2007 through a contract to Golder Associates Ltd. (Castlegar). The 2007-08 data report is complete and appended to this annual report.

The first year of underwater videography feasibility study was initiated in July 2007 through a contract to LGL Limited. The 2007-08 data report is complete and appended to this annual report.

4.4.3 Interpretation of Data

Egg Mat Monitoring Program

Thirty egg collection mats were deployed along 10 transects in the mid Columbia River from the Revelstoke Dam to the Big Eddy over the period July 25th to September 5th totalling 25 818 mat hours of effort. In addition, two D-ring drift nets were deployed; one upstream and one downstream of the Big Eddy for collection of white sturgeon larvae. No spawning event was detected in 2007 either through egg mat monitoring or larvae collection.

Year 2 of this study will continue in 2008-09.

Underwater Videography Feasibility Study

On August 1st, a fixed station DIDSON (Dual frequency Identification Sonar) unit began recording from a location near the putative white sturgeon spawning site in the mid Columbia River at Revelstoke. A DIDSON was chosen for this feasibility study as the technology best suited for detecting adult white sturgeon presence in the mid Columbia River. Several mobile survey techniques were also tested to evaluate the DIDSON’s ability to detect sturgeon in various habitat types (e.g., pool and eddy). From August 1st to 30th, 267 sturgeon observations were recorded from the fixed station DIDSON with 6 of the images showing two sturgeon. None of the sonic tagged adult sturgeon in the Arrow Lakes Reservoir was detected in the spawning area in 2007, therefore, these DIDSON detections are from other adults. The majority of detections occurred between August 1st and August 14th, corresponding with recorded movement data and spawning events from other years (although no spawning event was detected in 2007).

The final year of this feasibility study will be completed in 2008-09.
4.5 CLBMON-24 Mid Columbia River Sturgeon Genetics

4.5.1 Overview

Continuation of ongoing genetic assessment work to determine levels of stock differentiation in Arrow Lakes Reservoir and lower Columbia River white sturgeon is required as a pre-requisite to large-scale fish culture operations targeting release to the Arrow Lakes Reservoir. An additional year of related lab work is likely to be required to finalize direction on the need to address Arrow sturgeon separately.

The Upper Columbia White Sturgeon Recovery Initiative (UCWSRI) has been undertaking the analysis of genetic population structure of the Columbia sturgeon populations since 2003, and completed nuclear DNA analyses on the samples in 2007. It is anticipated that this work will provide additional information to direct future work that may be required under the Columbia River Water Use Plan.

4.5.2 Status

Until such a time that the UCWSRI can provide direction on future genetic assessment work, BC Hydro is unable to prepare the detailed Terms of Reference (ToR) for the work. Submission of the ToR is currently scheduled for January 2009, with work being initiated in April 2009.

4.5.3 Interpretation of Data

At this time, there are no data to interpret for this monitoring program.

4.6 CLBMON-25 Kinbasket Juvenile Sturgeon Detection and Habitat Use

4.6.1 Overview

This monitoring program will involve annual surveys and telemetric assessment of patterns of habitat use by juvenile sturgeon in Kinbasket Reservoir to address uncertainty as to whether habitats are sufficient to allow recruitment of larvae to age 1+ fish.

4.6.2 Status

This monitoring program is presently on the Conditional List, Clause 10.b., as its implementation is contingent on whether the decision is made to shift aquaculture efforts to Kinbasket Reservoir and the upper Columbia River in future years of the Columbia River WUP.

4.6.3 Interpretation of Data

At this time, there are no data to interpret for this monitoring program.
4.7 CLBMON-26 Kinbasket Sturgeon Recolonization Risk Assessment and Habitat Suitability

4.7.1 Overview

The Kinbasket Sturgeon Recolonization Risk Assessment and Habitat Suitability study is a 3-year study aimed at assessing the potential of Kinbasket Reservoir and the upper Columbia River to provide suitable larval sheltering-sites and habitat for under-yearling and juvenile white sturgeon. Suitability of sheltering-sites for newly hatched larvae will be measured by growth and survival rates in enclosures placed in predetermined areas, while the behaviour of juvenile sturgeon of different sizes carrying sonic and PIT tagged will provide information on the habitat use and movements of juveniles.

