Kootenai River Native Fish Conservation Aquaculture Program

Step 2 Document

Volume 1

Prepared by the Kootenai Tribe of Idaho

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Kootenai River Native Fish Conservation Aquaculture Program Step 2 Document

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EXECUTIVE SUMMARY

This document is the Kootenai Tribe of Idaho's (Tribe or KTOI) Step 2 submittal to the Northwest Power and Conservation Council (Council or NPCC) and the Bonneville Power Administration for the Kootenai River Native Fish Conservation Aquaculture Program. The Tribe's proposal includes several upgrades of the existing Tribal Sturgeon Hatchery near Bonners Ferry, Idaho and construction of a new facility (Twin Rivers Hatchery) to support production of Kootenai River white sturgeon (*Acipenser transmontanus*) and burbot (*Lota lota maculosa*) at a location approximately 15 miles upstream of the Tribal Sturgeon Hatchery on the Kootenai River.

A Step 1 Master Plan for the Tribe's conservation aquaculture program was submitted to the Independent Scientific Review Panel (ISRP) in August 2009 (KTOI 2009a). In October 2009, the ISRP provided a preliminary review of the Master Plan and comments on Step 1 Review Elements. The Tribe submitted a revised Master Plan in June 2010, accompanied by responses to the ISRP's comments (KTOI 2010). In August 2010, the ISRP concluded that the white sturgeon element of the revised Master Plan met requirements for Step 1, but qualified its approval by requesting that the Tribe provide additional specific information in the Step 2 document. The ISRP concluded that the burbot element of the aquaculture program met requirements for Step 1 and could proceed to Step 2.

This document addresses the Council's Step 2 requirements by updating the hatchery program details, facility designs, and estimated costs for all areas of the program; refining the monitoring and evaluation plans for sturgeon and burbot; and reporting progress on meeting environmental compliance requirements. It also responds to each specific ISRP comment and provides supplementary information to more fully support the program goals and rationale within the context of the Columbia Basin Fish and Wildlife Program. This document does not reiterate all of the detailed information provided in the Step 1 Master Plan.

The Kootenai River Native Fish Conservation Aquaculture Program is a central component of the Tribe's overarching commitment to ecosystem restoration in the Kootenai River. It is critical to achieving the Tribe's vision of the Kootenai River and its floodplain as a healthy ecosystem with clean, connected terrestrial and aquatic habitats that foster healthy, productive populations of sturgeon, burbot, and other native fish, and which is capable of fully supporting traditional Tribal and other important societal uses.

The Tribe has long recognized the need to protect Kootenai River white sturgeon (Kootenai sturgeon) and burbot. The U.S. Fish and Wildlife Service (USFWS) listed Kootenai sturgeon as endangered under the Endangered Species Act (ESA) in 1994. Burbot were proposed for ESA listing in 2000, but the USFWS determined in 2003 that this population was not eligible for listing because it did not meet the defining criteria of a Distinct Population Segment. Kootenai River burbot are functionally extinct, meaning that the population is too small to recover on its own, even if suitable habitat conditions existed or could be immediately restored. In the absence of an ESA listing, the Kootenai Tribe coordinated with the USFWS,

Kootenai Valley Resource Initiative (KVRI), agency partners and other stakeholders to develop a "pilot project" in the Kootenai River subbasin to develop, implement, and evaluate a Conservation Strategy for Lower Kootenai River Burbot (KVRI Burbot Conservation Strategy; KVRI 2005).

In 1989, the Tribe initiated a sturgeon conservation aquaculture program near Bonners Ferry in an effort to preserve an adequate demographic and genetic base for a healthy future population while waiting for ecosystem-based habitat restoration activities to be developed and implemented. The Tribe also participates actively in a beneficial partnership with the Idaho Department of Fish and Game, British Columbia Ministry of Forests Land Natural Resource Operations, the Freshwater Fisheries Society of British Columbia, and federal agency partners to sustain the Kootenai sturgeon population in the cross-boundary Kootenai River subbasin. Similarly, the Tribe has advocated and supported successful efforts at the University of Idaho to rear burbot to a juvenile life stage in a laboratory setting, paving the way for the larger scale production and reintroduction program proposed in the Step 1 Master Plan, explained in more detail in the revised Master Plan, and refined in this Step 2 document, based on new information and input from co-managers and technical experts.

The purpose of the Tribe's Kootenai sturgeon aquaculture program is to prevent extinction, preserve the existing gene pool, and continue rebuilding a healthy age class structure for this endangered population, using conservation aquaculture techniques with wild native broodstock. This program is intended to complement other ongoing and planned ecosystem-based habitat restoration activities in the Kootenai subbasin. Near-term and long-term objectives can be summarized as follows:

Near-term Objectives

- Prevent demographic extinction by replacing failed natural recruitment with fish produced in the hatchery.
- Establish an increasing trend and broad distribution of ages and sizes in the wild population to ensure future sustainability.
- Preserve and express native genetic and life history diversity by capturing and spawning significant numbers of representative broodstock.
- Provide contingencies for uncertain future availability of wild broodstock and prospects for restoring natural recruitment.
- Inform recovery strategies by using hatchery-produced fish to identify limiting life stages and habitat capacity.

Long-term Objectives

- Avoid annual broodstock limitation where too few fish might be available to capitalize on favorable natural spawning conditions in any year (or to continue to provide hatchery broodstock).

- Minimize the time interval between the functional extinction of remaining wild adults and maturation of the first hatchery generation.
- Maintain an effective population size in the natural environment adequate to avoid genetic bottlenecks that risk loss of diversity or inbreeding depression in the next generation.
- Avoid significant detrimental impacts of hatchery fish on natural production due to competition, predation, or disease magnification.
- Avoid hatchery selection or domestication that might reduce future fitness or viability.

The purpose of the Tribe's burbot aquaculture program is to reintroduce burbot into the lower Kootenai River and begin rebuilding the population using genetically similar stock from within the subbasin (from Moyie Lake in British Columbia). It is also possible that native broodstock from the remnant lower Kootenai population could be captured and incorporated into the program. The ultimate goal is to restore a naturally-reproducing burbot population that 1) is as similar as possible to historical populations in terms of structure and abundance; 2) is in equilibrium with the carrying capacity of the present and future environment; and 3) will support tribal and non-tribal harvest. Near-term and long-term objectives for burbot restoration include the following:

Near-term Objective

- Produce and stock burbot at rates and frequencies to sustain a minimum population of 2,500 - 9,500 adults in the Kootenai River and South Arm of Kootenay Lake

Long-term Objectives

- Produce and stock burbot at rates and frequencies to sustain a minimum population of 17,500 adults in the Kootenai River and South Arm of Kootenay Lake.
- Restore consistent natural recruitment in at least three different spawning areas that will result in a juvenile population of sufficient size to support the adult burbot population goal.

To accomplish these goals and objectives, the Tribe is proposing to expand and improve the existing Tribal Sturgeon Hatchery near Bonners Ferry and to develop the new Twin Rivers Hatchery to allow for additional sturgeon production, as well as supporting the new burbot aquaculture program. The Twin Rivers Hatchery will provide the opportunity to locate the expanded sturgeon and burbot programs at a shared site to reduce the cost of functional elements such as site utilities, administrative areas and storage areas, and to achieve efficiencies in design, permitting, construction, and operations. The new hatchery is being designed to provide flexible facilities that accommodate future changes in aquaculture

research, allow for program modification as needed, and provide efficient fish production in support of restoration efforts.

The Tribe initiated a collaborative process to develop biocriteria in the early stages of project planning, with participation by hatchery staff, contracted and agency sturgeon biologists, and University of Idaho personnel. The biocriteria provided the framework for facility designers to consider a range of potential future operational scenarios that would also meet the Tribe's design criteria. Neither Kootenai sturgeon nor burbot aquaculture protocols are as highly refined as salmonid culture protocols; therefore, planned facilities must be able to adapt to new information. By addressing production uncertainties at this early design stage, considerations have been incorporated that will accommodate modifications without significant cost increases or unanticipated space constraints.

The construction budget for work at the Tribal Sturgeon Hatchery is estimated at is $1.1 million in fiscal year (FY) 2013 dollars (without one alternate component which could be added during Step 3 final design or constructed in the future, based on available funding). The construction budget for the Twin Rivers Hatchery (without alternate components) is $14.4 million. These estimates are based on the current preliminary design and include a contingency of 15% to accommodate the level of uncertainty at this Step 2 stage of the project. Costs are escalated to a mid- point of 2013, at which time the Tribe is proposing to initiate construction, pending Council approval of Step 3 submittal that is expected to be complete in December 2012.

ACKNOWLEDGEMENTS

The Kootenai Tribe of Idaho would like to thank the many agency partners, scientists, engineers, and planners who have contributed their time, skills and energies to developing the Kootenai River Native Fish Conservation Aquaculture Program. This work is funded by the Bonneville Power Administration as part of the Northwest Power and Conservation Council's Columbia Basin Fish and Wildlife Program.

As always, the Tribal staff and consultants also wish to express our appreciation to the Tribal Elders and Tribal Council for their inspiring vision and guidance.

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ABBREVIATIONS AND ACRONYMS

BC Ministry	British Columbia Ministry of Forests, Lands, and Natural Resource Operations
BiOp	Biological Opinion (part of ESA)
BPA	Bonneville Power Administration
CFS	Cramer Fish Sciences
cfs	cubic feet per second
Clean Water Act	Federal Water Pollution Control Act
Council	Northwest Power and Conservation Council
EA	Environmental Assessment
ESA	Endangered Species Act
FY	Fiscal Year
FFSBC	Freshwater Fisheries Society of British Columbia
HGMP	Hatchery Genetic Management Plan
ID-CFWRU	Idaho Cooperative Fish and Wildlife Research Unit
IDFG	Idaho Department of Fish and Game
IEAB	Independent Economic Analysis Board
ISAB	Independent Scientific Advisory Board
ISRP	Independent Scientific Review Panel
KTOI	Kootenai Tribe of Idaho
KVRI	Kootenai Valley Resource Initiative
M&E	Monitoring and Evaluation
MFWP	Montana Department of Fish, Wildlife and Parks
NEPA	National Environmental Policy Act
NPCC	Northwest Power and Conservation Council
PVA	Population viability analysis

RPA	Reasonable and Prudent Action (part of ESA consultation)
UI-ARI	University of Idaho Aquatic Research Institute
UC Davis GVL	University of California Davis Genomic Variation Lab
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WSIV	White Sturgeon Iridovirus
YOY	Young-of-the-year

Kootenai River Native Fish Conservation Aquaculture Program Step 2 Document

1 INTRODUCTION

This document is the Kootenai Tribe of Idaho's (Tribe or KTOI) Step 2 submittal to the Northwest Power and Conservation Council (Council or NPCC) and the Bonneville Power Administration (BPA) for the Kootenai River Native Fish Conservation Aquaculture Program. The Tribe's proposal involves expansion and upgrades of the existing Tribal Sturgeon Hatchery near Bonners Ferry, Idaho and construction of a new facility (Twin Rivers Hatchery) to support production of Kootenai River white sturgeon (*Acipenser transmontanus*) and burbot (*Lota lota maculosa*) at a location approximately 15 miles upstream of the Tribal Sturgeon Hatchery on the Kootenai River (Figure 1-1).

This chapter provides an overview of the Council's three step review process requirements, the history of the conservation aquaculture program, and the Step 2 document organization.

1.1 NPCC Three-Step Process

The Northwest Power Act of 1980 directs the Council to develop a program to protect, mitigate and enhance fish and wildlife of the Columbia River Basin that have been affected by hydropower dams and make annual funding recommendations to the BPA for projects to implement the Council's Fish and Wildlife Program.

In 1997, the Council developed and adopted the three step review process in response to recommendations from the Independent Science Review Panel (ISRP). The process was initially adopted as an interim measure, pending completion of a comprehensive artificial production policy for the Columbia River Basin. In 2001, the Council decided to require the three step review process for all proposed new production programs, as well as for other large and/or complex implementation projects. As part of the Council's Fish and Wildlife Project Funding Recommendations for fiscal years (FYs) 2007 through 2009, the Council confirmed the continued use of the three step review process for new artificial production and other major projects. The three step review process is intended to ensure there are periodic and logical check points to allow decision makers to evaluate project scope, project design, consistency with project objectives, and the accuracy of cost estimates before substantial construction funding is invested.

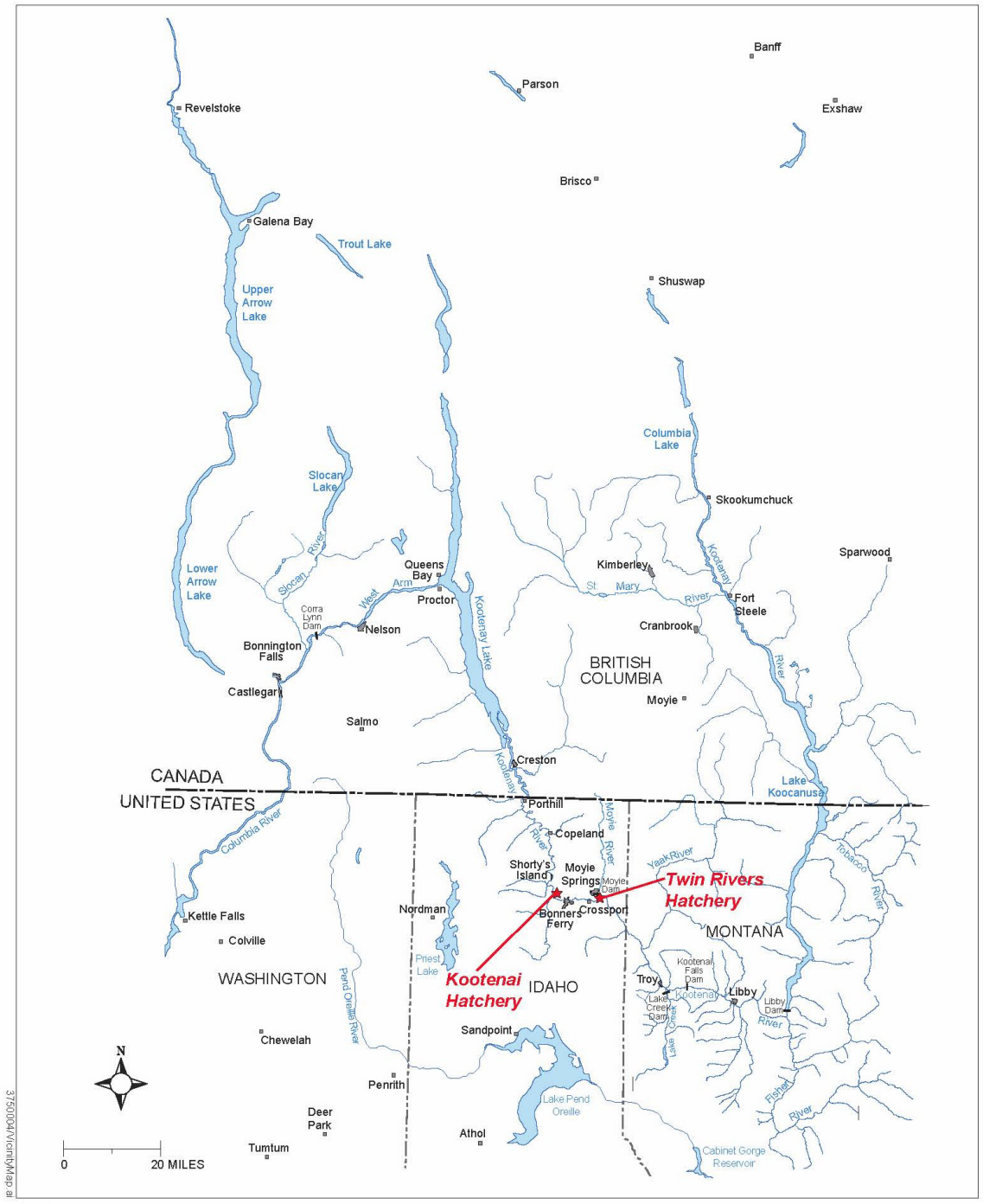

Figure 1-1. Existing and proposed hatchery sites with the Kootenai River subbasin.

1.1.1 Step 1

Step 1 of the three step review process consists of the presentation of a conceptual design (sometimes referred to as a feasibility study). At this stage project proponents are asked to identify major project components, present rough plans and layouts of facilities, and provide conceptual details for all elements of the proposed project. The degree of certainty associated with cost estimates ranges at this state is expected to range from plus or minus 35 to 50%. The Master Plan for the Kootenai River Native Fish Conservation Aquaculture Program was submitted to the Council in June 2010 to meet the Step 1 requirements.

1.1.2 Step 2

In Step 2, project proponents are asked to identify any major difficulties in the design and proposal. Step 2 also includes completion of environmental review and refinement of facility and programmatic design details and cost estimates. At Step 2, the degree of certainty associated with cost estimates is expected to range from plus or minus 25 to 35%. Specific Step 2 requirements are to:

- Describe the status of the comprehensive Environmental Assessment (EA) required under the National Environmental Policy Act (NEPA) (Steps 1 and 2);
- Describe the monitoring and evaluation plan (Steps 1, 2 and 3);
- Describe and provide specific items and cost estimates for 10 fiscal years for planning and design (i.e., conceptual, preliminary and final) construction, operation and maintenance, and monitoring and evaluation (Steps 1, 2 and 3); and
- Provide a preliminary design of the proposed facilities (Step 2).

1.1.3 Step 3

In Step 3, project proponents are expected to present a design that is ready to go out to bid. At this stage, the cost estimate includes a contingency of 10 to 15%. Specific Step 3 requirements are to:

- Describe the monitoring and evaluation plan (Steps 1, 2 and 3);
- Describe and provide specific items and cost estimates for 10 fiscal years for planning and design (i.e., conceptual, preliminary, and final) construction, operation and maintenance, and monitoring and evaluation (Steps 1, 2 and 3); and
- Provide a final design of the proposed facilities consistent with previous submittal documents and preliminary design (Step 3).

1.2 Project Chronology

The Kootenai Tribe has long recognized the need to protect Kootenai River white sturgeon (Kootenai sturgeon) and native Kootenai River burbot (burbot). In 1989, the Tribe initiated a Kootenai sturgeon conservation aquaculture program near Bonners Ferry in an effort to preserve an adequate demographic and genetic base for a healthy future population while waiting for ecosystem-based habitat restoration activities to be developed and implemented. The Tribe coordinated with the U.S. Fish and Wildlife Service (USFWS), Kootenai Valley Resource Initiative (KVRI), agency partners and other stakeholders to develop a Conservation Strategy for Lower Kootenai River Burbot (KVRI Burbot Conservation Strategy; KVRI 2005). The Tribe also participates actively in a beneficial partnership with the Idaho Department of Fish and Game (IDFG), British Columbia Ministry of Forests, Lands, and Natural Resource Operations (BC Ministry) and the Freshwater Fisheries Society of British Columbia to sustain the Kootenai sturgeon population in the cross-boundary Kootenai River subbasin. Similarly, the Tribe has advocated and supported successful efforts at the University of Idaho to rear burbot to a juvenile life stage in a laboratory setting, paving the way for the larger scale production and reintroduction program proposed in the Step 1 Master Plan.

The Master Plan was initially submitted for ISRP review on August 12, 2009. On October 13, 2009, the ISRP provided a preliminary review of the Master Plan and comments on Step 1 Review Elements (ISRP 2009-40).

The Tribe submitted a revised Master Plan on June 11, 2010. The revised Master Plan was accompanied by a response document entitled Project Sponsor Responses to ISRP Comments 2009-40, dated June 2010.

The ISRP completed a final review of the revised Master Plan on August 9, 2010 (ISRP 2010-27). The ISRP concluded that the Kootenai sturgeon element of the aquaculture program met requirements for Step 1, but qualified its approval by requesting that the Tribe provide additional specific information in the Step 2 document. The ISRP concluded that the burbot element of the aquaculture program met requirements for Step 1 and could proceed to Step 2.

This Step 2 document is intended to fulfill the Council's Step 2 requirements. It also addresses the specific concerns and comments expressed by the ISRP in their reviews of the Step 1 documents, and in particular, responds to the ISRP's qualified approval of the Kootenai sturgeon component of the program. This Step 2 document includes minor changes from the Step 1 Revised Master Plan that address ISRP comments, as well as incorporating additional input from co-managers and agency partners in the Kootenai subbasin.

1.3 Document Organization and Overview

The Step 2 document is organized into nine chapters, with four supporting appendices. In addition to this introduction, chapters are as follows:

- Chapter 2 provides an overview of the program purpose, goals and objectives. It also describes proposed fish production and releases, and program facilities and operations.

- Chapter 3 responds to each of the ISRP's comments on the Step 1 Revised Master Plan. Appendix A contains a more detailed discussion of the issues raised by the ISRP regarding the Kootenai Sturgeon Conservation Aquaculture Program and additional information to supplement the Step 1 Master Plan. The detailed information in Appendix A was not included in the main body of the Step 2 document in order to maintain the appropriate focus on Step 2 requirements; however, Appendix A does provide information that will be valuable to better understanding the technical basis for sturgeon conservation aquaculture program and readers are strongly urged to review this information. Appendix A also incorporates input provided by co-managers and partner agencies and was reviewed by those entities.

- Chapter 4 provides an overview of activities associated with Step 2 and related critical studies. It presents the highlights of progress to date, with subsequent chapters of this document providing additional detail.

- Chapter 5 presents a summary of monitoring and evaluation (M&E) plans for Kootenai sturgeon and burbot, describes the adaptive management approach, and explains coordination of the sturgeon and burbot M&E plans with other programs in the Kootenai River basin. Appendix B and Appendix C include the full text of M&E plans for Kootenai sturgeon and burbot, respectively.

- Chapter 6 provides an overview and status update of environmental compliance activities undertaken during Step 2. Chapter 6 addresses compliance with NEPA, Endangered Species Act (ESA) consultation, cultural resources, and permitting.

- Chapter 7 outlines the engineering and design work accomplished in support of this Step 2 submittal. Specific engineering and design topics include the basis of design and design biocriteria, Tribal Sturgeon Hatchery modifications, and the 30% design of the Twin Rivers Hatchery. Appendix D presents the Basis of Design Report. Design drawings are provided under separate cover.

- Chapter 8 provides a summary of estimated costs for construction, capital equipment, environmental compliance, operation and maintenance (O&M), and M&E activities, as well as a history of expenditures to date. Chapter 8 explains cost assumptions and reasons for any deviations from previous cost estimates.