4.7.2 Status

This monitoring program will be carried out over three years (2009 - 2011). Contract award is scheduled for July 2009. The first program report is expected in March 2010.

4.7.3 Interpretation of Data

At this time, there are no data to interpret for this monitoring program.

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

4.8.1 Overview

At present, there are only limited data regarding direct temperature effects on white sturgeon recruitment in the mid Columbia population. The primary objectives of this monitoring program are to:

1) assess the water temperature profile in the REV forebay area and its relationship to the thermal trend in the mid- Columbia spawning area,

2) assess whether post-hatch cultured white sturgeon larvae released downstream of REV display drift behaviour and development/growth similar to that observed in warmer temperatures, more common to sturgeon spawning, and

3) assess the magnitude of effect of a thermal regime on white sturgeon development, growth and survival during early life stages.

The scope of the monitoring program is based on three related but independent components. Information from the studies is expected to contribute to the mid Columbia sturgeon management plan review scheduled for 2011, and in the long term may influence subsequent or concurrent evaluations of Revelstoke and Arrow Lakes Reservoir operations and possible physical works alternatives.

4.8.2 Status

This monitoring program will be carried out over two years (2009, 2010). Contract award is scheduled for July 2009. The first program report is expected in May 2010.
4.8.3 **Interpretation of Data**

At this time, there are no data to interpret for this monitoring program.

4.9 **CLBMON-28 Lower Columbia River Adult Sturgeon Population Monitoring**

4.9.1 **Overview**

The Lower Columbia River Adult Sturgeon Monitoring and Broodstock Collection is a 10-year program to describe changes in age structure and population estimates, provide information on movements, habitat use and population interactions through telemetry, provide periodic spawn monitoring to measure trends in the numbers of spawning events, population demographics and reproductive potential, and provide an annual broodstock contribution to the conservation culture program.

The monitoring program is designed to address a number of information requirements related to the adult life stage, but it will also provide: (i) input to the ongoing consideration of recruitment failure hypotheses and the evaluation of the effects of future management responses on spawning success; and (ii) information to guide broodstock collection and stocking targets related to the conservation culture program and related recovery research.

The primary objectives for this program will have been met when:

1) Adult sturgeon life history characteristics including size, growth, age structure, and condition, and population characteristics including abundance and trajectory, mortality rates, genetic status and reproductive potential are described and quantified with sufficient consistency to understand trends.

2) Biological characteristics including spawn monitoring to assess timing and trends, and movements to assess seasonal habitat use and spawning site selection under the current range of operating conditions are defined.

3) A quantitative baseline of adult information needs identified in items 1) and 2) above has been established and maintained for the program period (2008-2019)

4.9.2 **Status**

This monitoring program will be carried out over 12 years (2008-2019). Field work is scheduled to be initiated in June 2008. The first program report is expected in December 2008.

4.9.3 **Interpretation of Data**

At this time, there are no data to interpret for this monitoring program.

4.10 **CLBMON-29 Lower Columbia River Juvenile Sturgeon Monitoring**

4.10.1 **Overview**

The lower Columbia River Juvenile Sturgeon Detection program is designed to describe life history aspects of juvenile white sturgeon, as well as provide input to the ongoing consideration of recruitment failure hypotheses, the evaluation of the effects of future management responses, and information to guide conservation culture
stocking targets. The primary objectives of the juvenile sturgeon detection program are to:

1. Assess the development and condition (early hiding/drift development patterns and rearing juvenile conditions), behaviour (drift and movements), growth and survival of free embryo and juvenile sturgeon.

2. Determine early life stage distributions over time, locate free embryo hiding and juvenile rearing habitats, and define the parameters of these habitats.

3. Relate free embryo and juvenile habitat quality to variations in discharge from upstream dams and water levels of Lake Roosevelt reservoir.

4. Collect data in support of assessing the effects of current operations and the feasibility of management responses.

The scope of the juvenile program focuses on the collection of data that define free embryo and juvenile habitat conditions, the use of these data to determine the effect of existing hydraulic conditions, and to identify and assess the most suitable of several management responses to be considered in lieu of operational changes.

To date, the UCWSRI has tagged, released and tracked sub-yearling conservation culture sturgeon within the lower Columbia reach for a number of years, and is aware of the location of their rearing habitat in Canada and the US. These habitats will continue to be used to monitor growth and survival among juveniles. Under this program, more consistent effort will be directed to assuring the accuracy of survival estimates by life stage and to defining the water quality, hydraulic, and substrate parameters of these habitats.

4.10.2 Status

The Terms of Reference for this monitoring program was submitted to the CWR in May 2008. It is anticipated that a contract will be awarded in early June 2008 with field work being initiated shortly following contract award.

4.10.3 Interpretation of Data

At this time, there are no data to interpret for this monitoring program.

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

4.11.1 Overview

The WUP Consultative Committee considered an experimental treatment involving a flow target of 200,000 cfs at the Canada/US border for one month during the late June to late July period to reduce predation pressures on larval and juvenile sturgeon in the lower Columbia River. However, it became apparent that achieving this target would require a large shift in current operations of Arrow Lakes Reservoir to supplement flows in most years and could be very costly due to implications on spill downstream in high flow years. As a result, the Committee recommended the high flow option only on an opportunistic basis, as opposed to through an operational
change, and undertaking an assessment in those years when it occurs naturally. Based on historical frequency of occurrence, it was estimated that these high flow events would occur naturally in 2 out of 10 years.

The primary objective of the opportunistic assessment is to gain a better understanding of the relationships between high flows and sturgeon egg, larval and juvenile survival. The program will include, but not be limited to a spawn detection program, water quality sampling (water temperature, TGP, turbidity), and monitoring of juvenile survival and growth. The study will expand on the monitoring efforts developed for both the Lower Columbia adult sturgeon and juvenile sturgeon.

4.11.2 Status

This monitoring program will be carried out in two years over the term of the Columbia River WUP when flows at the Canada/US border are expected to reach or exceed 200,000 cfs.

4.11.3 Interpretation of Data

At this time, there are no data to interpret for this monitoring program.

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

4.12.1 Overview

Based on recommendations of the Revelstoke 5 Core Committee, the WUP addendum includes the requirement to undertake a study to assess pre- and post-project flow changes on incubation and early rearing habitat conditions for sturgeon in the mid Columbia River.

The UCWSRI Technical Working Group viewed this work as an extension of CLBMON #20, which is designed to describe mid Columbia River spawning habitat depth, velocity, turbulence, and substrate in some detail, and to use this information to confirm the validity of estimates of Weighted-Useable-Area from the Preliminary White Sturgeon Spawning Habitat Suitability Model for the Middle Columbia River. The methods proposed for CLBMON #20 involved sampling of 10 transects including the 5 transects used for the model but also adding detail and expanding on the area. Modifying the location of the transects downstream under CLBMON-54 will allow calculation of likely larval hiding habitat suitability. As such, the ToR for this study is expected to involve the same methods as proposed for CLBMON #20 over a slightly different area, and realignment of the model to assess the WUA for rearing habitat in this area under a suite of flows and reservoir levels that reflect pre- and post-REV5 conditions, and approximate flow manipulation tests to encourage white sturgeon spawning.