- Chapter 9 provides literature citations for documents referenced in this Step 2 submittal.

2 KOOTENAI RIVER CONSERVATION AQUACULTURE PROGRAM SUMMARY

This chapter provides a summary of the proposed aquaculture program, including its purpose and rationale, goals and objectives, and plans for sturgeon and burbot production and release. It also describes the proposed hatchery facilities and operations. Additional detail about the program is presented in later chapters and in the supporting appendices.

2.1 Program Purpose and Rationale

Kootenai sturgeon and burbot were keystone species in the Kootenai River and are species of immeasurable cultural value to the Kootenai Tribe. These native species once sustained a culturally important fishery for the Kootenai people as well as a valued recreational fishery. A precipitous decline in populations of both species resulting from river corridor modifications worsened when Libby Dam operations began. The decline eventually resulted in the elimination of the Tribe's ability to exercise its Treaty-reserved fishing right, a situation that continues today despite efforts to manage flow to create somewhat more natural flow and temperature regimes. The relentless decline of both species underscores the urgency of implementing effective actions to restore these native populations to their ecologically and culturally important roles in the region.

2.1.1 Kootenai River White Sturgeon

The purpose of the Tribe's Kootenai sturgeon aquaculture program is to prevent extinction, preserve the existing gene pool, and continue rebuilding a healthy age class structure for this endangered population, using conservation aquaculture techniques with wild native broodstock. This program is intended to complement other ongoing and planned ecosystem-based habitat restoration activities in the Kootenai subbasin. It is a necessary stop-gap measure while those restoration activities are designed, implemented, and have a chance to take effect.

Several factors support the need for the proposed Tribal Sturgeon Hatchery expansion and upgrades and new facilities at the Twin Rivers Hatchery. These include: 1) the anticipated ongoing long-term need for the conservation aquaculture program in light of continued failure of natural recruitment; 2) biological and research objectives of the program; and 3) specific facility needs related to effective and efficient operations of the conservation aquaculture program.

2.1.1.1 Ongoing Need for Kootenai Sturgeon Conservation Aquaculture Program

Kootenai sturgeon were listed as endangered under the ESA in 1994. The USFWS Recovery Plan for Kootenai River White Sturgeon (Recovery Plan), published in 1999, calls for implementation of conservation aquaculture to prevent extinction and provide for recruitment. The Biological Opinion regarding the effects of Libby Dam Operations

on the Kootenai River White Sturgeon, Bull Trout and Kootenai Sturgeon Critical Habitat (Libby Dam BiOp) also specifically acknowledges the need for continued operation of the Tribe's sturgeon aquaculture program in Reasonable and Prudent Action (RPA) Component 4, and directs the action agencies (BPA and the U.S. Army Corps of Engineers) to provide funding to expand adult holding and spawning capability at the Tribal Sturgeon Hatchery (USFWS 2006, clarified in 2008).

The next 10 to 20 years will be a critical period for the future of sturgeon in the Kootenai River. There will be a significant bottleneck in spawner numbers as the wild population declines but hatchery fish are not yet mature. The remnant wild population is declining at 4% per year with an approximate 14-year abundance halving time (Beamesderfer et al. 2012a). Female Kootenai sturgeon begin maturing around 25 to 30 years of age, so the first hatchery-reared fish from releases in the early 1990s will begin reaching maturity around 2020. Given the continued failure of measures to restore natural recruitment, the conservation aquaculture program represents the sole demonstrated effective alternative for forestalling population extinction, preserving genetic diversity, and rebuilding the population.

2.1.1.2 Need for Program Expansion and New Facilities to Meet Biological and Research Objectives

The existing Tribal Sturgeon Hatchery facilities were developed to meet the near-term objectives of avoiding demographic extinction, with an assumption that natural recruitment would be restored by implementing flow measures. However, numbers of broodstock, families and total releases provided by current production facilities are inadequate to address longer-term conservation risks in the absence of substantial natural recruitment. The existing facility is operating at its physical and functional capacity, constraining any program operational flexibility in the future. Expansion of the current facilities is not a viable alternative because the available space and water sources are fully utilized.

The Twin Rivers Hatchery is designed to increase numbers of broodstock, families, and total annual releases necessary to sustain a demographically and genetically viable Kootenai sturgeon population through the next generation in the event that significant natural production does not occur in the near-term. Planned production levels are designed to balance often-competing short-term and long-term risks.

Increased numbers of broodstock provided by the new facility will help preserve native genetic and life history diversity by capturing and spawning adequate numbers of representative broodstock before the dwindling wild population reaches extinction or senescence. While genetic analysis of broodstock conducted to date has demonstrated that a high percentage of the common lineages are represented, we cannot conclude that a full complement of the population's functional genome has been captured (particularly rare alleles). Increasing the number of broodstock collected now will also provide contingencies for uncertain future availability of wild broodstock and prospects for restoring natural recruitment.

Increased numbers of families will recombine and express genetically-based (inherited) life history trait diversity and adaptive plasticity through a wider range of unique phenotypes. Diverse phenotypic expression will allow the population to take full advantage of current and future habitat and environmental conditions and increase the likelihood of future natural recruitment, a prerequisite for population downlisting and delisting. This strategy employs increased broodstock numbers and factorial mating matrices to maximize expression of the available diversity. Conserving and optimizing genetic diversity through maximum phenotypic expression will be critical to the long-term recovery strategy for Kootenai sturgeon.

Increased juvenile production will help bridge the "death valley" period between the disappearance of the remaining wild fish and the maturation of the hatchery-produced generation. During this interval, too few fish are expected to be available to capitalize on favorable natural spawning conditions in any year or to provide hatchery broodstock. Failure to maintain an adequate effective spawning population size in the wild will also exacerbate risks of genetic bottlenecks that reduce diversity or cause inbreeding depression in the next and subsequent generations. The Tribe is proposing an inclusive production approach that optimizes the probability of species persistence rather than extinction. At the same time, very large release numbers could exceed the uncertain capacity of the system and trigger potentially detrimental reductions in survival, growth and maturation of fish released into the wild. To address this risk, family size targets have been reduced to 500-1,000 from current facility and proposed Step 1 Master Plan levels of 1,000-1,500.

Increased operational flexibility at the new Twin Rivers Hatchery facilities will address current limitations at the Tribal Sturgeon Hatchery by reducing the risks of inadvertent and potentially detrimental hatchery selection or domestication. More space, water, volume, and containers will allow fish to be reared at lower densities to reduce stress, disease, and mortality. The availability of three water sources at the new Twin Rivers facility will provide cost-effective temperature controls, which will improve management of broodstock maturation and juvenile growth, health, and survival.

Additionally, the Twin Rivers Hatchery site, approximately 15 miles upstream of Bonners Ferry, is located closer to potential future spawning and incubation habitat that has desirable substrate attributes including large areas of cobble and gravel. The Twin Rivers location would allow fish to imprint on and home to waters near this higher quality habitat, thus addressing one of the possible causes of Kootenai sturgeon recruitment failure.

2.1.1.3 Need for Facility Upgrades at Kootenai Tribal Sturgeon Hatchery

The Tribal Sturgeon Hatchery has several significant shortcomings that would be addressed by the proposed improvements and expansion described above. As previously outlined, facility limitations have hampered the Tribe's ability to meet biological and population objectives.

In particular, the ability to meet production objectives has been limited by available rearing space. High rearing densities have contributed to unacceptably high mortality, an

effect exacerbated by high summer water temperatures. Facility expansion will enable more fish to be reared to Age-1+ (optimizing survival rates upon release to the river) in temperature and density conditions that optimize in-hatchery survival. Additional rearing space would also improve fish health by reducing density-related pathogen transmission and disease susceptibility (LaPatra et al. 1994).

Space is also needed to accommodate separation of sturgeon progeny groups (families) in the hatchery in order to maintain distinct family lineages until the fish are large enough to be permanently marked with passive integrated transponder (PIT) tags. Additional space is also required to facilitate separate rearing of large and small components of individual families to reduce mortality due to size-based selection in the hatchery.

2.1.2 Kootenai River Burbot

Kootenai River burbot are functionally extinct, a status that occurs when populations are too small to recover on their own, even if suitable habitat conditions existed or were immediately restored. Burbot were proposed for ESA listing in 2000. However, the USFWS determined in 2003 that this population was not eligible for listing because it did not meet the defining criteria of a Distinct Population Segment. In the absence of an ESA listing, the Kootenai Tribe coordinated with the USFWS, Kootenai Valley Resource Initiative (KVRI), agency partners and other stakeholders in proposing a "pilot project" in the Kootenai River subbasin to develop, implement, and evaluate a Conservation Strategy for Lower Kootenai River Burbot (KVRI Burbot Conservation Strategy; KVRI 2005). In 2002, the KVRI Burbot Subcommittee was formed to evaluate conservation aquaculture for burbot as part of an emerging conservation strategy to help restore Kootenai burbot. The KVRI Burbot Conservation Strategy was completed in 2005 and a multilateral conservation agreement was signed to ensure burbot population decline would be addressed.

The acutely imperiled status of lower Kootenai River burbot (n<50; Pyper et al. 2004) no longer affords the luxury of an extensive research and evaluation program. Emergency conservation aquaculture appears to be the only short-term approach capable of providing a population in the lower Kootenai River. The Kootenai Tribe's aquaculture program proposes to reintroduce burbot into the lower Kootenai River and begin rebuilding the population using genetically similar stock from within the subbasin (from Moyie Lake in British Columbia). It is also possible that native broodstock from the remnant lower Kootenai population could be captured and incorporated into the program.

2.1.2.1 Need for Conservation Aquaculture Program and New Facility to Meet Biological and Research Objectives

Very little was known about burbot conservation techniques prior to 2004. Over the past 8 years, the Kootenai Tribe has collaborated with fisheries scientists and supported work at the University of Idaho to advance research into burbot culture techniques, progressing through a phased approach. The research has moved from a developmental aquaculture feasibility analysis phase (2004-2008) to a developmental post-release pilot

study phase (2009-2013), which included successful release of burbot into the Kootenai River. The Tribe is now moving into the adaptive experimental evaluation phase (see Table 2-1 for detail), which requires a conservation aquaculture facility. Success in each phase is needed to move the program forward to a subsequent phase.

There is no physical capacity available at the existing Tribal Sturgeon Hatchery to accommodate the burbot conservation aquaculture program. The construction of a new facility is critical to advancing the burbot conservation efforts and to meeting the biological objectives identified in the KVRI Burbot Conservation Strategy.

Table 2-1. Proposed operational phases of the Kootenai River burbot aquaculture program (from the Step 1 Master Plan, KTOI 2010).

Phase	Program Phase	Objective	Test Hypothesis	Status/Duration
1	Developmental aquaculture feasibility analysis	Develop efficient, reliable, and successful aquaculture apparatus and techniques for spawning, incubation, and rearing.	▪ It is feasible to spawn and rear significant numbers of burbot in a hatchery.	~5 years (successfully accomplished) 2004-2008
2	Developmental, post-release pilot study	Initial experimental releases and research to evaluate distribution, movements, habitat use, food habitats, and effective sampling methods by life stage.	▪ Effective sampling methods can be developed to monitor and sample significant numbers of hatchery fish following release. ▪ Some hatchery-produced fish can adapt to natural conditions. ▪ Life stage-specific habitat suitability and limitations can be evaluated using hatchery fish.	~ 5 years (currently on schedule) 2009-2013
3	Adaptive experimental evaluation phase	Implement population-level monitoring to evaluate post-release survival, growth, and maturation to identify restoration feasibility and requirements.	▪ Hatchery fish survive, grow and mature in sufficient numbers to reestablish a significant burbot population in the Kootenai system.	~ 5 years 2014-2018
4	Population rebuilding and management phase	Produce fish, monitor and evaluate success, reevaluate hatchery practices consistent with natural production objectives and outcomes.	▪ A naturally self-sustaining burbot population can be restored through a combination of habitat and hatchery actions.	2019 and beyond

2.2 Program Goals and Objectives

The Tribe envisions the Kootenai River and its floodplain as a healthy ecosystem with clean, connected terrestrial and aquatic habitats that support traditional Tribal and other

important societal uses. This ecosystem vision includes productive populations of Kootenai sturgeon and burbot, both priority species for the Tribe. Accordingly, the facilities proposed in the aquaculture Master Plan and updated in this Step 2 submittal and its appendices are designed to support the requirements of both species in a manner that is cost effective, biologically sound, and sustainable.

2.2.1 Kootenai River White Sturgeon

A clear understanding of current recovery goals and criteria is needed to articulate the objectives of the Tribe's conservation aquaculture program. The need to revise and update the 1999 Recovery Plan has been widely recognized (Paragamian et al. 2005). The USFWS recently completed a 5-year status review for Kootenai sturgeon (Flory 2011) and has initiated discussions with the Kootenai River White Sturgeon Recovery Team regarding updating the 1999 Recovery Plan. In the interim, the Tribe has identified a series of working goals and criteria to guide the Kootenai sturgeon conservation aquaculture program. These goals and criteria are based on the Tribe's review of essential elements common to other sturgeon and salmon recovery plans (Dryer et al. 1993; UCWSRI 2002; LCFRB 2004; NMFS 2007; CDFO 2009; NMFS 2009).

The long-term recovery goal for the Kootenai sturgeon population is unchanged – it is to restore the population to a level where the species is no longer threatened with extinction. The current working recovery goal for Kootenai sturgeon is to ensure the persistence and viability of a naturally-reproducing population as an essential element of a functional ecosystem and a resource supporting traditional beneficial uses.

In light of continuing natural recruitment failure, and consistent with the essential role of the Tribe's program, conservation aquaculture objectives were developed to support long-term recovery goals and criteria. "Long-term" takes on a special meaning for species like sturgeon for which planning horizons must be expressed in decades or even centuries, with female Kootenai sturgeon first reaching sexual maturity at 25 or 30 years of age.

Developing an effective conservation aquaculture strategy is in effect an optimization exercise in balancing a number of time-sensitive risks. Near- and long-term objectives identified below are intended to address conservation-related risks over time. It is helpful to organize objectives by sturgeon generation. Near-term objectives focus primarily on the current generation, which includes the declining remnant wild population. Long-term objectives involve future generations, including fish produced primarily in the hatchery from the remnant wild generation and any future natural recruits in the interval until the last wild fish dies or becomes senescent.

Near-term Objectives

- Prevent demographic extinction by replacing failed natural recruitment with fish produced in the hatchery.
- Establish an increasing trend and broad distribution of ages and sizes in the wild population to ensure future sustainability.

- Preserve and express native genetic and life history diversity by capturing and spawning significant numbers of representative broodstock.
- Provide contingencies for uncertain future availability of wild broodstock and prospects for restoring natural recruitment.
- Inform recovery strategies by using hatchery-produced fish to identify limiting life stages and habitat capacity.

Long-term Objectives

- Avoid annual broodstock limitation where too few fish might be available to capitalize on favorable natural spawning conditions in any year (or to continue to provide hatchery broodstock).
- Minimize the time interval between the functional extinction of remaining wild adults and maturation of the first hatchery generation.
- Maintain an effective population size in the natural environment adequate to avoid genetic bottlenecks that risk loss of diversity or inbreeding depression in the next generation.
- Avoid significant detrimental impacts of hatchery fish on natural production due to competition, predation, or disease magnification.
- Avoid hatchery selection or domestication that might reduce future fitness or viability.

2.2.2 Kootenai River Burbot

Optimally, the burbot restoration effort will re-establish a stable-sized population with sufficient age distributions to assure long-term population viability and persistence. The ultimate goal is to restore a naturally-reproducing burbot population that 1) is as similar as possible to historical populations in terms of structure and abundance; 2) is in equilibrium with the carrying capacity of the present and future environment; and 3) will support tribal and non-tribal harvest. Biological objectives for burbot restoration include the following:

Near-term Objective

- The interim objective is to produce and stock burbot at rates and frequencies to sustain a minimum population of 2,500 - 9,500 adults in the Kootenai River and South Arm of Kootenay Lake (KTOI 2010). This range encompasses the minimum population goal listed in the KVRI Burbot Conservation Strategy (2,500 adults), a minimum abundance which is also suggested by Paragamian and Hansen (2008; 2011). This interim production and stocking objective is a starting point to restore a population that once numbered in the hundreds of thousands (Ahrens and Korman 2002; KVRI 2005).

Long-term Objectives

- The long-term objective is to produce and stock burbot at rates and frequencies to sustain a minimum population of 17,500 adults in the Kootenai River and South Arm of Kootenay Lake (Paragamian and Hansen 2008; 2011).
- In conjunction with re-establishing adult abundance, the long-term objective includes restoring consistent natural recruitment in at least three different spawning areas that will result in a juvenile population of sufficient size to support the adult burbot population goal. The Tribe concludes this is a realistic objective, based on initial results from sub-adult burbot telemetry studies, which indicate that existing hatchery-reared burbot are likely contributing to natural spawning under current conditions (Neufeld et al. 2011; Stephenson and Neufeld 2012).

2.3 Proposed Fish Production and Releases

This section summarizes production targets and releases for Kootenai sturgeon and burbot. Additional information about the sturgeon program is provided in Appendix A (Technical Basis for the Kootenai Sturgeon Conservation Aquaculture Program) and Appendix B (Monitoring and Evaluation Plan for Kootenai River White Sturgeon). Additional information about the burbot program is presented in Appendix C (Monitoring and Evaluation Plan for Kootenai River Burbot). These three appendices are intended to complement and update material provided in the Step 1 Master Plan about aquaculture programs for both species.

2.3.1 Kootenai River White Sturgeon

Production targets identified in the Master Plan have been updated and refined in this Step 2 submittal, as shown in Table 2-2. Targets for total broodstock, family size, fish per family, fish size at release, and total releases are derived from a series of quantitative analyses tailored to address specific short- and long-term risks. Note that targets for family size, families produced, and total releases have been reduced from the original Master Plan based on input from co-management agencies related to the potential to trigger adverse density-related population responses to the higher numbers. The number of families was reduced from 40 to 30 per year. Family size was reduced from 1,000-1,500 to 500-1,500. Total releases were reduced from 20,000-40,000 to 15,000. The hatchery design presented in this Step 2 submittal is consistent with the new production targets.

Table 2-2. Current and expected future Kootenai sturgeon production values[1] with and without the Twin Rivers Hatchery.

	Current Facilities[2]	Program Objective	Facility	
			Kootenai Tribal Sturgeon Hatchery	Twin Rivers Hatchery
Broodstock number	24	Up to 45	Up to 18	Up to 27
Families produced	12-18	Up to 30	Up to 12	Up to 18
Fish/family	1,000-1,500	500-1,000	500-1,000	500-1,000
Size @ release	30 grams	30 grams	30 grams	30 grams
Total releases per year	15,000-20,000	15,000-30,000	6,000-12,000	9,000-18,000

[1]: Estimates are based upon Age-1 juvenile releases and no contribution from natural recruitment.
[2]: Males and females

Juvenile Kootenai sturgeon are typically reared for up to 1 to 2 years in the Tribal Sturgeon Hatchery before release at sizes averaging 6 to 12 inches and 6 to 15 fish per pound. Fish are released from the Tribal Sturgeon Hatchery and the fail-safe sturgeon program at the Kootenay Trout Hatchery in the spring or fall. Fall releases from the Tribal Sturgeon Hatchery are typically Age-1+ fish. Fish reared at the Tribal Sturgeon Hatchery are released into the Kootenai River in Idaho and Montana and some juveniles migrate downstream into Canada as they grow. Those reared at the Kootenay Trout Hatchery are typically faster-growing due to ambient water temperature and are released at Age-1 in the spring. Releases are distributed from the Creston, British Columbia area upstream to Kootenai Falls in Montana.

Age-1 and Age-0 (free embryo) releases are concurrently managed for different but complementary purposes. Age-1 fish are released to build the population, whereas Age-0 (embryo and free embryo) releases are small and experimental to allow evaluation of incubation and early rearing habitat suitability as part of an RPA of the Libby Dam BiOp. Therefore, Age-1 releases are expected to continue (at most annually) and are considered the highest priority until repeatable, adequate natural production is restored. Experimental free embryo releases have been guided by the USFWS Kootenai River White Sturgeon Recovery Team, implemented by the Tribe and the IDFG, and are currently scheduled to end after 2012. To date, the free-embryo, larval, and Age-0 releases have not contributed to recruitment but have been a mandated part of recovery activities under the Libby Dam BiOp. More information is typically provided by controlled replicated studies of early life stage requirements, with results subsequently applied to field conditions and in-river habitats (e.g., Kynard and Parker 2006a, 2006b; Kynard et al. 2007). The Tribe will continue to investigate the results of additional studies as such information becomes available.

Fish from distinct family groups are divided for release at different sites to ensure that identical genetic material is not concentrated at one site. They are distributed to colonize all suitable habitats, avoid local concentrations that might increase competition and predation, and reduce initial post-stocking mortality. Releases directly into Kootenay Lake have been discontinued because of survival uncertainty (biologists have been unable to recapture released fish). In 2004, releases were expanded to include Montana

waters downstream from Kootenai Falls to take advantage of habitat throughout their historical range, and provide opportunities for potential imprinting to upstream areas where what is thought to be more favorable spawning, incubation and early rearing habitats currently exists.

2.3.2 Kootenai River Burbot

Burbot conservation aquaculture program production goals are a series of adaptive targets designed to release enough fish to meet estimates of survival to sexual maturity without swamping the reintroduced population with too many progeny from too few families. Table 2-3 shows targets (or Decision Guidelines[1]) for donor source, broodstock, number of families produced, and number of larvae, juveniles, and mature adults to be released, by program phase.

The current absence of empirical post-release survival data of larval and juvenile releases necessitates this adaptive method. Initially, the release strategy will focus on the release of 6-month-old juveniles. If juvenile survival does not prove sufficient to increase abundance of mature adults, the Twin Rivers Hatchery will provide the facilities necessary to rear Age-1+ sub-adults. The release strategy currently incorporates ten sites in Idaho and British Columbia that are known to have supported burbot historically.

Table 2-3. Initial Decision Guidelines for each phase of the burbot program.

Metrics	Phase 1 2004-2008	Phase 2 2009-2013	Phase 3* 2014-2018	Phase 4 2019 +
Donor Source	Moyie Lake	Moyie Lake	Moyie Lake	Moyie Lake
Percent Broodstock from Donor Source	100	100	50-100	0-100
Percent KR Natural-origin Broodstock	0	0	0-50	0-100
Families Produced	-	Up to 36	Up to 60	Up to 60
Larvae Released	-	0 – 350,000	TBD	TBD
Age-0+ 6 mo.-old Juveniles Released	-	5,000 - 20,000	20,000 - 100,000	Up to 125,000
Age-1 Released	-	100 - 500	TBD	TBD
Minimum Number Mature Adults (Ages 4+)	-	-	2,500	17,500
Minimum Number of Spawning Areas	-	-	3	3
Natural Recruitment	-	Possible	Probable	Significant
Harvest				
Fishing Mortality	-	0	0	TBD

*Twin Rivers Hatchery is expected to start production in Phase 3 (shaded column).

[1] For both sturgeon and burbot, Decision Guidelines pertain to donor source; % broodstock from donor source; % Kootenai River natural-origin broodstock; number of families produced number of Age-0+ young-of-year (YOY) released; number of Age-1 released. For burbot, Decision Guidelines also address the minimum number of mature adults (Age-4+); minimum number of spawning areas; natural recruitment (none, possible, or significant); and harvest. Decision Guidelines are discussed in more detail in Chapter 5, Monitoring and Evaluation.

2.4 Program Facilities and Operations

The Tribe is proposing several improvements to the existing Tribal Sturgeon Hatchery to address the need for additional rearing capacity (Figure 2-1). The Tribe is also proposing to develop a new aquaculture facility, the Twin Rivers Hatchery (Figure 2-2), to further expand the capabilities of the sturgeon program, maximize program flexibility, and to support implementation of the new burbot aquaculture program. The following sections summarize the improvements, new program facilities, and program operations.

2.4.1 Tribal Sturgeon Hatchery

The Kootenai sturgeon conservation aquaculture program involves broodstock collection and handling, spawning and fertilization, incubation and hatch, and marking and release. The Tribe will continue to use the existing Tribal Sturgeon Hatchery near Bonners Ferry for these purposes, to the extent space will allow. Upgrades at the Tribal Sturgeon Hatchery include the following:

- Adding weather protection and de-icing systems to the sediment pond to allow year-round operation of the sediment pond and drum filter
- Adding mechanical means to transfer broodstock from the dock on the Kootenai River to holding tanks (large broodstock are currently carried on stretchers up a steep bank to holding tanks several hundred feet away)
- Adding a new spawning room (broodstock holding tanks are currently in a separate building from the spawning room, so adult sturgeon must be moved manually between buildings during spawning activities)
- Developing additional feed, vehicle, and boat storage areas
- Upgrading buildings for safety, efficiency and sanitation

Figure 2-1. Tribal Sturgeon Hatchery site plan.

2.4.2 Twin Rivers Hatchery

The proposed Twin Rivers Hatchery aims to optimize efficiency and cost effectiveness by providing shared aquaculture facilities for the Kootenai sturgeon and burbot programs, as well as design elements that meet the specific needs of each species. Most infrastructure and physical operations for the Kootenai sturgeon and burbot programs will be combined. For example, power supply, support facilities, water sources, and water and temperature treatment will be designed with adequate capacity and flexibility to meet or exceed all water supply and quality needs. The proposed new facilities at the Twin Rivers Hatchery will include the following:

- Wells for one source of the hatchery water supply
- River water intakes, one on the Moyie River and one on the Kootenai River
- Influent and effluent water settling basins
- Utilities, including roads, parking lots, piping, sanitary drain field, electrical power, telephone and stormwater drainage
- Water filtration, heating and cooling capabilities
- Adult fish holding/spawning in round tanks with adequate cover to hold sturgeon and burbot
- Incubators for sturgeon and burbot eggs
- Start tanks where post-hatch sturgeon and burbot that have volitionally moved out of the incubators will be fed and closely monitored for disease as they grow to a size acceptable for transfer out of the start tank room
- Circular indoor rearing tanks for grow-out of sturgeon (6-foot- and 8-foot-diameter tanks) and burbot (4-foot-diameter tanks)
- Administrative and biological support facilities
- A building for vehicle and boat storage and maintenance
- Two employee residences

Figure 2-2. Twin Rivers Hatchery site plan.

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The Twin Rivers Hatchery will include facilities to rear rainbow trout to provide live feed for both Kootenai sturgeon and burbot broodstock. The hatchery will also include facilities to culture and rear *Artemia* and rotifers, as larval feeding trials with burbot showed that feeding live prey for 30 days was required, and that extended live prey feeding improves survival and fish health (Jensen et al. 2008a). Larval burbot from about age 10 to 50 days post-hatch will be fed a live zooplankton diet until they are mature enough to be transitioned to a commercial dry food diet.

For Kootenai sturgeon, the Tribe will use the Twin Rivers Hatchery to:

- Expand Kootenai conservation aquaculture program to incorporate an increased number of natural broodstock while they are still available.
- Increase rearing capacity in order to reduce rearing density.
- Allow fish to imprint and home to waters farther upstream where potentially suitable habitat exists
- Allow for greater segregation and size grading of fish families
- Accommodate basic aquaculture research needs

For Kootenai burbot, Twin Rivers Hatchery operations will involve broodstock collection and handling, spawning and fertilization, incubation and hatching, rearing, marking, and release. The Tribe will use the hatchery to:

- Hold and handle broodstock obtained from Moyie Lake or the Kootenai River/Lake in addition to field collection of gametes
- Incubate burbot eggs, with the capacity for periodic anti-fungal egg treatment, as needed
- Rear burbot indoors to 6-month old juveniles and/or ageAge-1+ sub-adults
- Conduct experimental larval or extended burbot rearing in outdoor tanks, ponds, or greenhouses
- Mark and release burbot in the summer and fall
- Accommodate basic aquaculture research needs

2.4.3 Off-site Rearing

The Tribe is leasing two privately-owned outdoor ponds and IDFG has two ponds that were constructed for extensive burbot culture on a nearby state wildlife management area to develop and test experimental rearing techniques. At these interim facilities, the Kootenai Tribe, IDFG, and the University of Idaho Aquatic Research Institute (UI-ARI) are collaboratively developing and refining burbot pond (extensive) culture until controllable ponds or other extensive culture facilities are developed at Twin Rivers Hatchery. While these remote ponds provide some information on extensive burbot culture, they have

some drawbacks, including water management limitations and predation. Furthermore, the replication needed for adaptive experimental trials is not possible. Information gained from operating these temporary ponds is intended to influence final design and operational provisions of the burbot hatchery facilities.

3 STEP 1 MASTER PLAN: REVIEW AND RESPONSES

This chapter addresses key issues identified in the ISRP's review of the Master Plan submitted in 2009 and comments on the revised Master Plan submitted in 2010. Supporting information about the Kootenai sturgeon program is presented in Appendix A (Technical Basis for the Kootenai Sturgeon Conservation Aquaculture Program) and Appendix B (Monitoring and Evaluation Plan for Kootenai River White Sturgeon). Additional information about the burbot program is provided in Appendix C (Monitoring and Evaluation Plan for Kootenai River Burbot). Information provided in the responses below and in these three appendices is intended to complement and update material provided in the Step 1 Master Plan.

3.1 Summary of Issues Identified by the ISRP

The primary issues identified by the ISRP in their initial comments on the Master Plan focused on recommendations to 1) strengthen the sturgeon element of the Master Plan, and 2) allocate resources toward developing an understanding of the factors that affect burbot survival after stocking before undertaking a production-scale hatchery for burbot. To prevent delays in the review process, the ISRP recommended separating the Master Plan into separate sturgeon and burbot proposals.

For Kootenai sturgeon, the ISRP's specific comments on the first iteration of the Master Plan highlighted the need for:

- A complete history of the sturgeon production and release program to permit an adequate assessment of whether captive propagation and release can work/is working toward recovery goals;
- Justification of the numerical biological objectives for genetic and abundance goals, with modeling (using a range of deterministic life-stage survival values and stochastic survival rates) to establish the extinction risk and population abundance trajectory;
- Demonstration that the production plan is designed to achieve the biological objectives, establishing the linkages between the number of sturgeon produced, the breeding design, and other biological outcomes with the facilities expansion and programmatic strategy; and
- Demonstration that the sturgeon production facilities are designed to achieve the production plan.

For burbot, the ISRP recommended that the program proceed on a feasibility scale, primarily using existing facilities, until sufficient proof exists to transition to pilot-scale efforts. The ISRP also commented that the Tribe should provide a more thorough discussion of other burbot culture programs, including an evaluation of the success of these programs toward re-establishing natural productivity.

3.1.1 Steps Taken to Address ISRP 2009 Comments

The Tribe submitted a revised Master Plan in June 2010, incorporating most of the ISRP's recommendations. The Tribe considers the Kootenai River sturgeon and Kootenai burbot plans as two elements of a single program, and therefore did not submit separate Master Plans, as suggested by the ISRP. However, the Tribe presented sturgeon and burbot in separate sections of the revised Master Plan to provide the necessary focus on each species' specific program needs. This approach is consistent with the Tribe's short- and long-term goals and its efforts to maximize efficiency and reduce the risk of catastrophic production loss by rearing fish at two separate facilities.

In the June 2010 response, the Tribe also provided answers to each of the ISRP's 36 specific questions about the proposed Kootenai sturgeon program. To address the ISRP's burbot concerns, the Tribe expanded the discussion of the burbot program to explain its focus on researching burbot habitat requirements and limiting factors, and provided a complete Hatchery Genetic Management Plan (HGMP).

3.1.2 Summary of ISRP 2010 Comments

Based on its review of the revised Master Plan and the Tribe's responses to its questions, the ISRP concluded that the Step 1 Master Plan for Kootenai sturgeon meets the requirements for proceeding to Step 2, but qualified this finding by identifying three areas that should be improved. These include:

1) Establishing benchmarks (i.e., estimated population size, survival rates, adequate number of families, and age structure) and a decision pathway to adjust production goals based on monitoring data of hatchery fish in the wild;

2) Refining the monitoring program to collect data necessary to determine if benchmarks are being met or exceeded; and

3) Providing additional details regarding the rationale and justification as to the need for additional hatchery capacity.

For burbot, the ISRP concluded that the Tribe has provided sufficient information and justification to proceed to Step 2, and requested only that the Tribe address three aspects of the burbot proposal:

1) Burbot's key regulatory role in the Kootenai River ecosystem;

2) The adequacy of Moyie Lake to provide broodstock; and

3) A future harvest plan with some estimated goals.

The following sections provide responses to the ISRP's 2010 comments, first for the sturgeon program (Section 3.2), and then for the burbot program (Section 3.3). More detailed discussion of these responses can be found in Appendix A.

3.2 Responses to ISRP 2010 Comments: Sturgeon Program

The ISRP provided comments in four categories, which are coded below with letters and numbers, e.g., Recommendations (R-#x), Summary Review Comments (SR-#x), Specific Comments (SP-#x), and Comments on Step 1 Review Elements (RE-#x). To provide the context for each response, the ISRP's initial October 2009 comment is summarized (if one was provided), and then the verbatim text of the corresponding August 2010 comments are presented (in *italics*). The Tribe's responses follow in shaded boxes. Appendix A contains a more detailed discussion of the issues raised by the ISRP regarding the Kootenai Sturgeon Conservation Aquaculture Program. This appendix also incorporates input on the technical basis for the program provided by co-managers and partner agencies and was reviewed by those entities. Appendix A provides supplementary information to complement and augment the Step 1 Master Plan and this Step 2 document. The discussion provided in Appendix A is critical to an understanding of the technical basis for the sturgeon program.

3.2.1 Recommendations (R)

ISRP Recommendation R-1: *The proponents have provided adequate responses to the majority of the ISRP's comments in the preliminary review of the Master Plan, and the ISRP appreciates the extensive detail provided in the response document and the revised Master Plan. However, the ISRP has identified several remaining issues for which we would like additional information/detail and qualify our review with expectations of seeing this information included in the Step Two Master Plan document.*

The qualifications are that the proponents: (1) establish quantitative benchmarks (i.e. estimated population size, survival rates, adequate number of families, and age structure) and a decision pathway to adjust production goals based on monitoring data of hatchery fish in the wild, (2) refine the monitoring program to collect the necessary data to determine if benchmarks are being met or exceeded, and (3) provide additional details regarding the rationale and justification as to the need for additional hatchery capacity (see summary comments/questions below).

Project Sponsor Response R-1

Sub-headings below address each of the ISRP's qualifications.

<u>1) Quantitative Benchmarks</u>

Three levels of quantitative benchmarks are identified for the sturgeon aquaculture program:

<u>Working recovery objectives</u> have been identified consistent with characteristics of a viable sturgeon population, including abundance, productivity, distribution,

diversity, and use (see Section 2.4 of the program technical description in Appendix A). Quantitative criteria are identified for abundance. Qualitative criteria are identified for other attributes where data and information are not yet sufficient to determine specific quantitative values.

Production targets identify numbers of broodstock, families, family size, size at release, and annual releases developed consistent with working criteria to guide hatchery planning and operations (see Section 4 of the program technical description in Appendix A). These numbers are based on working recovery objectives, and provide the basis for facility designs for the Kootenai sturgeon conservation aquaculture program.

Population Benchmarks provide reference values for monitoring and evaluating progress toward recovery criteria achieved by current production targets (see Section 6.3 of the program technical description in Appendix A). Benchmarks identify quantitative values for key population attributes. Targets for wild fish represent desired values that are expected to meet numerical recovery objectives. Targets for hatchery fish represent baseline values estimated from current information. Trigger points occur when target values are reached that warrant reconsideration and possible adjustment of hatchery production targets or methods under the program's adaptive management framework.

2) Decision Pathway& Monitoring Program

The Kootenai sturgeon conservation aquaculture program will include checkpoints and evaluations at periodic, scheduled intervals. These evaluations will be conducted as part of the adaptive management and implementation plans that are overseen by the Tribe, and will also include coordination with the Kootenai White Sturgeon Recovery Team led by the USFWS (see Section 6.2 of the program technical description in Appendix A).

Key decision points for the sturgeon program might be triggered by the restoration, frequency, and magnitude of natural recruitment; changes in spawning distribution following habitat restoration activities; identification of effective alternatives such as larval releases; unavailable or senile broodstock; strong density-dependent habitat limitations; or delayed maturation of hatchery-origin fish. Program termination or large substantive changes in program objectives and activities will be driven by monitoring and evaluation of the system responses. Program termination can be triggered by either success or failure. Programs will be terminated when and if:

- Productive naturally self-sustaining populations of Kootenai sturgeon are restored in the Kootenai system (e.g., recovery objectives are met).
- Conservation aquaculture activities significantly interfere with or otherwise preclude restoration of a productive naturally self-sustaining population of Kootenai sturgeon in the Kootenai system.

- Conservation and restoration objectives cannot be substantively achieved and programs cannot be reasonably adapted to achieve objectives.

- Benefits prove to be marginal and adaptations prove cost-prohibitive relative to program objectives.

3) Hatchery Rationale

It is now apparent that the next sturgeon generation will depend predominantly on hatchery production. The existing Tribal Sturgeon Hatchery facilities were developed to meet near-term objectives of avoiding demographic extinction with an assumption that natural recruitment would be restored by interim flow measures. However, current numbers of broodstock, families, and total releases provided by existing production facilities are inadequate to address longer-term conservation risks in the absence of substantial natural recruitment. Additionally, the existing facility is operating at its physical and functional capacity, thus constraining any future program operational flexibility without additional facilities. Expansion of the current facilities is not a viable alternative because the available space and water sources are fully utilized. Section 3.3 of the program technical description in Appendix A provides a more detailed explanation of current hatchery limitations relative to near- and long-term program objectives.

3.2.2 Summary Review Comments (SR)

ISRP Comment SR-1: *Rationale/justification for an additional hatchery – Based on the Master Plan and Response, it is argued that hatchery capacity is limiting and that the rationale for the additional hatchery is based on the needs for meeting several production targets outlined in Table 2, Page 13 of the Response document. Box 2, Page 8 in the Response also outlines some of the rationale for the additional hatchery. The proponents want to "Release numbers consistent with family numbers and family release number targets designed to minimize genetic risks… 30,000 to 40,000 sturgeon per year over 10 years." Despite these responses, it remains confusing as to exactly what aspect of hatchery capacity has actually, not just potentially, limited the program thus far from meeting production targets. The hatchery appears to have functioned well below production capacity thus far. Rearing capacity per se from the one hatchery plus B.C. contribution does not appear to be limiting. What aspect is limiting? This needs clarification as outlined below* [comments SR-1(a) through SR-1(f)]*:*

Project Sponsor Response SR-1:

Hatchery broodstock capacity is limited by facilities. The current annual broodstock capacity is approximately 24 adults. This number is dictated by space and tanks for holding broodstock, segregating sexes, and isolating ready females, and a limited ability to regulate water temperature to control maturation of individual broodstock. These limitations preclude increases in broodstock numbers. The program has not yet encountered significant difficulty in obtaining target

broodstock numbers and additional broodstock could be collected if suitable facilities were available. To address near-term and long-term conservation aquaculture objectives, plans call for increasing broodstock numbers and family capacity to 45 and 30, respectively.

Juvenile rearing capacity of the current facility also limits the number of families that can be produced. A family is defined as the offspring from one pair of parents. Families are reared separately to provide genetic and demographic accountability, and to limit the potential for inadvertent hatchery selection for some families at the expense of others due to density-dependent growth and fish survival, and health effects. The current facilities can produce approximately 12 to 18 full or half sibling families per year in separate tanks where juveniles are reared to sizes (30 grams) and ages (Age-1+) necessary to avoid apparent natural habitat limitations for Age-0 fish identified by Justice et al. (2009). The Tribal Sturgeon Hatchery can effectively rear up to about 5,000 to 10,000 juveniles under current family number and family size protocols, with additional production of up to 5 half-sibling families in the fail-safe Kootenay Sturgeon Hatchery in British Columbia. To address near-term and long-term conservation aquaculture objectives, plans call for increasing juvenile production to 15,000 to 30,000 juveniles per year.

Space and water constraints of the existing facility also limit flexibility to grade and manage portions of families as needed to effectively manage survival, growth, health and condition, and minimize the potential for inadvertent selection in the hatchery. Family and juvenile production numbers cannot be increased without increasing the risk of potentially detrimental hatchery selection effects that the conservation program is specifically designed and managed to avoid, such as differential growth, condition, and pre- and post-release mortality due to stress-mediated disease and competition. In some years, warm summer water temperatures in existing facilities also result in significant stress and mortality of juveniles.

ISRP Comment SR-1(a): *One rationale for the additional hatchery is that the proponents want to take advantage of any strong year class survival that may occur with released hatchery sturgeon. Several times it is mentioned (e.g., page 12) that there is a pressing need to front-load production while broodstock remain available. On page 16: "a front-loaded strategy requires maximum hatchery production rather than average hatchery production. This is one of reasons (sic) the proposed new hatchery is needed at Twin Rivers." Is there any sense of how often these "strong year classes" would occur? One in 10 years might be optimistic under current river conditions, and that is about the predicted time period until wild broodstock begins to decline. Have any of those strong year class situations occurred thus far? We found no evidence presented that current hatchery capacity has thus far limited their response to any past strong year class situations. Is there any indication that it has?*

Project Sponsor Response SR-1(a):

The rationale for the additional hatchery is not to "take advantage of any strong year class survival that might occur with released hatchery sturgeon." No strong year class of Kootenai sturgeon has been naturally produced since at least 1974 and possibly not since prior to 1960 (Paragamian et al. 2005; Rust and Wakkinen 2009). Natural flood events since 1974 and many years post-dam artificial flow measures have categorically failed to produce meaningful natural production. Given this long empirical history of failed natural recruitment, there is no reason to assume that a significant natural recruitment event will occur prior to the final expiration of the remnant wild population.

Under natural conditions, a viable sturgeon population might be sustained by periodic large year classes sufficient to bridge extended periods of poor recruitment. A life history strategy involving episodic recruitment is consistent with the longevity, delayed maturation, large fecundity, intergenerational spawning, and iteroparous characteristics of all sturgeons. However, at this point, following nearly 100 years of habitat alteration and over 50 years of failed recruitment for Kootenai sturgeon, natural conditions capable of sustaining a viable population through natural production are not available. It is no longer feasible to rely on the hope of an occasional large year class to restore and preserve this population.

Future production of strong year classes in the wild now depends on the availability of adequate numbers of ripe adult male and female sturgeon to spawn in any given year and the occurrence of migration, spawning, incubation, and early-rearing conditions conducive to success. Front-loading of hatchery production now to compensate for past decades of failed natural production is also expected to shorten the interval between the demise of the wild population and the maturation of adults from hatchery-reared juveniles, as the leading edge of faster-growing, earlier-maturing individuals from successive hatchery cohorts reach adulthood first, followed by slower-growing, later-maturing individuals.

ISRP Comment SR-1(b): *Starting with Table 2, page 13 of the response document:*

<u>Broodstock number/Families produced</u> – It is argued that the existing hatchery is inadequate, resulting in an inadequate number of families, and that the new hatchery will help.

The goal is 40 families per year. "Current production capacity of the combined Tribal sturgeon hatchery and the Kootenai Sturgeon hatchery in British Columbia is 12-18 families per year, with up to 5 families currently produced annually at the B. C. facility" (Page 16).

Our concern is that based on past efforts, it does not appear that total age 1+ rearing capacity or family capacity has been limiting (See Figure 4, page 20 of response), but rather there was a limit of how many brood fish were available. Current capacity is only 22,500 total age-1+ fish per year, or it can only accommodate between 15 and 22.5 families per year

at 1,000 to 1,500 fish per family. See Table 2, Page 13. In recent years (2002-2009), though, even with many fewer fish per family, the number of families has varied from 9 in 2002 to 18 in 2007. There has evidently been a lack of available families (i.e., broodstock?) and not a lack of rearing capacity. Is this so? If so, how would this change with the additional hatchery?

Project Sponsor Response SR-1(b):

Juvenile capacity is currently limited by the need to rear family groups separately and to size-grade fish to Age-1+ prior to release. Families are reared separately to enable genetic and demographic accountability, and to guard against inadvertent hatchery selection for some families at the expense of others. Fish are being reared to a larger size (>30 grams) to avoid empirically confirmed size-related post-release mortality (Justice et al. 2009). Not every circular tank will ultimately be filled with juveniles to its theoretical capacity every year due to differential fertilization success and survival among families. However, it is not appropriate to fill underutilized tank space by moving unmarked (too small to be marked) fish from different families into the same tanks. A significantly greater number of juveniles cannot be reared in the existing facility without increasing risks of potentially detrimental hatchery selection effects that the conservation program is actively managing to avoid (differential growth, condition, disease, pre- and post-release survival, etc.). Section 4 of the program technical description in Appendix A provides a more detailed explanation of current hatchery limitations relative to production targets.