4.12.2 Status

This monitoring program will be carried out over 2 years (2009 and 2012). Field work is scheduled to be initiated in July 2009. The first program report is expected in June 2010.
4.12.3 Interpretation of Data

At this time, there are no data to interpret for this monitoring program.

5 Summary of Columbia River WUP Physical Works - Columbia River White Sturgeon Management Plan

This section summarizes the status of the physical works being implemented under the Columbia River White Sturgeon Management Plan of the Columbia River Water Use Plan, as per the Order under the Water Act, dated January 26, 2007.

5.1 CLBWORKS-24 Mid Columbia Experimental Aquaculture

5.1.1 Overview

The Mid Columbia River White Sturgeon experimental aquaculture is a 4-year program to provide juveniles for release into the river to assess impacts of flow treatment on sturgeon survival, and impacts of Arrow operations on juvenile habitat availability and suitability and juvenile survival. If these fish survival, the release will also contribute to the rebuilding of the existing mid Columbia sub-population. The specific objectives of this program are:

1. The incubation, rearing and annual release of approximately 4,050 healthy sub-yearling juveniles (including 50 juveniles of a size adequate for sonic nano-tagging) (in 2008-2011), comprised of those families most likely adapted to the conditions found in the mid Columbia, to facilitate research into juvenile habitat use and survival.

2. The incubation, rearing and release (in 2008 and 2009) of approximately 500,000 healthy post-hatch but unfed larval sturgeon (with reliance on parentage genetic markers as tags) to research larval survival.

3. The incubation, rearing and release (in 2010 and 2011) of approximately 100,000 healthy fed larval sturgeon (with reliance on parentage genetic markers as tags) to further research larval survival.

4. The annual marking and tagging of all sub-yearling/yearling releases according to protocol, including scute removal to designate brood year, Passive Integrated Transponder (PIT) tagging, sonic nano-tagging and other tagging as may be required.

5. Annual participation in public awareness and educational activities including but not necessarily limited to release events, school events, public events, open houses workshops etc.

6. Provision of testing and pilot programs exploring techniques for improved efficiencies and an ability to provide for broader genetic diversity of released stock.

An additional objective of the program is the incubation, rearing and release of juveniles resulting from the collection and incubation/rearing of collections on >200 wild eggs per year. The expectation is that if more than 200 eggs are collected within
a year during egg mat monitoring of sturgeon spawning below Revelstoke Dam, the eggs will be retained on site in incubation canisters and the resulting larvae released to the mid Columbia Reach.

5.1.2 Status

The Mid Columbia Sturgeon Experimental Aquaculture program was initiated in 2006 through funding from the Revelstoke Unit 5 Project, which resulted in the spring 2007 release of 4000 sturgeon into the mid Columbia River. Ongoing culture activities are being provided by the Freshwater Fisheries Society of BC (FFSBC), as the only entity within the province that has the necessary expertise and facilities to provide government-sanctioned sturgeon culture facilities capable of the requirements of the breeding plan.

The program is delivered by the FFSBC through a 4-year Contribution Agreement with BC Hydro and the Columbia Basin Fish and Wildlife Compensation Program.

5.2 CLBWORKS-25 Mid Columbia Sturgeon Conservation Aquaculture

5.2.1 Overview

In the longer term, a conservation aquaculture program is required to support the Arrow sturgeon population until such a time that stock abundance/age structure and habitat conditions can support a self-sustaining population and address residual impacts from providing lower than optimal spawning, incubation and rearing flows. If flow and stage conditions required to support a self-sustaining (or hatchery-supplemented) population are not economically feasible, a decision may be made to direct all or part of the conservation aquaculture effort to Kinbasket Reservoir.

The specific objectives of the program are:

1. The incubation, rearing and annual release of healthy sub-yearling juveniles, or unfed or fed larvae in sufficient numbers and combinations to provide for studies and management plans for either the mid Columbia or Kinbasket reaches during 2012-2018.

2. The annual marking and tagging of all sub-yearling/yearling releases according to protocol, including scute removal to designate brood year, Passive Integrated Transponder (PIT) tagging, sonic nano-tagging and other tagging as may be required.

3. Annual participation in public awareness and educational activities including but not necessarily limited to release events, school events, public events, open houses workshops etc.

4. Provision of testing and pilot programs exploring techniques for improved efficiencies and an ability to provide for broader genetic diversity of released stock.

A detailed approach of the conservation aquaculture program will be developed following the review of the mid Columbia sturgeon plan scheduled for 2011. Modifications may include release targets, timing, fish sizes, and both release
locations and locations of remote incubation and rearing facilities. The UCWSRI TWG is expected to be a key advisory body during the review, and will assist the WLR sturgeon management program with decisions on the approach.

5.2.2 Status

The Mid Columbia River White Sturgeon Conservation Aquaculture program is a 6-year program (2012-2018), which will be delivered by the FFSBC.

5.3 CLBWORKS-26 Mid Columbia Sturgeon Upgrade Hatchery

5.3.1 Overview

Upgrades of the culture facilities at the Kootenay Sturgeon Culture Hatchery (KSCH) in Wardner are required to support the experimental and conservation sturgeon aquaculture programs in the mid Columbia River. This will involve:

1. The construction and full service provision of a portable incubation facility capable of handling the production of 500,000 post-hatch larvae to be initially located at the KSCH and completed in time for use during the 2008 brood year.

2. Relocation and full service provision of the portable incubation facility to a remote location (e.g., Revelstoke), and construction and full service provision of portable rearing facilities capable of producing 100,000 fed larvae at the same remote location or at the KSCH and completion in time for use during the 2010 brood year.

5.3.2 Status

Construction of a portable incubation facility at KSCH is underway and is expected to be completed in June 2008. A construction completion report is currently in preparation and will be submitted to BC Hydro in June 2008.

5.4 CLBWORKS-27 Lower Columbia Sturgeon Physical Works

5.4.1 Overview

Given the low frequency and high costs of achieving a 200 kcf/s flow target at the Canada/US border, the Columbia WUP Consultative Committee recommended turbidity augmentation in the lower Columbia River as a physical works in lieu. This plan involves the delivery of bentonite (or other turbidity agents) into the river during low flow periods (i.e., when discharge at the border is below 90 kcf/s), and when sturgeon larvae are known to be hatching and undergoing their downstream drift phase. This was based on the premise that sturgeon spawn every year regardless of discharge, but larvae would be most vulnerable to predation when flows are low and clear.

A technical working group involving members of the UCWSRI has since been established to examine and prioritize key hypotheses for sturgeon recruitment failure in the lower Columbia River, and provide direction to the Columbia Water Licence Program for undertaking a feasibility study of various physical works options.
5.4.2 Status

The technical working group is holding its final workshop in July 2008, at which time the group will be developing sequencing plans for the different responses. This information will be used to finalize the Terms of Reference for the feasibility study (CLBWORKS-28).

The physical works project is presently on the Conditional List, Clause 10.a., as its implementation is contingent on the outcome of the feasibility study.

5.5 CLBWORKS-28 Lower Columbia Planning & Assessment for the Physical Works

5.5.1 Overview

The Columbia WUP Consultative Committee recognized that a review and consultation with the agencies will be required prior to initiation of any physical works project to address recruitment failure of white sturgeon in the lower Columbia River to ensure that regulatory and legal issues are fully considered. Further, feasibility assessments will be required to address impacts on other interests in the river. Once a feasibility option is found, monitoring the response of the sturgeon population will be critical to informing on the effectiveness of the action and ensuring that adopted changes do not result in a decline in the population.

5.5.2 Status

The feasibility work is scheduled to begin in September 2008, with a final report prepared in March 2009.