ISRP Comment SR-1(c)*: Can the proponents catch enough potential spawners to meet this family target? It does not appear that they have been able to do so thus far, so this point should be clarified. What are the plans for improved protocols for meeting this more ambitious goal? In seeking prime broodstock, it is possible that many mature Kootenai sturgeon do not migrate very far upriver of the lake. They may move a lesser distance upriver as they age and explore less, concentrating energy on feeding and reproduction. This may account for the larger population estimates in Beamesderfer et al. 2009 (as acknowledged) and may give a clue as to where to seek more broodstock. How much effort is Canada putting into this effort by catching brood fish in their waters?*

Project Sponsor Response SR-1(c):

The sturgeon aquaculture program has not yet encountered difficulty in obtaining sufficient numbers of broodstock to support past hatchery production targets. Evidence from the past 20 years suggests that increased broodstock needs can be met by collection of broodstock from Idaho waters, at least in the near future. Sampling in proximity to current spawning areas consistently provides high catch per unit effort and a high percentage of ripening adults suitable for broodstock. All fish in this population appear to spawn exclusively in Idaho. Telemetry data indicate that maturing adults generally migrate into Idaho over an extended period from late fall until spring; some

overwinter in the river and migrate upstream during the following spring to reproduce.

There is no indication that numbers of available broodstock are currently inadequate to support the additional spawners needed to meet the increased production targets associated with the additional facilities. Although broodstock numbers may vary from year to year, the program has been able to capture as many as the current facility and staff can support at one time. The need for additional broodstock can only be met with a new facility because there is not enough space or capacity for additional personnel at the existing Tribal Sturgeon Hatchery to handle them, or to grade and separately rear numerous groups of individual families.

Based on population estimates of fewer than 500 adults in 2005 and an annual mortality rate of 9% (Paragamian et al. 2005), the Tribe feared that broodstock limitations were imminent. However, more recent empirical data analyses indicate the current population is around 1,000 fish with an annual mortality rate of 4% (Beamesderfer et al. 2012a). These findings point to an opportunity to increase broodstock numbers while substantial numbers of adults are still available. Rather than relaxing hatchery efforts in light of the updated population estimates, the Tribe is taking a rigorous, precautionary approach of increasing hatchery production to take advantage of these "additional" fish before they die. If the wild population was in its last stage of decline, it would be too late to increase broodstock numbers. However, there are still good numbers of broodstock available that will allow us to bolster the effective population size of the founder population for the next and subsequent sturgeon generations.

There is still significant ground to make up from a broodstock incorporation perspective following more than 50 years of failed natural recruitment. Furthermore, failure to take advantage of this opportunity because of an assumption that these fish will be available indefinitely, or for other reasons, would pose an unacceptable risk to long-term species conservation.

ISRP Comment SR-1(d): *On efforts to increase broodstock acquisition, it is not clear when during the year effort is made to acquire, maintain, and presumably inject broodstock for acquisition of gametes. The typical season for this is in spring. However, has it been considered that because these sturgeon, especially females, have a very protracted period of gonadal recrudescence (3-4 years between spawns), there are many phases of reproductive status occurring in these fish at any time of the year? That is, although natural spawning is in spring, fish are at many phases of reproduction and some are always "out of phase" for a narrow natural spawning window. Is it known if potentially useable females are or could be available for capture and use at any time of the year with injections and some temperature/photoperiod acclimation? Perhaps this is done now. This may be in the plan, but it was not clearly stated.*

Project Sponsor Response SR-1(d):

Females in earlier stages of egg development are readily identifiable by biopsy at capture, and could potentially be held following capture until ready for spawning in

the following year. However, previous efforts to hold developing females at the Tribal Sturgeon Hatchery, in addition to lessons learned from other white sturgeon hatchery programs, suggests that collection of ripe females is a more effective approach. Extended holding requires additional tanks and water, and the fish must also be fed and monitored. Holding may also disrupt the normal maturation cycle, resulting in dedication of resources to fish that cannot ultimately be spawned. Given the current availability of ripe females, there has been no need to collect early vitellogenic females and hold them in captivity until they ripen. Although holding sturgeon for extended periods before spawning might increase the efficiency of broodstock collection under certain circumstances, the management costs and biological risks currently outweigh the potential benefit.

Currently, male broodstock are not typically held in the hatchery, as sperm has been successfully collected in the field from flowing males since the mid-1990s. As the wild population continues to decline, more males may need to be held temporarily in the hatchery to meet production objectives. The new facility will provide the space and systems required to hold and manage more males, including the ability to manipulate water temperature. The collaborative Canadian fail-safe sturgeon hatchery program supported by the Tribe successfully regulates water temperature to ensure a ready supply of ripe males from broodstock held in the hatchery. A similar practice will be employed, as necessary, to optimize operations in the Idaho culture facilities. Section 4.1 of the program technical description in Appendix A provides additional explanation of broodstock collection practices, alternatives and production targets.

ISRP Comment SR-1(e): *Fish per family/size at release – Targets for numbers per family are 1,000 to 1,500 per family at age-1 for genetic benefits. The proponents lay out the defense for the 1,000 to 1,500 fish per family in Figure 5, page 22. Is the 1,000 to 1,500 fish per family a genetically defensible and defended target? It seems instead to be based mostly on expected survival rates as related to size at release.*

Project Sponsor Response SR-1(e):

With the construction of the Twin Rivers facility, family size release targets will be reduced from the current 1,000 to 1,500 yearlings down to 500 to 1,000 yearlings. This reduction is intended to balance the need for increased broodstock numbers to optimize phenotypic expression while also controlling total release numbers that could trigger negative compensatory response at higher densities. The Tribe anticipates that average family size will be intermediate within the target range due to normal variation in fertilization and survival rates of different family groups.

Family size targets are established to: 1) ensure survival of a representative number of offspring from each family to an age where they can spawn and contribute to the next generation, 2) avoid excessive contributions from any one family or a few families that might swamp the population genetics, and 3) limit total population size in order to reduce intra-species competition and density-dependent growth and

survival limitations. Section 4.2 of the program technical description in Appendix A presents additional explanation of the basis for family size targets.

ISRP Comment SR-1(f): *In using the 1000-1500 family size target as a justification, first year survival (i.e., of age-1 releases) seems critical in estimating the family sizes actually needed. The proponents base their estimates on the idea that age-1 fish (30 grams each) will survive at 15%. In preparing their Figure 5, it is not clear why they chose a first year survival of 15%. Is this based on a rate for fish released into the wild strictly as age-1 fish? Or does it include age-0 fish? This is very difficult to figure out from their presentations and from Justice et al. (2009). It would be very helpful if the projections were made based on a size of age-1 fish to be released and the best estimates of survival of those fish. What was the survival rate in 2005-2007 for fish comparable in size to fish released in earlier years? Was it as low as 15%? Were any similar sized fish released? Figure 10 of the response is not informative on this point either because it does not account for fish size. The basis of the 15% number needs to be clarified.*

The expected survival is very critical to projections, as their Figure 8 [summarized below] *shows. For example, for a slightly higher (25%) survival rate in year 1, and the projected rates of 88% in year 2, and 96% after that, the pattern would be:*

Year	*Survival rate*	*Number of brood year fish per family at large (500 age-1 fish released)*
2012	*(released)*	*500*
2013	*.25*	*150*
2014	*.88*	*132*
2015	*.96*	*127*
2016-2035	*.96*	*122-56*
2036	*.96*	*54 age 25 fish ("Mature")*

In this case, the number of fish needed per family to achieve Ne, effective population size goal, is less than the proponent's target size, and the proponent's justification of the additional hatchery is less obvious based on family size.

Project Sponsor Response SR-1(f):

Revised population projections are presented in Section 4.5 of the program technical description in Appendix A. Revised population projections are based on updated information on release numbers and survival rates. Projected population size is extremely sensitive to survival rates of future release groups, which remain

uncertain. Since the program began annually releasing substantial numbers of fish, variable first year survival rates averaged an estimated 12%, but ranged from less than 1 to 23%. This range includes years of predominately Age-0 (2005-2007) and Age-1 releases (2002-2004, 2008). High and low values were seen for both types of releases. It remains to be seen what rates will be consistently associated with a return to Age-1 releases. It is reasonable to assume that survival will rebound to values intermediate between recent extremes (e.g., 12%) but will be nowhere near the high rates (40-90%) seen in the early years of the program. Section 5.1 of Appendix A also provides additional discussion of the uncertainty in future survival rates and the implications for future population projections.

***ISRP Comment SR-2**: Density dependence – The proponents acknowledge that such front-loading could have negative impacts from density dependence. In the Response document, (P.9) "Recent analysis of post-release hatchery fish survival suggests there may be size-related density-dependent limitations during the first year of age." Also, "Current habitat capacity for sturgeon is unknown" and "it remains to be seen whether the larger fish will survive at similar rates to the like-sized fish groups released before 2004, given the density of hatchery-reared juvenile sturgeon in the river. In addition, as the habitat restoration program is implemented, the magnitude of the habitat carrying capacity limitation may be reduced." This evidently means that carrying capacity may increase.*

***ISRP Comment SR-2(a)**: The issue of carrying capacity in the plan in terms of its possible effects on the hatchery program is clearly acknowledged, but not effectively addressed. Not even ballpark estimates of carrying capacity are presented nor any calculations supporting them. Based on the available evidence of apparent density-dependent survival and perhaps growth with the comparatively modest releases thus far, it remains to be seen if the larger releases of larger fish into the river will show positive results. Has it been adequately considered that nearly all larger fish should be released into the lake or just above the lake, where carrying capacity limitations may not be as severe?*

Project Sponsor Response SR-2(a):

The Tribe shares the ISRP's concern regarding potential future effects of density dependence. However, this is just one of many unknowns and risks that must be considered by this program. Program objectives and strategies have been designed to balance a wide spectrum of very uncertain demographic, genetic, and ecological risks and benefits over multiple generations of sturgeon recovery and over different phases of this program. Section 5.5 of the program technical description in Appendix A includes an extensive description of uncertainties associated with habitat capacity and density dependence.

It is important to note that not all density-dependent responses are detrimental. While there are certainly potentially negative aspects (e.g., reduced survival, delayed maturation), significant positive responses can also be anticipated which could balance or surpass the negative effects. For instance, the upstream expansion of juvenile distribution into Montana might represent a behavioral

response to high densities in the meander reach. It would be a huge benefit if increased competition stimulates a wider dispersal of fish into upper river reaches where they subsequently may spawn in more favorable habitats. It is also unclear whether current recruitment failure is simply related to spawner stock abundance and might be at least partially ameliorated by rebuilding the adult population to higher levels.

The role of density dependence in a normally functioning natural sturgeon population is unclear. Density-related processes are a normal dynamic in many healthy wild fish populations. Natural selection will act to regulate year class abundance and density dependence might serve some functional role in sustaining long-term viability.

With respect to the question of hatchery release location, current releases are distributed throughout the meander reach between the lake and Bonners Ferry to avoid the potential for concentrations which might trigger local carrying capacity effects. Mark recovery and telemetry data has shown that most hatchery juveniles quickly disperse from release sites and distribute themselves throughout the lower river, river delta and portions of the lake.

ISRP Comment SR-2(b): *[However], because of the importance of estimating carrying capacity and as the habitat restoration program planning moves ahead, it is strongly suggested that a workshop using trophodynamic models be convened.*

Project Sponsor Response SR-2(b):

The Tribe agrees with the ISRP that the capacity of the Kootenai system is a critical issue for this program, and could ultimately prove to be a significant limiting factor. Carrying capacity is currently unknown and density dependence is poorly understood. Based on ISRP recommendations for utilization of trophodynamic models, bioenergetics, and feeding ecology assessments to evaluate the question of capacity, the Tribe conducted additional exploration of these methods. Results are reported in Appendix A, Section 8.

It was clear from this exercise that the theoretical food requirements of a large sturgeon population could easily surpass the amount of food available in a relatively unproductive system like the Kootenai. It can also be inferred that planned production levels could reasonably be expected to elicit some type of density-dependent response at some point in time. Perhaps the most valuable lesson from this exercise is that it highlights the need to consider the ecosystem context of the sturgeon recovery effort and the complexity of ecological interactions that must be taken into account. Even where these models have little real-world predictive value, they are still useful in helping us understand how the system works.

However, this exercise also illustrates the challenges of attempting to infer capacity based on limited information and inherently variable parameters. Capacity

estimates might be derived using various models, but these inferences would be speculative, at best, given the broad assumptions required to parameterize the models. Modeling requires detailed information, which is currently not available, about the following factors: 1) age-specific white sturgeon abundances, 2) age-specific white sturgeon weights, 3) feeding ecology of juvenile and adult white sturgeon, 4) estimates of primary productivity, 5) biomass estimates of prey species, 6) temperature-specific growth rates for white sturgeon across age classes, and 7) nutritional information on prey species. Where, when, and how density-related effects will be manifested remains to be determined.

Due to considerable variability and uncertainty associated with the sturgeon population and the altered Kootenai River ecosystem, the Tribe chose to adopt an adaptive, experimental management approach to estimate carrying capacity. This issue was also a topic of consideration at a hatchery workshop hosted by the Tribe in February 2012. Co-manager and agency participants at this workshop agreed on the limitations of modeling efforts and supported implementation of a collaborative and robust adaptive management approach to evaluating carrying capacity and density dependence in the Kootenai River. The program is summarized in Chapter 5 of this document and presented in more detail in Appendix B (Sturgeon M&E Plan).

3.2.3 Specific Comments (SP)

ISRP Comment SP-1: The ISRP's 2009 comment requested that the Tribe provide a complete history of the sturgeon production and release program from adults collected and spawned, juveniles released, survival and current status of released individuals (for example, the repeat recapture history of individual brood fish).

The ISRP's 2010 comment to address is: *Good information was provided in the response, but it is still not clear if propagation and release can work. The carrying capacity of the Kootenai River remains unknown and may be insufficient to meet conservation goals.*

Project Sponsor Response SP-1:

As discussed in our response to SR-2(b) above, it is absolutely true that the carrying capacity of the Kootenai River remains unknown. However, the proposed hatchery strategy is specifically designed to empirically evaluate system carrying capacity at each sturgeon life stage by releasing significant numbers of hatchery-reared sturgeon and monitoring the system response in terms of survival, growth, and condition. Hatchery-related measures will be adjusted accordingly to achieve an optimum balance between competing risks and demographic and genetic objectives. For instance, total releases and family sizes might be reduced, fish might be reared to a larger size to avoid size-related post-release survival bottlenecks, biomass might be reduced by removing fish from the population, or the program might be adjusted to simply allow demographic selection to occur in the current environment.

ISRP Comment SP-2: The ISRP's 2009 comment indicated a need for a modeling exercise using a range of deterministic life-stage survival values and stochastic survival rates to establish the extinction risk and population abundance trajectory.

The ISRP's 2010 comment to address is: *Better justification for numerical objectives and abundance goals is needed (see summary comments above). Some basic life history models are provided, but the proponents may be relying too much on adaptive management (almost trial and error). The proponents declined the ISRP's request to use stochastic models because of a lack of information to parameterize them for Kootenai sturgeon. They insisted that this population is unique, and maybe it is, but it is troubling that the proponents did not provide much literature review and what they provided was focused on "their" population of upper Columbia white sturgeon.*

Project Sponsor Response SP-2:

The ISRP comment identifies concerns about the Tribe's reliance on adaptive management, rather than using stochastic models to justify numerical objectives and abundance goals. The following addresses these two topics.

Adaptive Management

Rather than pursuing a speculative, reductionist approach to key uncertainties, the program supports an active adaptive management strategy involving a systematic, rigorous approach for learning through designing management actions as experiments. True adaptive management is an appropriate strategy when uncertainty is high, risks are acceptable or reversible, and answers can be obtained in a reasonable time frame (Marmorek 2011). Far from "trial and error", this involves a structured, iterative process designed to support optimal decision making in the face of uncertainty, with an aim to reducing uncertainty over time by learning via experimental management and system monitoring, as originally conceived by Holling (1978) and Walters (1986) and reiterated by Ludwig and Walters (2002).

With Kootenai sturgeon, there is a rare opportunity to manage fish recovery in a truly adaptive fashion involving large-scale implementation, monitoring, and evaluation of actions to test the limits of the system and to monitor the response(s). This approach has already proven successful in identifying critical new information during the initial 20 years of the program. Research and monitoring efforts have produced a number of surprises, each with significant implications for recovery. For instance, age validation studies showed that the wild fish are substantially older than previously thought, which led to reassessing the importance of non flow-related (pre-dam) habitat requirements and the nature, timing and causes of natural recruitment failure. Monitoring post-release survival of hatchery-reared fish identified a second critical life history bottleneck at the young-of-the-year (YOY) stage that may constrain our ability to restore natural recruitment (Justice et al. 2009). Expanded sampling efforts in Kootenay Lake demonstrated that the wild population is larger than previously estimated but that many of these fish appear to rarely participate in spawning (Beamesderfer et al. 2012a). And finally, recent

sampling in Montana has found large juvenile hatchery fish dispersing into upstream riverine habitats (Stephens et al. 2010; Stephens and Sylvester 2011), which might be much more conducive to successful reproduction when those fish reach sexual maturity.

Current plans reflect the Tribe's best attempt to implement an effective precautionary sturgeon aquaculture program. However, experience has demonstrated that surprises and course adjustments will be inevitable. The hallmark of the Kootenai sturgeon recovery effort has been its effective experimental adaptive approach. Over its brief history, the program has evolved in response to new data, information, and changing demands. New information and evaluations have characterized the sturgeon conservation and recovery effort in the face of very large uncertainty regarding limiting factors and effective remedies. Program needs will also change over the course of the recovery effort, in response to risks encountered at various stages. There is every reason to expect this pattern to continue for the duration of the recovery effort. The additional facility at Twin Rivers, along with upgrades of the Kootenai Tribal Sturgeon Hatchery, will provide the flexibility in space, systems, and water necessary to continue to implement this program in an effective adaptive manner.

Implementation of a truly adaptive management approach for Kootenai sturgeon will continue to involve: 1) aggressive use of hatchery production to inform recovery strategies by experimentally evaluating system dynamics and limitations, and 2) implementation of a comprehensive monitoring and evaluation program involving explicit test hypotheses, quantitative benchmarks, and a decision pathway for program adjustments. This work will continue to be implemented through the cooperative efforts of the Kootenai Tribe, IDFG, and other co-managers, and will involve regular annual operational reviews and consultations to make decisions based on progress and new information.

Stochastic Analysis

Stochastic analysis suggested by the ISRP is a commonly used approach in conservation biology to evaluate the chances that a population might "bottom out" due to combined effects of reduced productivity and normal environmental variation. These Population Viability Analyses (PVA), have been widely applied to salmon (Beamesderfer 2010) but are used less frequently for sturgeon. These models very effectively consider the status of listed salmon populations in a risk-based framework that takes into account the interaction of low numbers and productivity with environmentally-mediated variability in recruitment and survival. The use of stochastic models for sturgeon PVA has also been explored for a variety of sturgeon populations (Jager 2001, 2005, 2006a, 2006b; Jager et al. 2001, 2010; Paragamian and Hansen 2008; Schueller and Hayes 2011; ODFW 2011).

These analyses have been most useful for evaluating the relative influence of different parameters, assumptions and actions on risk, but have also demonstrated that absolute estimates of risk depend strongly on speculative underlying assumptions regarding depensatory thresholds. Conventional PVAs of the effects

of environmental variability on population cycles are not particularly informative for Kootenai sturgeon, where the problem is not variable recruitment, but no recruitment. Because of their longevity and delayed mortality, the viability of sturgeon populations over the long term is relatively insensitive to normal annual variation in demographic parameters.

Rather than employing a stochastic PVA approach as suggested by the ISRP, the Tribe identified production targets for this program based on a series of deterministic model projections focused on time-specific risks. Risks are compartmentalized into specific periods, which the Tribe proposes as a more effective alternative to the problem of unstable population patterns addressed by the PVA. Section 5.7 of the program technical description in Appendix A includes an extensive description of uncertainties related to stochastic processes and the potential application of stochastic models to Kootenai sturgeon.

ISRP Comment SP-5: The ISRP's 2009 comment indicated that holding young sturgeon for extended periods of time in the captive environment, while elevating short-term survival, carries risks to future natural recruitment, and requested a concise presentation of the logic path for these risk/benefit trade-offs.

The ISRP's 2010 comment to address is: *Based on the proponent's responses, releases of both 0 and 1 fish are planned, and both are necessary because of the high risk of extinction. The proponents try to make the case there will be no "in-hatchery" evolution occurring if age-1 fish are reared. However, they do not adequately cover the literature of sturgeons elsewhere.*

Project Sponsor Response SP-5:

In the past, Age-0 fish were released in an attempt to assess survival from early life stages. It was initially hypothesized that sufficient numbers might survive, thereby reducing the need, with associated costs and risks, of hatchery rearing from the post-larval to the YOY stage. However, no survival has been documented following the release of millions of embryos, free embryos, larvae and YOY over many years. By contrast, releases of Age-1 and Age-1+ sturgeon are documented to result in reasonable post-release survival (Ireland et al. 2002; Justice et al. 2009; Beamesderfer et al. 2009; 2012a), consistent with genetic and demographic objectives. For this reason, releases of only Age-1 or Age-1+ sturgeon are currently planned.

Unfortunately, there is little or no published information addressing the degree of "*in-hatchery evolution*" for any sturgeons. Most of what is known about this comes from the salmon world and much of that is either hypothetical or based on production programs that were not designed solely with conservation in mind. In practice, it is difficult to operate any hatchery program without some degree of inadvertent artificial selection. This is why minimizing the length of time in the hatchery is desirable. Unfortunately, sturgeon released as post larvae or Age-0

juveniles survive either very poorly or not at all in the Kootenai. Thus, the Kootenai program must rely on releases of Age-1 or older fish to be effective. The hatchery strategy has also been designed to recognize and minimize genetic risks to the greatest extent possible in both the existing and proposed facilities. Section 3.3 of the program technical description in Appendix A discusses the risks of in-hatchery selection or domestication and the hatchery approach to addressing this concern.

ISRP Comment SP-6: The ISRP's 2009 comment requested information about the proposed release schedule of age-1 versus age-0 fish, and the ecological rationales for the proposed approach.

The ISRP's 2010 comment to address is: *The ecological rationale is not well developed. If density-dependence is operating perhaps food is mediating, but the proponents have not provided any data on feeding differences between 0 and 1 age fish.*

Project Sponsor Response SP-6:

The Tribe agrees that food limitations could well account for possible density-related differences in survival of Age-0 and Age-1 fish. A narrower array of prey items may be available for Age-0 than Age-1 fish due to differences in fish size, gape limitation, and available foraging strategies. Other factors including increased vulnerability to predation and effects of food reserves on first overwinter survival may also contribute to the differences. Current production goals are for release of Age-1 fish to avoid the apparent Age-0 survival bottleneck that was identified through monitoring the post-release survival of hatchery-reared fish (Justice et al. 2009). An experimental river fertilization program has also been undertaken in portions of the Kootenai River to improve productivity of the system. In addition, the Tribe's Kootenai River Habitat Restoration Program (BPA Project 200200200) and Reconnect Project (BPA Project 200200800) also include actions designed to enhance the food web through off-channel and floodplain reconnection and enhancement and riparian habitat enhancement.

Feeding ecology of juvenile sturgeon in the Kootenai River has not been investigated extensively, and would be a valuable subject for future study when time and funding allows. Section 5.4 of the program technical description in Appendix A discusses the available information and uncertainties related to sturgeon food and feeding in the Kootenai River.

ISRP Comment SP-7: The ISRP's 2009 comment asked how many Age-1 sturgeon of a defined, post vulnerability size can be effectively reared in the existing hatchery facility (a) in its present form, (b) with proposed upgrades of the existing hatchery, and (c) with the new hatchery.

The ISRP's 2010 comment to address is: *Mostly adequate response, but this is the crucial issue. If issues like density-dependence are really going to be tested they need to increase*

the number of fish in the river and monitor for years. However, there is still the lingering question of whether hatchery fish are going to behave in the same way as wild fish.

Project Sponsor Response SP-7:

The Tribe agrees that the best way to test for density-dependence will be to increase the number of fish in the river and monitor the response. This is one of the ancillary purposes of the new hatchery. Part of the answer to whether hatchery fish behave the same way as wild fish can be inferred for juveniles from monitoring of performance following release. This work has consistently shown that poor initial survival (annual survival of approximately 15 to 60% during first year at large) is followed by increased survival (greater than 90%) during all subsequent years, as hatchery fish adapt to the wild (Ireland et al. 2002). No direct comparisons can be made between hatchery and wild fish in the Kootenai, since no wild juvenile fish are in the river. However, post-release survival, growth, and condition of the hatchery-produced fish is generally comparable to what would be expected for prevailing conditions based on data for wild sturgeon populations in other areas.

One of the biggest unknowns is how the hatchery fish will behave upon maturity, in terms of migration, spawning site selection, and success of natural production. The new hatchery will enable the Tribe to spawn and rear fish farther upstream in the Kootenai system in an effort to induce fish to spawn where habitat conditions are thought to be more suitable for recruitment. Because significant numbers of hatchery-reared sturgeon are not expected to mature for at least 10 to 20 years, the answer to these questions will not be immediately known.

ISRP Comment SP-8: The ISRP's 2009 comment was that assuming survival rates of 60% in year 1 and 90% thereafter, how does (a) the current stocking capability with hatchery in its present form, (b) the current hatchery with proposed upgrades, and (c) the new hatchery (which can result in up to 1,500 fish per family for up to 40 families annually) translate into future numbers of 5, 10, 15, 20, 25, 30, 34, and 40 year old sturgeon? What do the numbers of adult sturgeon become when survival rates are raised to 70% (year 1) and 95% (thereafter) and lowered to 50% and 80%? The evaluation of a 95% survival seems appropriate because of recent information by Beamesderfer et al. (2009) that annual mortality rates of (admittedly larger) wild fish appear to be about 4%. This is lower than the 10% originally reported by Paragamian et al. (2005). The point is, the larger sturgeon seem to have very high survival rates. If hatchery fish do nearly as well, there would need to be fewer stocked than would have been projected prior to 2009.

The ISRP's 2010 comment to address is: *The proponents recognize that long-term issues of too many hatchery fish could arise but state that they are focused on the short-term risk of not capturing the genetic diversity. They are concerned with variation in survival rates and uncertainty in future availability of broodstock. The proponents seem reluctant to accept the Beamesderfer et al. (2009) data.*

Project Sponsor Response SP-8:

The question of carrying capacity is addressed in our response to Comment SP-2. The implications of updated abundance estimates are addressed in our response to Comment SP-1(c). The Tribe agrees with the data and conclusions regarding current adult abundance from Beamesderfer et al. (2009; 2012b).

ISRP Comment SP-9: The ISRP indicated that a few scenarios would better enable reviewers to evaluate the critical issue, namely, the importance and need of the proposed hatchery.

The ISRP's 2010 comment to address is: *See summary comments above - some scenarios were presented using models. On Page 40, the proponents state that, "Many sturgeon species around the world and in North America display specific homing fidelity to natal areas of native rivers." No references are provided for this assertion, and none of us are aware of any studies testing this hypothesis. Please provide references and evidence/verification for this statement.*

Project Sponsor Response SP-9:

Homing and attraction are among the critical uncertainties for Kootenai sturgeon. Section 5.3 of the program technical description in Appendix A presents additional discussion of homing and attraction, including relevant references from the scientific literature.

ISRP Comment SP-10: The ISRP's 2009 comment indicated a need for stochastic modeling, and an evaluation of the probability of extinction under various stochastic scenarios.

The ISRP's 2010 comment to address is: *The proponents reject the idea of stochastic modeling because data on the Kootenai stock are not available for calibration. However, data from other white sturgeon populations could have been used, as the sponsors do comment that their stock is a typical "k" life history fish.*

Project Sponsor Response SP-10:

This question is addressed in our response to ISRP Comment SP-2.

ISRP Comment SP-11: The ISRP's 2009 comment (2009-40) questioned how the proposed stocking rates under the scenarios and their resulting adult fish compare to (a) historical estimated numbers of fish and (b) current carrying capacity of the river system for the fish. That is, given the lowered productivity of the Kootenai River and limited prospects for major improvement in this area, can the river support the high numbers of sturgeon proposed to be stocked?

The ISRP's 2010 comment to address is: *No estimates of carrying capacity were provided. The proposal would be improved by further information on particulars of the restoration work underway in the river. They state there are now "millions" more kokanee but give no reference for this statement. Nutrient addition experiments are also underway, but no specific information is given – the ISRP should not have to follow up on cited references. As in other matters, the proponents are reluctant to extrapolate data from other white sturgeon stocks, or, for example to use bioenergetics models to forecast food needs. There is excessive reliance on adaptive management.*

Project Sponsor Response SP-11:

Current plans include a combination of experimental flow, physical habitat restoration, and nutrient enrichment actions. These actions could have significant effects on the entire ecosystem, including habitat conditions and capacity for sturgeon. The net effects of changes on system trophic dynamics and habitat capacity are extremely difficult to predict. For these reasons, the Tribe is proposing to implement an empirical M&E approach to identifying sturgeon capacity, using releases of hatchery-reared sturgeon. Improvements may or may not be significant, but changes will be monitored, and future recovery efforts, including the conservation aquaculture program, will be adapted accordingly. Section 5.6 of the program technical description in Appendix A provides additional detail on ecosystem restoration projects including additional detail on the kokanee and nutrient enhancement projects.

The issue of adaptive management is addressed by the project proponent response to ISRP Comment SP-2.

ISRP Comment SP-12: The ISRP's 2009 comment (2009-40) was that more thought should be provided on the desirability of "stocking and stacking" one-year class after another on top of each other in this comparatively unproductive environment. Justice et al. (2009) identifies the possibility that competition may be a factor affecting age-0 survival. It could also affect survival of older fish, but its main effects might be on growth and perhaps size and age at maturation. Studies on sturgeon in natural settings suggest that there may be wide differences in year class strength, and that for a variety of reasons, it may not be optimal to have every year class be "strong" and of the same approximate size. Has this been considered?

The ISRP's 2010 comment to address is: *The issue was discussed in some detail – but always refers back to adaptive management.*

Project Sponsor Response SP-12:

Studies on sturgeons in natural settings suggest that there may be big differences in year class strength, and that for a variety of reasons, it may not be optimal to have every year class be "strong" and of the same approximate size. In fact, the reproductive and life history strategies of sturgeons can provide long-term population sustainability in the face of missing year classes or even periods of missing year classes. However, the protracted recruitment failure in the Kootenai River has created a very large hole in the current population structure. Failing to incorporate as much of the remaining genetic and life history diversity would be inconsistent with the stated goals and inherent approach of the Tribe's program. The current production strategy is to support significant annual production to compensate for this unnatural, extended period of recruitment failure.

Carrying capacity of the Kootenai system is a critical issue for this program, and could ultimately prove to be a significant factor that could limit the extent of recovery. Carrying capacity is currently unknown and density dependence in sturgeon is poorly understood. Section 5.5 of the program technical description in Appendix A includes an extensive description of uncertainties associated with habitat capacity and density dependence. Given these uncertainties, the Tribe has elected to experimentally identify habitat capacity based on monitoring the population response to increasing sturgeon numbers or densities. After extensive consideration of various alternatives for inferring capacity, the Tribe and agency co-managers concluded that an experimental approach is the only effective approach. Rather than speculating on where capacity lies and artificially limiting production based on questionable assumptions, the proposed experimental approach will provide a real answer with no significant downside risk. Consequently, the recovery program incorporates an intensive hatchery marking and annual monitoring program. Post-release fish growth, condition, and survival are being monitored in the wild in relation to population size and density. Habitat capacity will be identified by a detectable response. Future juvenile, sub-adult, and adult population levels will be managed adaptively based on continuing monitoring and evaluation.

ISRP Comment SP-13: The ISRP's 2009 comment questioned how projections of expected habitat restoration alter estimates of carrying capacity.

The ISRP's 2010 comment to address is: *The response to this question was very general and consisted mainly of narrative of planned work. Nutrient addition has stimulated food production for whitefish in the Kootenai River but the proposal does not tie these results to white sturgeon feeding ecology (also see comment in # 11 above).*

Project Sponsor Response SP-13:

The response to ISRP Comment SP-11 (above) addresses this comment.

ISRP Comment SP-14: The ISRP's 2009 comment recommended the Tribe expand (from brief description in Section 6.5) on the alternatives for program termination if the production program is successful or fails.

The ISRP's 2010 comment is: *Alternatives are adequately described.*

Project Sponsor Response SP-14:

No response to SP-14 is needed.

ISRP Comment SP-15: The ISRP's 2009 comment referenced a study (Beamesderfer et al. 2009) indicating that the wild component stock will persist a few decades longer into the future than previously assumed. Does this revised population status make it less critical for an immediate second hatchery than if the demise of the wild component was more imminent? Can current stocking be spread out over more years to achieve the desired rebuilding status while seeking ways to improve wild reproduction? Under the situation outlined in Beamesderfer et al. (2009), would spreading out the stocking make more sense?

The ISRP's 2010 comment to address is: *If spreading out the stocking was to occur, detailed carrying capacity monitoring would be required to account for inter-annual variation (and presumably progressive improvement) if the habitat restoration program goes ahead.*

Project Sponsor Response SP-15:

As indicated in the response to SR-2(a) above, the Tribe recognizes that detailed carrying capacity monitoring is required to evaluate the relative effects of abundance, inter-annual variation, and long term trends in conditions. This monitoring approach is summarized in Chapter 5 and detailed in the Technical Basis for the Sturgeon Conservation Aquaculture Program (Appendix A) and the Kootenai River White Sturgeon Monitoring and Evaluation Plan (Appendix B).

ISRP Comment SP-16: The ISRP's 2009 comment was that a significant influence on whether this program will work depends on the actions and approaches occurring/proposed in British Columbia. Much of the watershed, headwater, and compounding impacts are located north of the border. While the Master Plan outlines a number of cooperative actions north of the border (i.e., redundant rearing), a more thorough discussion of out-of-subbasin actions on program success would improve the plan.

The ISRP's 2010 comment to address is: *Partially addressed. The proponents acknowledged that water from upstream flows from north of the border into Kootenai white sturgeon habitat. However, the implications were not discussed. Have the tribes and B. C. considered pen-rearing or some sort of grow-out of fish in the lake? Can sturgeon be effectively pen-reared up to post predation size in a lake? There seem to be very few references in the literature on this possibility. The response clearly outlined the long-term cooperation at some level between Canada and the Tribe. It is not clear, though what Canada plans to do in the future to complement this proposed program. A specific letter from Canada would help and perhaps be appropriate.*

Project Sponsor Response SP-16:

Water from the Kootenai River headwaters is unregulated until it reaches Lake Koocanusa, the impoundment created by Libby Dam in Montana. The effects of Libby Dam operations on conditions in sturgeon habitat downstream dwarf any minor influence of Canadian activities in the headwaters above Libby Dam. A significant portion of the meander reach of the river as well as Kootenay Lake occur in Canada, and large fractions of the sturgeon population may occur on both sides of the border at any time, although spawning occurs only in U.S. waters. Sturgeon habitat in Canada is affected by regulation of Kootenay Lake surface elevation and lake fertilization activities. Pen rearing of sturgeon has not been pursued because of logistical and environmental concerns. This practice would be unique in sturgeon aquaculture.

The Tribe contracts with the BC Ministry to provide white sturgeon capture and stock assessment services on Kootenay Lake and associated waters in Canada to assist in the restoration process. Under this contract, the BC Ministry is responsible for monitoring movements, habitat use, growth and survival of the Tribal Sturgeon Hatchery progeny and wild progeny and adults in Canada. Additional cooperative components include telemetry projects to monitor adults and juveniles, tagging subjects in Canada for telemetry projects completed in Idaho, larval sampling, and other monitoring related to white sturgeon conservation aquaculture and recovery. This relationship has been successfully ongoing for over 15 years. Data and databases are successfully shared, and personnel from the BC Ministry, Kootenai Tribe, IDFG, and Montana Fish Wildlife & Parks (MFWP) freely communicate and work together in the field to ensure total coverage and cooperation concerning all aspects of Kootenai sturgeon research, monitoring and evaluation. IDFG's role in these efforts is more fully described in our response to Comment No. RE-A12.

ISRP Comment SP-17: The ISRP's 2009 comment was that the monitoring and evaluation component of the Master Plan needs to reflect the changes recommended above. For example, measuring post-release survival with marked fish has different design criteria than determining whether these releases ultimately led to or will lead to natural recruitment.

The ISRP's 2010 comment to address is: *The proponents have provided the key elements of a comprehensive monitoring plan. However, statistical aspects were not included (e.g., power analysis and strategy for spatial sampling (probabilistic, stratified or?). We assume this will be developed in Step Two.*

Project Sponsor Response SP-17:

The sturgeon population monitoring program includes three primary sampling components: adult stock assessment, juvenile stock assessment, and telemetry of adults. Stock assessment monitoring has been conducted since the early 1990s. The monitoring program also employs egg and larval sampling and focused telemetry studies to evaluate the effectiveness of recovery-specific actions and experiments. Details of sampling methods and annual results are documented in an extensive series of annual reports (e.g., Paragamian et al. 1996; Rust and Wakkinen 2011) and peer-reviewed papers (Ireland et al. 2002; Justice et al. 2009; Neufeld and Rust 2009). More detailed descriptions of the monitoring program, including statistical aspects, may be found in the program technical description (Appendix A) and the Sturgeon M&E Plan (Appendix B).

ISRP Comment SP-18: The ISRP's 2009 comment was that supplemental information (including a memo and some pertinent sturgeon and burbot papers) was received from the proponents after receipt of the Master Plan. While this information was helpful in addressing some of the questions above, it is still incomplete. For example, it did not reconcile the "healthy age structure" and abundance targets, or reconcile the abundance targets and release of 40 families of 1500 progeny. The table that showed the mortality schedule was for a single cohort, but there would be several cohorts recruiting to reproduction and substantially more than 8,000 to 10,000 adults. Some of this is identified in the updated recruitment analysis (Beamesderfer et al. 2009). Much of this material should be included in an updated Master Plan or Appendix.

The ISRP's 2010 comment to address is: *Most of the new information is tabulated or graphed in the response document and updated Master Plan.*

Project Sponsor Response SP-18:

No response to ISRP Comment SP-18 is needed.

3.2.4 *Comments on Step 1 Review Elements (RE)*

A. All Projects

ISRP Comment RE-A1: The ISRP's 2009 comment indicated that one area in which the proposal could be improved is in explaining the importance of the food web in the Kootenai River ecosystem. The proponents state on page 9-3 concerning the white

sturgeon "This apex predator species plays a key role in the food web of the Kootenai River ecosystem." This statement is provided as support for Principle 3. However, the proposal would be improved by adding more information on this point – the document does not provide any insight into white sturgeon feeding habits at present (when presumably important forage species are in low abundance). There is also a lack of information on feeding of the hatchery-reared white sturgeon once released. Are they going to be able to switch to natural food quickly, or is there a period of acclimation needed? Are food supplies sufficient to support them? Perhaps a trophic model such as ECOSIM or another model would help in this regard. The proponents also state (as support for Principle 3) that burbot played a "key regulatory role" in the river ecosystem, but no information is provided as to what that role was.

The ISRP's 2010 comment to address is: *Some new food information is provided but the sponsors declined the idea of trophodynamic models. Generally they provided a good response for burbot, using best available scientific literature. However, only inferential comments were provided on the role of burbot's "key regulatory role."*

Project Sponsor Response RE-A1:

Please see the response to Comment SR-2(b) above, regarding white sturgeon. The Tribe's responses to the ISRP's comments on Step 1 Review Elements for burbot are provided in Section 3.3, below.

ISRP Comment RE-A2: The ISRP notes that the KTOI has a good team of biologists working on this important project and they are working closely with numerous state, federal, and provincial researchers and managers to achieve many of their goals.

ISRP's 2010 comment to address is: *No change.*

Project Sponsor Response RE-A2:

No response is needed.

ISRP Comment RE-A3: The ISRP 2009 comments indicated that the objectives are defined for white sturgeon and burbot in Chapters 4 and 6. However, additional development of the biological objectives is needed. The final biological objective(s) should be used to design the fish production program, and the fish production program should be used to design the scope and scale of production facilities. "Healthy age class structure" needs to be defined, and more thought should be provided on the desirability of "stocking and stacking" one-year class after another on top of each other in this comparatively unproductive environment. The measures that define progress must be viewed in relation to carrying capacity and desired numbers of fish in the river, preferably in relation to historical numbers and 20th century reductions in carrying capacity.

The ISRP 2010 comment to address is: *Carrying capacity issues were not well described. The proponents prefer to use an adaptive management approach to this problem but do not describe the details of what they would do to estimate carrying capacity with this technique.*

Project Sponsor Response RE-A3:

For white sturgeon, please see the responses to ISRP Comment SR-2, SP-12 and SP-15. Responses regarding burbot are provided in Section 3.3.

ISRP comments RE-A4 through RE-A10: The ISRP commented that the Tribe's responses to its 2009 comments on defining the project benefits (RE-A4), describing implementation strategies (RE-A5), and addressing the relationship to basinwide habitat strategies (RE-A6) were adequate and did not require further response. The ISRP also concluded that the Tribe's responses to its 2009 comments on the historical and current status of anadromous and resident fish and wildlife in the subbasin (RE-A8), current and planned management of resident fish and wildlife in the Kootenai river subbasin (RE-A9), and information about the consistency with NOAA Fisheries recovery plans and other fishery management and watershed plans (RE-A10) were adequate.

The ISRP requested additional information about published literature that would provide guidance for moving forward with burbot conservation (RE-A7); this comment is addressed in Section 3.3.3, below.

ISRP Comment RE-A11: *The ISRP 2009 comment indicated that there is no separate section in the plan as the comprehensive environmental assessment, asking whether subsections 3.1, 3.2, and 3.3 serve this function, and noting that it seems like this information was taken directly from the Kootenai River Subbasin Plan.*

The ISRP 2010 comment to address is: *According to Section 7 of the Master Plan the comprehensive environmental assessment will be prepared in Step 2.*

Project Sponsor Response RE-A11:

The Bonneville Power Administration is the lead federal agency for this project and is preparing an Environmental Assessment under the NEPA. As of the date of this submittal, project scoping is complete and the effects of construction and operation of the proposed project are undergoing evaluation. This evaluation is expected to be completed, including all public outreach, by the fall of 2012.

ISRP Comment RE-A12: *The ISRP 2009 comments indicate that the monitoring and evaluation plan is adequate for white sturgeon Step 1, but lacking adequate detail for burbot. Once the biological objectives are clarified, Step 2 and Step 3 need to provide specifics on the monitoring to establish that both the production and post-release phase monitoring is reasonable and feasible. The ISRP is concerned that post-release survival*

monitoring, which obviously is very important to the KTOI aquaculture plan goals, depends on the cooperation of agencies outside the KTOI. The links are supposed to be made with other agencies, but the proposal would be improved by providing more explicit information. For example, are agreements in place or firmly proposed?

The ISRP 2010 comment to address is: *Some agreements are in place and others are still proposed.*

Project Sponsor Response RE-A12:

The IDFG is an implementation partner and supports the Tribe's Sturgeon M&E Plan through the IDFG/BPA-funded Project No. 198806500 and through regular coordination with the Tribe. IDFG reviewed and provided input on the Sturgeon M&E Plan (Appendix B), as well as on the overall conservation aquaculture program and technical information upon which this Step 2 document is based (Appendix A). IDFG has worked with the Tribe to establish the more formal Annual Project Review (APR) process described in the Sturgeon M&E Plan, with the intent of participating into the future. Project No. 1988-065-00 specifically includes monitoring and evaluation of sturgeon movement, habitat use, growth, and survival of both wild and hatchery progeny in the Idaho section of the Kootenai River. IDFG also estimates spawning success and natural recruitment of sturgeon, and collects key vital statistics in relationship to the conservation aquaculture program and other recovery activities.

The Tribe and IDFG have a strong history of effective collaboration for over 20 years, and continue to identify and implement improved processes to foster effective coordination and collaboration, and to build scientific rigor into, and find consensus on, decisions to implement conservation measures to benefit Kootenai River native fishes. IDFG is committed to supporting recovery of sturgeon through their management, monitoring and evaluation activities, and through collaboration and active participation in the APR process.