5.6 CLBWORKS-34 Lower Columbia River Sturgeon Conservation Aquaculture Program

5.6.1 Overview

The UCWSRI has been releasing marked and tagged sub-yearling juvenile sturgeon into the lower Columbia River below Hugh L. Keenleyside Dam since 2002, which has numbered approximately 76,720 juveniles to date (fall 2007). These fish are produced by the FFSBC at the Wardner facility. In addition, approximately 10,000 juveniles have been released from US hatcheries into Lake Roosevelt.

Since the culture program started, it has relied on various forms of support. Initially funded by BC Hydro and the province’s Habitat Conservation Trust fund, it is now funded by a combination of resources including major contributions from BC Hydro and the Fish and Wildlife Compensation Program – Columbia Basin (FWCP), and a number of other supporters including grant foundations and other industrial sources. Reliability of full funding has not been assured. In order to provide for dependable financial resources for the maintenance of the culture program, the WUP CC decided to include in the Sturgeon Management Plan the maintenance of the existing conservation culture program to provide juveniles to the Columbia Reach between HLK and the US border.

Specific objectives include:
1. The capture, transportation between the Columbia River and KSCH, care and breeding of mature adult sturgeon at targeted numbers of 10 females and 10 males to provide for an annual objective of 8 genetically distinct families or secondarily subfamilies. Adults are to be returned to the Columbia River upon completion of spawning.

2. The successful incubation and rearing of approximately equal numbers of healthy juveniles from each family or subfamily bred in a given year targeting an annual release in the fall of the brood year or subsequent spring of a total of 12,000 sub-yearling sturgeon to facilitate stock rebuilding and research needs.

3. The annual marking and tagging of all fish according to protocols, including scute removal to designate brood year, Passive Integrated Transponder (PIT) tagging, nanotag sonic tagging and other tagging as may be required of both broodstock adult and juvenile sturgeon.

4. Annual participation in public awareness and educational activities including but not necessarily limited to release events, school events, public events, open houses workshops etc.

5. Provision of testing and pilot programs exploring techniques for improved efficiencies and an ability to provide for broader genetic diversity of released stock.

5.6.2 Status

Broodstock acquisition is scheduled to begin in June 2008. This work will involve the capture and identification of mature, reproductively-suitable sturgeon collected from the Columbia River downstream of HLK Dam. Mature adults will be examined for reproductive condition, and if acceptable, will be transported to the Kootenay Hatchery for possible breeding.

6 Columbia River White Sturgeon Management Plan - Monitoring Programs and Physical Works Costs

The following table summarizes the approved costs of the monitoring programs and physical works under the Columbia River White Sturgeon Management Plan of the Columbia River WUP, as well as the Actual Costs to 31 May 2008.

Table 6-1: Columbia River Monitoring Programs and Physical Works Costs

<table>
<thead>
<tr>
<th>Description</th>
<th>Costs Approved by Comptroller of Water Rights</th>
<th>Actual Costs to 30 May 2008</th>
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</thead>
<tbody>
<tr>
<td>CLBMON-19 Kinbasket: Sturgeon Inventory &amp; Habitat</td>
<td>Direct Management $47,474</td>
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<td>Implementation $544,293</td>
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<td>Implementation $275,500</td>
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<tr>
<td>Description</td>
<td>Costs Approved by Comptroller of Water Rights</td>
<td>Actual Costs to 30 May 2008</td>
</tr>
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<td>-----------------------------------------------------------------------------</td>
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<tr>
<td><strong>Direct Management</strong></td>
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<tr>
<td>CLBMON#21 Mid Col: Juvenile Sturgeon Detection &amp; Habitat Use Study &amp; Tracking of Existing Tagged Adults</td>
<td>Direct Management $167,316</td>
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<td>CLBMON#27 Mid Col: Sturgeon Incubation &amp; Rearing</td>
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<td>Implementation $0</td>
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<td>Experiment</td>
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<td>of WSG Turbidity</td>
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