The Tribe also works closely with the BC Ministry on sturgeon recovery activities. The Tribe contracts with the BC Ministry to provide white sturgeon capture and stock assessment services on Kootenay Lake and associated waters in Canada to assist in the restoration process. Under this contract, the BC Ministry is responsible for monitoring movements, habitat use, growth and survival of the Tribal Sturgeon Hatchery progeny and wild progeny and adults in Canada. Additional cooperative components include telemetry projects to monitor adults and juveniles, tagging subjects in Canada for telemetry projects completed in Idaho, larval sampling, and other monitoring related to white sturgeon conservation aquaculture and recovery. This relationship has been successfully ongoing for over 15 years. Data and databases are successfully shared, and personnel from the BC Ministry, Kootenai Tribe, IDFG, and Montana Fish Wildlife & Parks (MFWP) freely communicate and work together in the field to ensure total coverage and cooperation concerning all aspects of Kootenai sturgeon research, monitoring, and evaluation.

ISRP Comment RE-A13*:* The ISRP 2009 comment indicated that Appendix D of the Master Plan provides specific items and cost estimates for ten fiscal years for planning and design, but notes that the conceptual facility designs need to be verified once the biological objectives are justified. Until they are better established, the need for additional facilities is pending.

The ISRP 2010 comment to address is: *This will be addressed during Step Two.*

Project Sponsor Response RE-A13:

The proposed new facilities and infrastructure at Twin Rivers are designed to ensure maximum flexibility for both the sturgeon and burbot programs. These facilities include flexible space for incubation and rearing areas and three water supplies that can be utilized for all life stages for sturgeon and burbot. While specific objectives are critical in the planning and refinement of hatchery facilities and water supplies, the designs for these programs are not based solely on biological objectives; they are also designed to accommodate program changes over time as M&E data becomes available and adaptive management decisions are made.

B. Artificial Production Initiatives

ISRP Comment RE-B1: The ISRP 2009 comment stated that the Master Plan addressed basin-wide artificial production standards and strategies adequately, although no risk assessment to white sturgeon populations out of subbasin was done.

The ISRP 2010 comment to address is: *The 2010 comment pertained only to burbot and is addressed in Section 3.3.*

Project Sponsor Response RE-B1:

Risks associated with the Tribe's aquaculture programs for white sturgeon and burbot are discussed in Appendix A, while details for assessing specific program risks are provided in the associated M&E plans for sturgeon (Appendix B) and burbot (Appendix C).

ISRP Comment RE-B2: The ISRP 2009 comments indicated that a HGMP for white sturgeon is included in Appendix A, but it is dated 2000. It is the only source for some of the history of fish production of sturgeon by the program. While the HGMP doesn't require updating if it is not required for permitting under the ESA, additional presentation and summary of the production, release, and evaluation program is needed early in the Master Plan. No HGMP is provided for burbot.

The ISRP 2010 comment to address is: *The HGMP for white sturgeon has been updated and is adequate. An HGMP was also prepared for burbot and was well done. Risk assessments were not provided. See also above regarding comments to Question A.7.*

Project Sponsor Response RE-B2:

A detailed discussion of the production, release, and evaluation program can be found in Appendix A (Technical Basis for the Kootenai Sturgeon Conservation Aquaculture Program).

ISRP Comment RE-B3: *The ISRP 2009 comment indicated that the Master Plan addressed the harvest plan, but noted that this is premature for species on the verge of extinction. More could be provided on the potential to harvest both sturgeon and burbot produced by artificial production in the medium term even if natural self-sustaining populations are not being reestablished by the restoration of required environmental attributes through the habitat Master Plan (to be reviewed in the future). Also, for burbot, one of the expected benefits is to "restore and maintain a viable and harvestable burbot population…" so a future harvest plan should be projected with some estimated goals.*

The ISRP 2010 comment to address is: *The sponsors assume a "wild" population of burbot will eventually develop from hatchery releases but no harvest goals for the former are provided.*

Project Sponsor Response RE-B3:

Any future harvest planning will be a collaborative, multi-agency effort, including IDFG, the BC Ministry, and possibly MFWP). Any future harvest goals will also be dictated by empirical evaluation of burbot population dynamics, including abundance, production (natural and/or hatchery propagation), growth, survival, and age class structure, in the river. However, no empirical data or information about production capacity of burbot currently exists, due to the functional extinction of burbot in the lower Kootenai River. Development of future harvest strategies or goals will be developed when such data are available to guide and inform those efforts.

ISRP Comment RE-B4: The ISRP commented that conceptual designs appear adequate for Step 1 of the review, but need to be revisited once the production goals are clarified and justified based on the conservation needs of the species.

The ISRP 2010 comment to address is*: See above.*

Project Sponsor Response RE-B4:

Designs have been updated based on clarified production goals. Updated designs are summarized in Chapter 7, while the Basis of Design Report (Appendix D) and design drawings (provided under separate cover) provide additional detail.

ISRP Comment RE-B5: The ISRP 2009 comments did not address whether the Master Plan provided a preliminary design for the proposed facilities.

The ISRP 2010 Comment to address is: *Not applicable for this review; this is a Step 2 issue.*

Project Sponsor Response RE-B5:

The Master Plan included concept designs and associated cost estimates for the facilities, at the level required for the Step 1 submittal. This Step 2 submittal includes preliminary designs and associated cost estimates at the more detailed level now required for this phase of the planning process.

ISRP Comment RE-B6: The ISRP 2009 comments recommended the Tribe provide a final design of the proposed facilities, including appropriate value engineering review, consistent with previous submittal documents and preliminary design (Step 3).

The ISRP 2010 comment to address is: *Not applicable for this review; this is a Step 3 issue.*

Project Sponsor Response RE-B6:

A final design and associated cost estimates will be provided as part of the Step 3 submittal.

3.3 Responses to ISRP 2010 Comments: Burbot Program

The ISRP commended the proponents for providing the detailed burbot HGMP and for the proposed program's focus on research regarding burbot habitat requirements and limiting factors, as little is known of their life history in the subbasin and elsewhere. The ISRP concluded that the burbot element of the aquaculture program meets requirements for proceeding to Step 2, but requested additional information in the three areas discussed below.

Comments on Step 1 Review Elements (RE)

A. All Projects

ISRP Comment RE-A1: The ISRP's 2009 comment indicated that one area in which the proposal could be improved is in explaining the importance of the food web in the Kootenai River ecosystem. The proponents state on page 9-3 concerning the white sturgeon "This apex predator species plays a key role in the food web of the Kootenai River ecosystem." This statement is provided as support for Principle 3. However, the proposal would be improved by adding more information on this point – the document does not provide any insight into white sturgeon feeding habits at present (when presumably important forage species are in low abundance). There is also a lack of information on feeding of the hatchery-reared white sturgeon once released. Are they

going to be able to switch to natural food quickly, or is there a period of acclimation needed? Are food supplies sufficient to support them? Perhaps a trophic model such as ECOSIM or another model would help in this regard. The proponents also state (as support for Principle 3) that burbot played a "key regulatory role" in the river ecosystem, but no information is provided as to what that role was.

The ISRP's 2010 comment to address is: *Some new food information is provided but the sponsors declined the idea of trophodynamic models. Generally they provided a good response for burbot, using best available scientific literature. However, only inferential comments were provided on the role of burbot's "key regulatory role."*

Project Sponsor Response RE-A1:

The use of trophodynamic models is discussed in the Tribe's response to Comment SR-2(b). Regarding the key regulatory role of burbot, adults have been reported to be aggressive top (apex) predators that are highly piscivorous in both lentic (Bailey 1972; Kirillov 1988; Bonar et al. 2000) and lotic habitats (Amundsen et al. 2003; McPhail and Paragamian 2000). Burbot have also been reported to alter prey selection seasonally and in response to competition to include a greater proportion of invertebrates (Tolanen et al. 1999). Burbot prey species include kokanee, peamouth, smallmouth bass, rainbow trout (Bonar et al. 2000), and whitefish (Bailey 1972). All these species except smallmouth bass currently inhabit the Kootenai River.

It has also been noted that inter-specific competition may occur between burbot and other top predators such as arctic char (Knudsen et al. 2010) and pike (Kirillov 1988). Knudsen et al. (2010) reported that competition of burbot and arctic char in two lakes in Norway restricted the realized trophic niche of arctic char, and may be responsible for several evolutionary elements of the char population (e.g., they may limit adaptation of certain morphological traits), as well as ecological elements (e.g., behavioral habitat shifts and high predation risk). In addition to directly competing with other upper trophic level predators, burbot predation has been shown to have significant structuring effects on the benthic prey community (Baumgartner and Rothhaupt 2005). Thus, key trophic and ecological functions of burbot, along with their cultural, socio-economic, and recreational value, make them an important species to the Tribe for conservation and management in the Kootenai River.

ISRP Comment RE-A7: The ISRP 2009 comments indicated the Master Plan presented alternatives and generally described them in Chapter 4 of the Master Plan. The alternatives for Kootenai white sturgeon were well presented and discussed; however, the basis for selecting the Expanded Aquaculture Alternative needs to be supported with additional information, as indicated above.

The ISRP 2010 comment to address is: *Considerable progress has been made since the original proposal was written. A number of published papers provide guidance for moving forward with burbot conservation aquaculture. Canadian officials are monitoring the*

burbot in Moyie Lake to prevent overharvesting of the species for brood stock. However, the proposal does not describe a back-up plan for another source of brood stock should this supply be terminated. No response was given to the ISRP comment, "Because so few burbot remain in the lower Kootenai (less than 50), a remnant neighboring stock is proposed. Are there clearly enough fish from this neighboring stock for the proponents to be sure that they will be a viable egg source?"

Project Sponsor Response to RE-A7:

There is good evidence that the Moyie Lake burbot stock will remain a viable long-term egg source. The BC Ministry is a committed partner in Kootenai/y burbot recovery, regularly monitors angler harvest and adult population size, and sets angling regulations to allow fish for conservation aquaculture operations on Moyie Lake (Neufeld and Spence 2009). The population is robust and has been recently estimated at over 3,700 adults (Neufeld 2008). Given the high fecundity of individual burbot females (up to 2 million eggs), a maximum of 20 to 40 females is required for large-scale annual conservation aquaculture production (<2% of the female population annually). In recent years, gametes have been collected from wild fish at spawning locations in Moyie Lake (Neufeld et al. 2011), and spawned females are subsequently returned to the population and contribute to natural recruitment in future years. Given the small number of females required each year and their return to the wild after handling, the impact of gamete collection at the population level is thought to be very small. Going forward, population abundance estimates will continue to be generated annually as part of captures during egg collection to evaluate any abundance changes, along with periodically updated age frequency assessments, following recommendations from a recent project review (Schwarz 2011). If changes in broodstock abundance threaten egg collection activities, the BC Ministry has the authority to regulate fishing seasons and associated harvest to safeguard conservation aquaculture activities (Neufeld and Spence 2009).

Although there is no reason to suspect that the burbot population in Moyie Lake will not continue to provide a long-term source for conservation aquaculture gametes, early attempts at developing culture methods were successful using burbot from Arrow Lakes Reservoir (Jensen et al. 2008a; 2008b; 2010a; 2010b), where burbot numbers are thought to be very robust. In the unlikely event that Moyie Lake would become temporarily or no longer suitable for egg takes, the BC Ministry supports the use of individuals from the Arrow Lakes Reservoir population as a fail-safe or back-up brood source.

ISRP Comment RE-A12: The ISRP 2009 comments indicate that the monitoring and evaluation plan is adequate for white sturgeon Step 1, but lacking adequate detail for burbot. Once the biological objectives are clarified, Step 2 and Step 3 need to provide specifics on the monitoring to establish that both the production and post-release phase monitoring is reasonable and feasible. The ISRP is concerned that post-release survival monitoring, which obviously is very important to the KTOI aquaculture plan goals,

depends on the cooperation of agencies outside the KTOI. The links are supposed to be made with other agencies, but the proposal would be improved by providing more explicit information. For example, are agreements in place or firmly proposed?

The ISRP 2010 comment to address is: *Some agreements are in place and others are still proposed.*

Project Sponsor Response RE-A12:

The IDFG is an implementation partner and supports the Tribe's Burbot M&E Plan through the IDFG/BPA-funded Project 198806500 and through regular coordination with the Tribe. IDFG reviewed and provided input on the Burbot M&E Plan, as well as on the overall conservation aquaculture program and technical information upon which this Step 2 document is based. IDFG has worked with the Tribe to establish the more formal APR process described in the Burbot M&E Plan, with the intent of participating into the future. Project No. 1988-065-00 specifically includes monitoring and evaluation of burbot movement, habitat use, growth, and survival of both wild and hatchery progeny in the Idaho section of the Kootenai River. IDFG also estimates spawning success and natural recruitment of burbot, and collects key vital statistics in relationship to the conservation aquaculture program and other recovery activities.

The Tribe and IDFG have a strong history of effective collaboration for over 20 years, and continue to identify and implement improved processes to foster effective coordination and collaboration, and to build scientific rigor into, and find consensus on, decisions to implement conservation measures to benefit Kootenai River native fishes. IDFG is committed to supporting recovery of burbot through their management, monitoring and evaluation activities, and through collaboration and active participation in the APR process.

The Tribe also works closely with the BC Ministry on sturgeon recovery activities. The Tribe contracts with the BC Ministry to provide white sturgeon capture and stock assessment services on Kootenay Lake and associated waters in Canada to assist in the restoration process. Under this contract, the BC Ministry is responsible for monitoring movements, habitat use, growth and survival of the Tribal Sturgeon Hatchery progeny and wild progeny and adults in Canada. Additional cooperative components include telemetry projects to monitor adults and juveniles, tagging subjects in Canada for telemetry projects completed in Idaho, larval sampling, and other monitoring related to white sturgeon conservation aquaculture and recovery. This relationship has been successfully ongoing for over 15 years. Data and databases are successfully shared, and personnel from the BC Ministry, Kootenai Tribe, IDFG, and Montana Fish Wildlife & Parks (MFWP) freely communicate and work together in the field to ensure total coverage and cooperation concerning all aspects of Kootenai sturgeon research, monitoring, and evaluation.

B. Artificial Production Initiatives

ISRP Comment RE-B1: The ISRP 2009 comments indicated that the Master Plan addressed each artificial production principle/standard, but the ISRP recommended the project sponsor provide additional detail on the currently naturally existing population of burbot to serve as a model to guide artificially reared fish production to the point of release.

The ISRP 2010 comment to address is: *The burbot material added was adequate considering that not much is known about burbot in the subbasin.*

Project Sponsor Response RE-B1:

No response is necessary.

ISRP Comment RE-B2: The ISRP 2009 comments indicated that a HGMP for white sturgeon is included in Appendix A, but it is dated 2000. It is the only source for some of the history of fish production of sturgeon by the program. While the HGMP doesn't require updating if it is not required for permitting under the ESA, additional presentation and summary of the production, release, and evaluation program is needed early in the Master Plan. No HGMP is provided for burbot.

The ISRP 2010 comment to address is: *The HGMP for white sturgeon has been updated and is adequate. An HGMP was also prepared for burbot and was well done. Risk assessments were not provided. See also above regarding comments to Question A.7.*

Project Sponsor Response RE-B2:

As noted above, risks associated with the Tribe's aquaculture program for white sturgeon are discussed in Appendix A, while details for assessing specific program risks are provided in the associated M&E plans for sturgeon (Appendix B) and burbot (Appendix C).

ISRP Comment RE-B3: *The ISRP 2009 comment indicated that the Master Plan addressed the harvest plan, but noted that this is pre-mature for species on the verge of extinction and they may be correct on this. More could be provided on the potential to harvest both sturgeon and burbot produced by artificial production in the medium term even if natural self-sustaining populations are not being reestablished by the restoration of required environmental attributes through the habitat Master Plan (to be reviewed in the future). Also, for burbot, one of the expected benefits is to "restore and maintain a viable and harvestable burbot population…" so a future harvest plan should be projected with some estimated goals.*

The ISRP 2010 comment to address is: *The sponsors assume a "wild" population of burbot will eventually develop from hatchery releases but no harvest goals for the former are provided.*

Project Sponsor Response RE-B3:

Any future harvest planning will be a collaborative, multi-agency effort, including IDFG, BC Ministry and possibly MFWP. Any future harvest goals will be dictated by evaluation of empirical data on burbot population dynamics (abundance, production [natural and/or hatchery propagation], growth, survival, and age class structure) in the river. However, no empirical data currently exists, because the species is functionally extinct in the Lower Kootenai River. Future harvest strategies or goals will be developed when suitable data are available to guide and inform planning and management efforts.

4 OVERVIEW OF STEP 2 PROGRESS AND ACCOMPLISHMENTS

This chapter summarizes the Tribe's progress in program planning, environmental compliance, hatchery design, and refining costs since the revised Master Plan was submitted in 2010. Additional detail about each of these aspects of the conservation aquaculture program is presented in subsequent chapters.

4.1 Planning and Coordination

Step 2 activities were initiated at a planning and coordination meeting and site visit in June 2011. BPA environmental staff and the Tribe's biologists and consultant team met to discuss the program history and the purpose and need for expanded facilities. Project biologists presented the scientific basis for the program and the extensive sturgeon and burbot research that is informing both the program design and fish culture procedures. Other tasks completed during the meeting and site visit included developing a schedule for BPA's NEPA evaluation, identifying other important permitting requirements, confirming the status of the ISRP review and setting a date (July 2011) for the start of Step 2 engineering activities.

In addition, the Kootenai Tribe gave multiple presentations on the sturgeon components of the conservation aquaculture program to the Kootenai River White sturgeon Recovery Team and hosted a workshop in February 2012 for members of the Recovery Team, sturgeon experts, and regional co-managers to review the technical basis for the program and discuss specific program elements. The Tribe has also coordinated actively with co-implementers of the KVRI Burbot Conservation Strategy during an in-person meeting with collaborating agencies hosted by the Tribe on September 27, 2011 and through multiple conference calls and review of production goals and individual components of the Burbot M&E Plan (Appendix C).

Section 4.1.1 summarizes the key internal team meetings that were held during the Step 2 process. In addition to these meetings, formal and informal communication between Tribal staff and the contractors occurred whenever necessary to relay specific data or discuss general planning and design information.

4.1.1 Program Verification and Development of Preliminary Designs

After submitting the Step 1 Master Plan in June 2010, the Kootenai Tribe initiated a structured planning and review process to assure that all details of the preliminary design would meet the future operational requirements of the program and ensure future operational flexibility. The first step involved confirming the overall production goals for each program. This included ensuring that the biocriteria (developed by life stage for both the sturgeon and burbot programs) and related operational water requirements, including source, amount, and temperature, were verified before proceeding with the preliminary design.

Work sessions were held in July, September, November and December 2011, and February 2012. Depending on the specific topic, attendees included Tribal staff, consultants, and BPA. Meetings included verification of biocriteria and resulting implications to water budgets, decision-making exercises for space planning and facilities layout and capital equipment needs, and tours of current and planned facility sites. Below is a list of meetings and major accomplishments.

A general start-up session was held in July 2011. This session included scientists, engineers, project planners, and fish culture staff actively involved in various aspects of the Tribe's sturgeon and burbot programs. The objectives of this session were to 1) review, verify and update the assumptions utilized for Step 1 planning (including biocriteria and designs for each function of the fish culture operation); 2) establish an outline for the Step 2 submittal; and 3) confirm critical actions, next steps and task assignments.

A follow-up session was held in September 2011. This session provided an opportunity to review verified design and operational requirements with engineers, planners and hatchery staff. This session involved detailed reviews of each function of the fish culture operation and associated infrastructure and equipment needs at the Tribal Sturgeon Hatchery (sturgeon) and Twin Rivers Hatchery (sturgeon and burbot).

In November 2011, the Tribe held a progress review session to evaluate design accomplishments and check on key issues related to the biocriteria, operations schedule, and water requirements. In this session, operations staff and designers discussed specific design alternatives for both the Tribal Sturgeon Hatchery and the Twin Rivers Hatchery. This involved review of infrastructure needs by operational function at both facilities. All operational requirements were documented, and direction was provided to the engineering team for revisions to the preliminary designs. Site visits were conducted to verify specific design issues.

A follow-up work session and conference call was held in early December 2011 to discuss overall site concepts for the Twin Rivers Hatchery. Three options for the site layout were

reviewed and the pros and cons of the options were evaluated. The Tribe selected a design and directed the engineering team to carry it forward through the remainder of the preliminary design process.

A final technical work session was held in late February 2012 with Tribal staff and contracted engineers to assess all aspects of the preliminary design for each function of the operation. The group prioritized infrastructure needs at the Tribal Sturgeon Hatchery and Twin Rivers Hatchery. Each operational function of the design was discussed, focusing especially on items that may not fit within the current budget. Input from the Kootenai Tribe on priorities for infrastructure at the Tribal Sturgeon Hatchery and Twin Rivers Hatchery was documented to provide direction to the engineering team for finalizing the Step 2 design and associated cost estimates that were provided to the Tribe.

The structured work sessions included the Tribe's consultants and technical team and resulted in an ongoing internal value analysis (also known as value engineering) throughout Step 2. The value analysis process was employed to verify the planning details; facility, equipment and related infrastructure needs for each fish culture operational area and function; and alternatives for each operational area and function. The value analysis supports development of the basis for the design and revised cost estimates presented in this Step 2 document and discussed in more detail in Appendix D (Basis of Design Report).

4.1.2 Coordination with Kootenai River White Sturgeon Recovery Team and other Regional Efforts

The Kootenai Tribe hosted a workshop attended by members of the USFWS Kootenai River White Sturgeon Recovery Team, sturgeon experts, and regional co-managers on February 28 and 29, 2012. The purpose of this workshop was to review and discuss in detail the overall sturgeon conservation aquaculture program, Tribal Sturgeon Hatchery upgrades, the Twin Rivers Hatchery, and underlying technical background. Additionally, the workshop was designed to help identify any concerns and/or recommendations that should be addressed in the refinement of the sturgeon program and facility design and in development of the Step 2 document. The workshop was also intended to expand discussion of issues raised by the ISRP in their reviews of the Step 1 Master Plan. The workshop incorporated in-depth review and discussion of the following topics: 1) the current facilities and how they are being used; 2) hatchery operations; 3) proposed goals and objectives of the expanded program; 4) genetics work to date and the relationship of the new facility to meeting genetics objectives; 5) production targets, broodstock and family numbers and size; 6) carrying capacity and density dependence; 7) imprinting and attraction; 8) monitoring and evaluation; and 9) adaptive management. In addition to members of the Recovery Team, participants included representatives from IDFG, MFWP, BC Ministry, USFWS, the U.S. Army Corps of Engineers (USACE) and BPA. Participants also included some members of the Upper Columbia River White Sturgeon Recovery Initiative Technical Working Group and individuals who are organizing and participating in the Columbia River Basin Sturgeon coordination workshops.

The primary outcome of the workshop was revised production targets and related adjustments to the proposed program, clarification of genetics background information, and incorporation of recommendations regarding annual coordination around production targets, M&E, and adaptive management. The workshop also resulted in development of an updated discussion of the technical basis for the program (Appendix A), which was sent for review to workshop participants in May 2012. Much of the information from Appendix A has been incorporated into this document. The Tribe will continue to actively coordinate with the Recovery Team and other regional sturgeon managers throughout the design and implementation of the sturgeon components of the conservation aquaculture program.

4.1.3 Coordination with KVRI Burbot Conservation Strategy Implementation Team

The KVRI Burbot Subcommittee was formed in 2002 to develop a conservation strategy for Kootenai burbot. The Burbot Subcommittee evaluated a range of actions and agreed that conservation aquaculture would be a key element of restoration. The Burbot Technical Working Group is an implementation arm of the KVRI Burbot Subcommittee and integrates the activities of multiple agencies directly involved in burbot aquaculture, monitoring, and evaluation. The members of this group, with their affiliations and duties, are listed in Table 4-1, below.

The Technical Working Group participates in quarterly teleconferences and actively communicates via e-mail, telephone, and in-person meetings to determine and coordinate broodstock collection, aquaculture production, release strategies and schedules, and monitoring and evaluation activities and results. The group often reviews and provides comment on burbot -related work products. For example, IDFG and the BC Ministry (the agencies most involved in burbot restoration in collaboration with the Tribe) were given the opportunity to review and discuss a draft of the Burbot M&E Plan. The final Burbot M&E Plan (Appendix C) reflects the input from those entities.

Table 4-1. Burbot Technical Working Group members, affiliations, and duties.

Member	Affiliation, Position	Duties
Sue Ireland	Kootenai Tribe, Fish and Wildlife Department Supervisor	Oversees, coordinates, and assists with Kootenai Tribe's burbot activities
Chris Lewandowski	Kootenai Tribe, Tribal Sturgeon Hatchery Co-Manager	Co-manages Kootenai Tribe's burbot activities
Shawn Young	Kootenai Tribe, Tribal Sturgeon Hatchery Co-Manager	Co-manages Kootenai Tribe's burbot activities
Matt Neufeld	BC Ministry, Fish Biologist	Supervises BC burbot activities
Sarah Stevenson	BC Ministry, Fish Biologist	Assists with BC burbot activities

Member	Affiliation, Position	Duties
Ryan Hardy	IDFG, Fish Biologist	Supervises IDFG Kootenai River fish research, monitoring and evaluation program
Pete Rust	IDFG, Fish Biologist	Supervises IDFG sturgeon and burbot field research and monitoring project implementation
Ken Cain	UI-ARI, Professor	Supervises all aspects of burbot aquaculture research at UI
Neil Ashton	UI-ARI, Project Supervisor	Manages all aspects of burbot aquaculture at UI
Paul Anders	Cramer Fish Sciences, Consultant	Assists with all aspects of burbot research
Ray Jones	USFWS, Biologist	Represents USFWS on Kootenai River burbot related topics

4.2 Sturgeon and Burbot Population Monitoring and Production Objectives

4.2.1 Refined Sturgeon Population Monitoring and Production Objectives

Prior to completion of the Master Plan in 2010, sturgeon monitoring and production was guided by an international, multiagency, 5-Year Monitoring and Evaluation Plan and Implementation Schedule (KTOI 2005). This 5-Year Plan had four main components corresponding to the four primary strategies in the 1999 Recovery Plan. These included 1) recruitment restoration, 2) conservation aquaculture, 3) monitoring and evaluation, and 4) Recovery Plan adaptation and revision. The accompanying implementation schedule identified annually implemented core program elements and the timing and progression of additional measures, including critical uncertainties research, designed to recover Kootenai sturgeon.

During the 2 years since the Master Plan was completed, several achievements and scientific findings have increased the probability of restoring the endangered Kootenai sturgeon population. Highlights include the following:

- Based on population estimates of fewer than 500 adults in 2005 and an annual mortality rate of 9% (Paragamian et al. 2008), it looked like broodstock limitations were imminent. However, recent empirical data analyses (since 2010) now indicate current population abundance is approximately 1,000 fish, with an annual mortality rate of 4% (Beamesderfer et al. 2012a). These findings highlight the critical opportunity to increase broodstock numbers while substantial numbers of adults are still available. Rather than relaxing hatchery efforts in light of the updated population estimates, the Tribe has taken a rigorous, precautionary approach of increasing hatchery production from 15,000-20,000 at the current time to meet the program objective of 15,000-30,000 releases per year to take advantage of these

"additional" fish before they die. This will increase the probability of providing adequate demographic and genetic resilience for future generations, ultimately improving the chance for successful long-term population recovery and sustainability.

- Since the program began annually releasing substantial numbers of fish, first year survival rates have averaged an estimated 12%, but ranged from less than 1 to 23%. This range includes years of predominately Age-0 (2005-2007) and Age-1 releases (2002-2004, 2008). High and low values were seen for both types of releases. Although it remains to be seen what rates will be consistently associated with the current return to Age-1 releases, it is reasonable to assume that survival will rebound to values intermediate between recent extremes (e.g., 12%) but not likely to the highest rates (40-90%) seen during the early years of the program when no other juvenile sturgeon were in the river due to ongoing natural recruitment failure (Beamesderfer et al. 2012a, 2012b).

- Five years of free embryo release and subsequent M&E will be completed during the summer of 2012, as part of an experimental action recommended by the USFWS Sturgeon Recovery Team. However, no evidence of post-release survival of more than a few hours has been observed during the past 4 years (IDFG unpublished data). Based on these annual results, free embryo releases will not be continued after 2012.

- Post-larval releases were also discontinued following the lack of any observed post-stocking survival from any release locations (IDFG unpublished data).

- Analysis of past Age-0 releases indicated poor survival and suggested an initial survival bottleneck of Age-0 releases (Justice et al. 2009; Beamesderfer et al 2012a).

- Refined parental-based genetic tagging is underway to enable more accurate determination of hatchery versus wild origin and year class of origin.

- Construction activities associated with the Kootenai River Habitat Restoration Program (BPA Project 200200200) were initiated in 2011, with potentially beneficial effects on sturgeon habitat use and availability. The first in a series of restoration projects was completed in 2011 and is functioning as expected. Additional projects are planned for implementation from 2012 through 2017. Furthermore, the Tribe's Reconnect Project (BPA Project 200200800) incorporates reconnection of the Kootenai River with the historical floodplain as part of wildlife habitat restoration.

- Nutrient additions in the Canyon Reach of the Kootenai River and in Kootenay Lake (BPA Project 199404900) have increased the productivity of the ecosystem, which should improve conditions for growth, survival and production of sturgeon. This project also includes aquatic-based trophic level and water chemistry monitoring of a 235-kilometer (km) reach of the Kootenai River and key tributaries.

- Cooperation among agencies and stakeholders for future research, monitoring, and evaluation activities is ongoing, and will contribute to the likelihood of program success. IDFG is conducting monitoring and evaluation activities associated with

Kootenai sturgeon that help inform planning for recovery, habitat restoration, Libby Dam operations for sturgeon, and evaluation and adaptive management in the Kootenai River (BPA Project 198806500).

- The location of the Twin Rivers hatchery at the upstream end of the Braided Reach also addresses the issue of imprinting and homing, providing the opportunity for maturing released hatchery produced fish to spawn further upstream in more suitable spawning and early life stage habitats.

- This combination of new population and habitat information, improved genetic tagging techniques, habitat enhancement activities, and continued cooperation and updated demographic and genetic analyses is reflected in the refined Sturgeon M&E Plan (Appendix B). The following general recommendations guide the Sturgeon M&E Plan:

    - Implement, monitor, and evaluate an aggressive adaptive program of experimental population restoration measures.

    - Employ conservation aquaculture methods as a key component for sturgeon protection and population restoration.

    - Maintain a strong adaptive management scientific monitoring and evaluation program to guide implementation of population conservation and restoration activities.

Unlike the major changes reported below (Section 4.2.2) for burbot M&E activities since the original Master Plan was submitted, relatively few changes in M&E activities have occurred for sturgeon since the original Master Plan submission. This is because the current Sturgeon M&E Plan is the result of more than 20 years of adaptive experimentation and optimization. However, additional analyses of population data, carrying capacity, and production allocation (future production levels, and family sizes) have been recently undertaken, and will continue to be adaptively implemented in the future to meet the long-term M&E needs for sturgeon. These program updates are discussed below.

Carrying capacity/density dependence analyses

- The ISRP recommended the Tribe use trophodynamic modeling to develop at least ballpark estimates of carrying capacity. The ISRP also inquired about bioenergetics modeling and feeding ecology as part of this program. Based on these comments, the Tribe conducted additional exploration of these methods. Outcomes strongly suggested that excessive variability significantly compromised predictive power based on even small levels of variation over long periods of time. Appendix A provides more discussion about trophodynamic modeling.

- Given these uncertainties, the Tribe has elected to experimentally identify habitat capacity based on monitoring the population response to increasing sturgeon numbers or densities. Consequently, the conservation aquaculture program incorporates an intensive hatchery marking and annual monitoring program. Post-release fish growth, condition, and survival are being monitored in the wild in relation

to population size and density. Habitat capacity will be identified by a detectable response in resulting metric values. Future juvenile, sub-adult, and adult population levels will continue to be managed adaptively based on continuing monitoring and evaluation.

Production allocation

- Updated release numbers consistent with family number and family size number targets developed to meet genetic objectives range from 15,000 to 30,000 sturgeon per year. This represents an increase from previously reported production targets of 15,000 to 20,000 per year. While current production targets are expressed as a range, recent release levels have typically been around the low end of this range (~15,000).

- Although family number is being increased from about 15 per year to $\leq$ 30 per year, family size has been reduced from 1,000-1,500 to 500-1,000. This change has been made to ameliorate potential risks of a strong negative density-dependent response due to large release numbers. The reduction in family size (and corresponding total releases) is a change from the target numbers identified in the Step 1 Master Plan and addresses concerns raised by the Tribe's co-managers and agency partners and the ISRP in their review of the initial proposal. These genetic contribution changes also address the incorporation of rare alleles, while conserving and optimizing genetic diversity and maximizing the range of phenotypic, behavioral, and life history trait expressions available to future generations of this endangered population.

Biological objectives of the sturgeon aquaculture program, including production objectives, have also been updated since 2010, as project design and data analyses have progressed. The construction and operation of Twin Rivers Hatchery will support the following near- and long-term biological objectives for sturgeon restoration:

Near-Term Objectives

1. Prevent demographic extinction by replacing failed natural recruitment.

2. Establish an increasing trend and broad distribution of ages and sizes in the wild population in order to ensure future sustainability.

3. Preserve and express native genetic, phenotypic, and life history diversity by capturing and spawning significant numbers of representative broodstock.

4. Provide contingencies for uncertain future availability of wild broodstock and prospects for restoring natural recruitment.

5. Inform recovery strategies by using hatchery fish to identify limiting life stages and habitat capacity.

Long-Term Objectives

1. Avoid annual spawning stock limitation where too few fish might be available to capitalize on favorable natural spawning conditions in any year (or to continue to provide hatchery broodstock).

2. Minimize, to the extent possible, the time interval between the functional extinction of remaining wild adults and maturation of the first hatchery generation.

3. Maintain an effective population size in the wild adequate to avoid genetic bottlenecks that risk loss of diversity or inbreeding depression in the next generation.

4. Avoid significant detrimental impacts of hatchery fish on natural production due to competition, predation, or disease magnification.

5. Avoid hatchery selection or domestication that might reduce future fitness or viability.

4.2.2 Refined Burbot Population Monitoring and Production Objectives

Chapter 5 of the revised Master Plan provided a conceptual plan for burbot monitoring and evaluation. Several achievements and scientific findings have increased the probability of restoring the Lower Kootenai burbot population since the Master Plan was submitted in 2010. Highlights include the following:

- Research at UI-ARI has improved and further refined aquaculture techniques that have produced larvae, juveniles, and sub-adults for research purposes and general release to begin restoring abundance. The advances made by UI-ARI in developing culture techniques produced over 70,000 hatchery-reared burbot (50,000 larvae; 20,000 Age-0+ juveniles, and several hundred 1- to 3-year-old sub-adults) during 2011.

- Other studies completed or currently underway to evaluate and refine tagging techniques have demonstrated that juvenile burbot can receive internally-implanted PIT tags with minimal effects. Also, newly-developed genetic, parental-based tagging will allow determination of hatchery versus wild origin and year class without large-scale artificial tag application.

- Several telemetry studies of hatchery-reared burbot, ages 1 to 3 years old, have investigated post-release survival, movements, and habitat use. These studies suggest that initial survival and dispersal of hatchery released individuals are consistent with assumed values and are sufficient to restore the population.

- Restoration goals (time to recovery) for burbot in the Kootenai River were further investigated using a stochastic density-dependent population model that estimated annual recruitment rates based on known demographic parameters to provide recommendations to the program (Paragamian and Hansen 2011).

- Construction activities associated with the Kootenai River Habitat Restoration Program (BPA Project 200200200) were initiated in 2011. The first in a series of restoration projects was completed in 2011 and is functioning as expected. Additional projects are planned for implementation from 2012 through 2017. Additionally, the Tribe's Reconnect Project (BPA Project 200200800) incorporates reconnection of the Kootenai River with the historical Floodplain as part of wildlife habitat restoration.

- Nutrient additions in the Canyon Reach of the Kootenai River and in Kootenay Lake (BPA Project 199404900) have increased the productivity of the ecosystem, which should improve conditions for a restored burbot population. This project also includes aquatic-based trophic level and water chemistry monitoring of a 235-kilometer (km) reach of the Kootenai River and key tributaries.

- Cooperation among agencies and stakeholders for future research, monitoring, and evaluation activities is ongoing, and will contribute to the likelihood of program success. IDFG is conducting monitoring and evaluation activities associated with Kootenai sturgeon and burbot that help inform planning for recovery, habitat restoration, Libby Dam operations for sturgeon and burbot, and evaluation and adaptive management in the Kootenai River (BPA Project 198806500).

This combination of new information, improved aquaculture and tagging techniques, habitat enhancement activities, and continued cooperation is reflected in the refined Burbot M&E Plan (Appendix C). The Burbot M&E Plan has also been strengthened by incorporating several articles listed in Section 8.0 of the Conservation & Restoration Strategies of the KVRI Burbot Conservation Strategy. The following general recommendations guide the Burbot M&E Plan:

- Implement an aggressive adaptive program of experimental recovery measures.

- Employ conservation aquaculture methods as a key near-term component for burbot protection and restoration.

- Maintain a strong adaptive management scientific monitoring and evaluation program to guide implementation of population conservation and recovery activities.

The Burbot M&E Plan addresses many of the specific recommendations for research, monitoring, and evaluation outlined in the KVRI Burbot Conservation Strategy, as well. The main components are as follows:

- Monitor the current broodstock donor source to ensure long-term viability for use in the future.

- Refine aquaculture techniques to improve survival, growth, and conditioning across life stages to increase potential for individual survival in the natural environment.
- Monitor in-hatchery production and practices.
- Develop, test, and analyze tagging methods that do not compromise survival and growth. The appropriate tagging methods will provide a means to determine origin (hatchery vs. wild) and also provide individual identification to evaluate survival and growth.
- Conduct annual sampling and telemetry projects that will provide population estimates and information about population structure, as well as survival, dispersal, and behavioral data needed to evaluate the status of restoration over time. This will include analysis of sampling design in terms of sampling gear efficiency and spatial and temporal distribution of sampling effort.
- Monitor natural spawning.
- Determine if natural recruitment is occurring; and if so, to what extent is natural recruitment contributing to rebuilding the population.
- Continue to utilize data acquired by the ongoing Kootenai River bio-monitoring project(s) and the Kootenai River native fish investigations project(s).
- Determine if habitat restoration has benefited restoration of the burbot population; and if so, how the habitat improvements positively affected burbot.

Biological objectives of the burbot aquaculture program, including production objectives, have been updated since 2010, as project design has progressed. The construction and operation of Twin Rivers Hatchery will support the following biological objectives for burbot restoration:

- The interim goal is to produce and stock burbot at rates and frequencies to sustain a minimum population of 2,500 - 9,500 adults in the Kootenai River and South Arm of Kootenay Lake, as described in the Master Plan. This range includes the minimum population goal listed in the KVRI Burbot Conservation Strategy, and this minimum abundance is also suggested by Paragamian and Hansen (2008; 2011). This interim goal is a starting point to restore a population that once numbered in the 100,000's (Ahrens and Korman 2002; KVRI 2005).
- The long-term goal is to produce and stock burbot at rates and frequencies to sustain a minimum population of 17,500 adults in the Kootenai River and South Arm of Kootenay Lake (Paragamian and Hansen 2008; 2011).
- In conjunction with re-establishing adult abundance, the long-term goal is also to restore consistent natural recruitment in at least three different spawning areas that results in a juvenile population of sufficient size to support the adult burbot population goal.

- The design, scale, and initial production estimates concentrate on producing 60 families, and then rearing to and releasing 6-month-old juveniles, remaining consistent with the current release strategy. However, a substantial number of Age-1 burbot can be reared if needed. At current design using current aquaculture techniques, 125,000 6-month-old juveniles could be produced, and if needed, Twin Rivers could support grow-out of 45,000 – 60,000 juveniles to Age-1.

4.3 Engineering Design

Since the Master Plan was completed in 2010, three important changes in the engineering design have been proposed for the Tribal Sturgeon Hatchery. The engineering design for the Twin Rivers Hatchery has been refined, and now includes a base plan with several alternate components. Base plans and alternate components are summarized below and discussed in more detail in Chapter 7.

4.3.1 Tribal Sturgeon Hatchery

Tribal Sturgeon hatchery design changes include the following features, which are intended to increase the efficiency of hatchery operations and accommodate current and future staffing needs:

- The existing office building would be expanded to provide additional office space and a new meeting room.
- Additional floats would be installed to extend the existing dock, to allow safer personnel access to the boats and provide space for additional boats to use the docks.

The Tribe is considering one alternate component to the base proposal, listed below. The costs and benefits of this alternate will be considered further as planning and design activities move forward.

- The existing manufactured home used for a temporary residence would require extensive upgrades to provide safe, livable conditions for hatchery personnel. It may be more economical to construct a new crew quarters building to accommodate 24-hour on-site staffing when needed for critical functions (e.g., broodstock collection, spawning, etc.).

4.3.2 Twin Rivers Hatchery

The Twin Rivers Hatchery design has been refined and modified to improve efficiency, add flexibility, and reduce cost. Changes since 2010 include the following:

- The hatchery building is bigger due to increased rearing areas, increased mechanical and electrical spaces, the addition of a wet lab, and increased fish rearing area requirements to meet refined biocriteria targets.

- The water supply quantity has been increased to satisfy the increased rearing requirements and support the wet lab.
- The septic drain field, three new wells, and influent and effluent settling ponds have been sited.
- A new vehicle and boat storage and maintenance building would be constructed to provide security and weather protection of vehicles and equipment.
- Two new staff residences would be constructed, in addition to the existing store/office/residence.
- The Moyie River intake was revised to allow for vehicle access to the pump station and to provide a fish return pipe back to the Moyie River.
- River access to support hatchery operations will be improved by grading the existing boat ramp on the Kootenai River, expanding and resurfacing the adjacent parking, and providing a temporary dock at the mouth of the Moyie River.
- Sturgeon spawning channels were eliminated from the preliminary design due to the uncertainty of their success. Spawning channels were initially proposed as an experimental approach to promote voluntary mate selection under a more natural setting than is possible in the Tribal Sturgeon Hatchery. After evaluating the costs and feasibility of design, construction, and successful operation of multiple spawning channels, Tribal biologists and their consultants concluded that voluntary spawning in such channels would not produce the quantities of fertilized eggs and larvae that would be adequate to meet program goals.

The Tribe is considering several alternate components to the base proposal. These components, listed below, will be analyzed further as the planning and design process proceeds.

- Construction of a small visitor center (with amphitheater) to provide a space for public interaction, outreach, and education.
- Outdoor ponds could be used to increase capacity for burbot and provide the flexibility for 6-month grow-out, if needed to support the release strategy.
- A roof over the influent water sedimentation structure could be installed to provide shade that would maintain cooler temperatures and reduce algae growth, as well as preventing leaves and debris from falling into the pond.
- Constructing ramps for influent and effluent sedimentation structures would accommodate access for maintenance and cleaning.
- Adding emergency generator load reduction capability would reduce the electrical loads connected to the generator to the minimum required to keep the hatchery operational.

An internal value engineering process will be integrated into final design in Step 3. At that time, the operational functions for the hatchery building and support facilities will be reviewed to look at the costs and benefits of potential size reductions in some project features (e.g., hatchery building) and alternatives to the base design (e.g., boat ramp improvements).

4.4 Project Cost Estimates

The following is a brief update of significant issues related to costs in the key program areas. At the time the Step 1 Master Plan was completed (June 2010), it was anticipated that construction might occur in 2012; estimated costs for all capital and operational areas have been updated from the Master Plan to reflect construction occurring in 2013.

Additional discussion of costs is provided in Chapter 8, along with detailed cost tables. Chapter 8 presents costs for 10 years, as required, but some costs back to 2009 are also provided, reflecting the planning and land acquisition expenditures that occurred during Step 1. Table 8-2 shows a cost summary by program area. Table 8-10 presents cost estimates for each program in the year in which they are expected to occur, escalated to that year.

4.4.1 Cost Estimates for Construction

Table 8-7 summarizes the estimated Step 2 construction costs for the Twin Rivers Hatchery and modifications to the Tribal Sturgeon Hatchery, showing the primary construction cost and alternate components. The total estimated cost without alternate components is $15.3 million and with alternate components is $16.6 million. It should be noted that several cost reduction measures are being considered and will be addressed in the Step 3 planning and design process. The difference in cost associated with these design changes could range from $500,000 to $800,000, based primarily on reducing the hatchery building size and modifying the approach to boat ramp improvements at the Twin Rivers site. The construction budget for base requirements has not significantly changed from Step 1 to the current Step 2 estimate.

4.4.2 Capital Equipment

At Step 1, capital equipment was estimated to be $549,000 in 2012 dollars (Table 8-8). This figure is still considered to be reasonable at this time and is escalated to $565,000 (FY 2013). Other than escalation at 3% annually to the year costs would likely occur, there are no identified increases in capital equipment since Step 1.

4.4.3 Environmental Compliance

No significant changes in environmental compliance costs have been identified since Step 1. Table 8-9 presents a comparison of the Step 1 estimated cost of $164,000 (2011 dollars) and Step 2 (escalated at 3% to 2012 dollars). Costs for Step 2 are estimated to be approximately $176,000 to meet all requirements.

4.4.4 Refined Operations and Maintenance Cost Estimates

At Step 1, the Tribe estimated that the annual budget for operations and maintenance for the existing Tribal Sturgeon Hatchery would be $990,000 annually (2012 dollars) with consideration of sharing resources with the proposed Twin Rivers program. This estimate was escalated from 2012 to 2014 dollars (when Twin Rivers operations will start), resulting in an annual cost of about $1.05 million (Table 8-10). Note that the estimated annual cost of $1.42 million (2012 dollars) shown in Table 8-10 does not include sharing operations and maintenance (O&M) resources with Twin Rivers. Significant O&M efficiencies will be gained by sharing personnel and services between the Tribal Sturgeon Hatchery and Twin Rivers Hatchery. As noted in Step 1, sharing of equipment and staff is expected to reduce the annual operating cost by approximately 30% from the estimated cost of operating the facilities as separate entities.

At Step 1, the Tribe estimated that the annual budget for O&M for the Twin Rivers Hatchery would be $980,000 annually (2012 dollars), taking into account shared resources with the existing Tribal Sturgeon Hatchery (Table 8-11). This estimate was escalated from 2012 to 2014 dollars, resulting in an annual cost of about $1.24 million in FY2014 dollars (Table 8-11). Based on the estimates for the Tribal Sturgeon Hatchery (Table 8-10), the Tribe expects that operating the Twin Rivers Hatchery in isolation, i.e., not sharing staff and facilities, could increase costs by about 30%.

4.4.5 Refined Monitoring and Evaluation Cost Estimates

At Step 1, the Tribe estimated that the annual budget for M&E activities would be about $702,000 annually (2010 dollars). Estimated expenses for FY 2012 (Step 2), which are currently being incurred, are about $745,000. These expenses are not expected to increase with the addition of the Twin Rivers Hatchery facility. Escalating current costs by 3% annually shows that costs in FY 2015, when Twin Rivers is anticipated to be in full operation, would be $813,000 (Table 8-13). There are no significant changes to estimated out-year expenses for monitoring and evaluation.

4.5 Environmental Compliance

Since the Master Plan was submitted in June 2010, the Tribe has completed several of the environmental compliance steps that will be needed to meet federal regulatory requirements and support applications for state permits. BPA prepared a draft EA and held a public information meeting in Bonners Ferry on May 30, 2012 to provide an opportunity for public comment on the proposed Twin Rivers Hatchery. The wetland delineation report and draft Biological Assessment (BA) were updated to address Step 2 changes in project design. Additional cultural resource surveys were conducted at the Twin Rivers Hatchery site (also to address changes in project design) and at the Tribal Sturgeon Hatchery to ensure an adequate base of information about potential effects of hatchery expansion and upgrades. Section 6.2 provides additional detail regarding environmental compliance for the aquaculture conservation program.

5 MONITORING AND EVALUATION PROGRAM

Preliminary M&E plans for sturgeon and burbot have been refined, reviewed by co-managers and implementing partners, and updated since they were described in the Master Plan. The updated M&E plans are presented in Appendix B (Kootenai sturgeon) and Appendix C (burbot).

The two M&E plans share a common purpose: to ensure that hatchery operations produce high-quality, disease-free fish that can survive in the receiving environment. The plans also share a common framework, emphasizing an adaptive management approach to ensure that hatchery production, management, and habitat goals are compatible with conservation goals, and to track progress toward those goals over time.

Section 5.1 describes the approach to adaptive management that is common to both plans, Section 5.2 describes coordination with other entities that is associated with both plans, and Section 5.3 provides a summary of each M&E plan. The M&E plan summaries highlight the objectives, monitoring variables and parameters/attributes that will be monitored for each species. The summaries also identify the other entities (federal, state, Canadian provincial government, university, private consultancy) that now are or will be involved in monitoring programs for Kootenai sturgeon or burbot.

5.1 Adaptive Management

Adaptive management is a framework that incorporates the scientific method to resolve complicated natural resource problems. It is based on the premise that informed, deliberate experimentation is the most reliable means of understanding and addressing complex problems in resource systems. The Tribe is committed to using this framework to adaptively incorporate changes and manage its aquaculture and ecosystem restoration programs.

Because of the complexity of issues in the altered Kootenai River ecosystem and the degree of scientific uncertainty associated with Kootenai sturgeon and burbot, resource management is challenging. Monitoring a standard series of program variables and associated metrics and tracking the response of the species to the receiving habitat will enable the Tribe to adaptively manage sturgeon and burbot production and releases, and to make informed decisions regarding population restoration for both species. The design of the Twin Rivers Hatchery incorporates components that are specifically designed to be flexible, in order to allow the Tribe to adjust production based on annually updated M&E outcomes. The operation of the existing Tribal Sturgeon Hatchery in combination with the Twin Rivers Hatchery will further support extensive operational flexibility.

5.1.1 Decision Framework

The Kootenai River Native Fish Conservation Aquaculture Program will include checkpoints and evaluations during annual reviews (Section 5.1.4) and at periodic intervals, as new data becomes available. These efforts will be coordinated with the

Kootenai River White Sturgeon Recovery Team (led by the USFWS) and the KVRI Burbot Subcommittee (led by the Tribe). Figure 5-1 and Table 5-1 present a decision tree and decision pathway, respectively, for adaptively managing the conservation aquaculture program based on monitoring and evaluation of wild and hatchery-origin sturgeon and burbot.

As discussed in Section 3.2.1, key decision points may be triggered by the restoration, frequency, and magnitude of natural recruitment, changes in spawning distribution following habitat restoration activities, identification of effective alternatives such as larval releases, unavailable or senescent (non-reproducting) broodstock, strong density-dependent habitat limitations, or delayed maturation of hatchery-origin fish. Program termination or substantive changes in program objectives and activities for both species will be driven by monitoring and evaluation of the system responses. It is difficult to foresee which specific factors, conditions, or metrics might trigger a fundamental reconsideration of the conservation aquaculture program. Program objectives and activities will continue to be refined over time based on evolving conditions and new information.

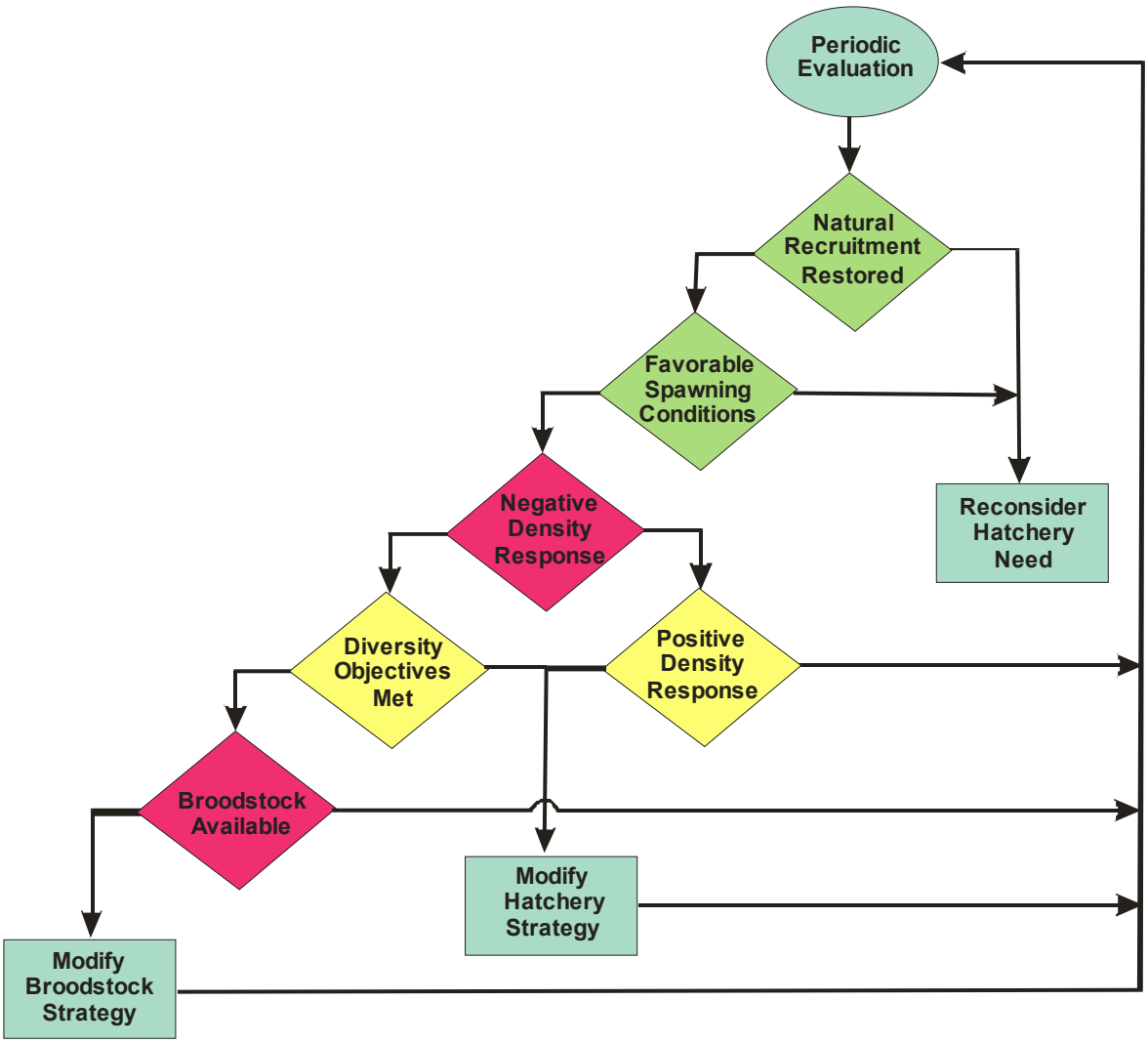

Figure 5-1. **The adaptive management decision tree for the Kootenai River Native Fish Conservation Aquaculture Program.**

Table 5-1. Decision pathway guiding future monitoring and implementation of the Kootenai River Native Fish Aquaculture Program.

	Question	Metrics	Reponse
1	Has substantial natural recruitment occurred?	Number/percentage of unmarked fish in juvenile sampling program.	Re-evaluate appropriate level of hatchery supplementation based on frequency and magnitude of natural recruitment.
2	Has the wild spawning distribution shifted to upstream areas of potentially more suitable spawning habitat?	Telemetry data on movements of mature fish during spawning periods	Re-evaluate whether wild broodstock, if limited, are best employed in the wild or the hatchery.
3	Are wild spawner numbers adequate to continue to provide hatchery broodstock?	Catch per unit effort, annual number of broodstock collected, percentage of previously-unspawned individuals in annual adult sampling program	Consider modification of broodstock collection program numbers, need for extended broodstock holding, or reduction in program based on cost/benefit analysis and progress toward objectives.
4	Are broodstock numbers and mating strategies adequate to optimize genetic diversity?	Effective population size based on broodstock numbers, representation of genetic types in broodstock.	Consider increasing or decreasing annual broodstock numbers as appropriate.
5	Has survival, growth or condition of age 1 or older juveniles declined substantially in response to increasing density?	Annual survival and growth rates estimated with mark-recapture data from juvenile monitoring program. Condition estimated from length-weight relationship. Size and age at maturation and reproductive periodicity of hatchery-origin fish.	Consider reductions in annual releases, changes in release distribution, changes in family sizes, rearing fish to a larger size to avoid size-specific limitations, and fish removal to reduce biomass as appropriate based on risk/benefit calculation and progress toward objectives.
6	Has juvenile sturgeon distribution or behavior changed substantially in response to increasing density?	Catch per unit effort by area, movement data from tagged fish.	Weigh relative benefits of expanded distribution versus detriments of increased competition in considering program modifications.
7	Are there other new data, information or developments that warrant consideration?	Associated with habitat, nutrient and other species monitoring efforts.	Program refinements as appropriate.

5.1.2 Quantitative Benchmarks

Three levels of quantitative benchmarks are identified for the sturgeon and burbot elements of the conservation aquaculture program:

Working population objectives serve as interim restoration objectives (Appendix A, Section 2.4). Criteria have been identified consistent with characteristics of a viable sturgeon population, including abundance, productivity, distribution, diversity, and other purposes including harvest. Quantitative objectives are identified for abundance. Qualitative objectives are identified for other attributes where data and information are not yet sufficient to determine specific quantitative values. The USFWS is expected to develop more explicit quantitative objectives for sturgeon as part of a planned revision of the Recovery Plan.

Production targets identify numbers of broodstock, families, family size, size at release, and annual releases developed consistent with working criteria to guide hatchery planning and operations (Appendix A, Section 4). These numbers are based on working recovery criteria and provide the basis for facility designs for the Kootenai sturgeon and burbot programs.

Population benchmarks provide reference values for monitoring and evaluating progress toward recovery criteria achieved by current production targets. Benchmarks identify quantitative values for key population attributes (Appendix A, Section 6.3). Targets for wild fish identify desired values based on recovery objectives. Targets for hatchery fish identify baseline values from current information. Triggers identify values that warrant reconsideration and possible adjustment of hatchery production targets under the adaptive management framework for the conservation aquaculture program.

5.1.3 In-Season Management Procedure (ISMP)

To support implementation of the decision tree shown above in Figure 5-1 and the decision pathway shown in Table 5-1, the Tribe will make use of an In-season Management Procedure (ISMP) and an Annual Project Review (APR) process.[2] General information on the ISMP and APR is provided below and discussed in more detail in Chapter 3 of Appendix B, the Sturgeon M&E Plan, and Chapter 3 of Appendix C, the Burbot M&E Plan.

[2] The ISMP and APR that the Tribe is modifying and tailoring specifically to the Kootenai sturgeon and burbot M&E plans are based on M&E plans developed by the Confederated Tribes of the Colville Reservation and their consultant, D.J. Warren and Associates, Inc. in 2009 (Colville Tribes 2009a; 2009b). The ISMP and APR serve as a template that can be used to support, focus and manage ongoing M&E and hatchery operational program changes for any aquaculture program, for any species. Since it was first presented to the Council, this approach has been incorporated into the M&E plans for IDFG's Snake River Sockeye Hatchery Program, Yakima Nation's Yakama Summer/Fall and Coho Program, the Shoshone-Bannock Snake River Chinook Program, and the Cowlitz Hatchery Fish Hatchery Management Plan.

The ISMP provides a structured decision making framework designed to guide hatchery operations, identify M&E needs, facilitate effective agency cooperation and communication, and support adaptive management of the conservation aquaculture program. The ISMP will be implemented in cooperation with management agencies, critical research entities, and stakeholders (as appropriate) through the APR.

Four overarching steps are involved in the ISMP, as illustrated in Figure 5-2. The first step consists of updating key assumptions about donor broodstock, hatchery and natural (in-river) production, and harvest (there is no harvest of burbot or Kootenai sturgeon at this time). In the second step, the most recent stock status information for both the hatchery and natural components of the population is entered into a database. The third step includes review of a set of Decision Guidelines for each phase of the program to determine if those Decision Guidelines should be adjusted to reflect changes in conservation goals in the U.S. or Canada, unequal goal achievement across the project area, Libby Dam operations/habitat related issues, new science discoveries, or environmental changes in the subbasin or the region. The fourth step involves setting updated biological targets (broodstock needs, release strategy, release numbers, and at some point in the future harvest levels) for the coming year.

The ISMP is formalized in a database and set of management tools. The database is used to store and document data and assumptions, which is critical to the effective implementation of adaptive management over the longer-term. The management tools are designed to use predictive models to arrive at outcomes from which Decision Guidelines and biological targets can be derived. The management tools document the basis for these targets and establish expectations for all performance indicators. The use of management tools helps to simplify the implementation process and document the rationale for recommended annual management actions. The Tribe has developed predictive management tools for sturgeon and burbot for use with the ISMP and will, in coordination with key management agencies, researchers, and subject area experts, refine those through the APR as new information becomes available.

The APR is the formal coordination mechanism for implementing the four steps of the ISMP. As described below, the APR is a science-driven process that is intended to result in an action plan for the coming season.

5.1.4 Annual Project Review

The Tribe will sponsor facilitated APR workshops for sturgeon and burbot each year. The APR workshops will guide decisions about broodstock management, gamete collection, production goals, release strategy, harvest, and M&E activities for the coming year. The workshops will incorporate expertise from members of the USFWS Kootenai River White Sturgeon Recovery Team (for sturgeon) and the KVRI Burbot Subcommittee (for burbot). The action plans will be completed during each workshop.

The first segment of the workshops will be devoted to presentations of results of monitoring and research activities related to the key assumptions for the Tribe's hatchery program (see ISMP Step 1). The workshop will incorporate sessions covering: 1) hatchery operations, 2) post-release survival and distribution, 3) habitat, 4) spawning and natural

recruitment, and 5) future harvest planning (once it is appropriate to consider for either burbot and/or sturgeon).

The Tribe will coordinate with cooperating agencies to ensure the most up-to-date information for each of these subjects is presented and discussed at the APR. The ISMP tools (once developed) will be populated with the most recent data and analytical results to update status and trends (see ISMP Step 2).

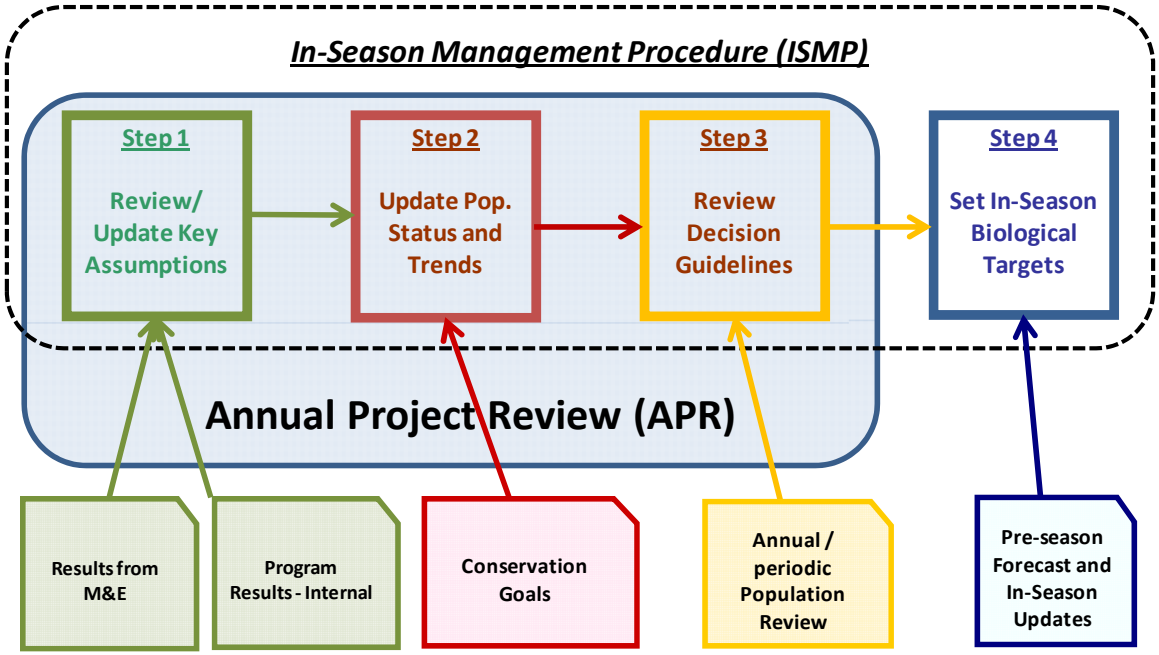

Figure 5-2. **In-Season Management Procedure framework for the sturgeon and burbot M&E plans.**

During the second part of the workshop, the management team (which will include policy and technical personnel) will meet to review the implications of conclusions from day one relative to any necessary revisions to the Decision Guidelines (see ISMP Step 3). Based on this information, the management team will finalize a set of biological targets for the upcoming year (see ISMP Step 4). The purpose of the Decision Guidelines is to assure that the long-term goals for conservation (and when appropriate, for harvest) are met over time. The product of the second day will be an updated action plan for the coming year.

During the final portion of the workshop, the M&E operational plan will be reviewed and updated. Each agency with an active role implementing the M&E Plan will review and confirm how the workshop outcomes will guide hatchery and/or field M&E activities during the upcoming year. The workshop facilitator will provide a draft workshop summary incorporating findings, conclusions and final decisions for review to all participants at the conclusion of the workshop. Workshop participants will confirm (and if necessary, correct) the workshop summary. The facilitator will produce and distribute

a final workshop record. A final annual report will then be completed and distributed by Tribal staff. The ISMP database, management tools, Decision Guidelines and other associated products will be retained, along with the workshop summary, for reference in subsequent APR workshops.

5.2 Coordination with Other Programs

The adaptive management approach outlined for the Tribe's conservation aquaculture program is one component of a broader effort by the Kootenai Tribe and other state, federal, and provincial co-managers to restore ecosystem functions in the Kootenai River. Ongoing complementary activities in the Kootenai subbasin include the following:

- The Tribe's Kootenai River Ecosystem Restoration Project (BPA Project 199404900) provides nutrient addition in the Canyon Reach of the Kootenai River and Kootenay Lake in Canada, and aquatic-based, trophic level and water chemistry monitoring of a 235-km reach of the Kootenai River and key tributaries.

- The Tribe's Kootenai River Habitat Restoration Project (BPA Project 200200200) is implementing habitat restoration actions (including mainstem, substrate enhancement, off channel, riparian, and floodplain habitats) in the Braided Reaches, Straight Reach and Meander Reaches to address the habitat needs of all life stages of Kootenai sturgeon, burbot, bull trout, kokanee, westslope cutthroat trout, redband trout, and other native fish.

- The Reconnect Kootenai River with the Historical Floodplain Project (BPA Project 200200800) involves habitat improvements as part of a larger wildlife habitat restoration effort.

- The Tribe is developing an Operational Loss Assessment (BPA Project 200201100) that will help measure and aid in understanding the impacts of various changes to the ecosystem since construction and operation of Libby Dam.

- The Tribe is implementing actions identified in the Albeni Falls Wildlife Mitigation Project (BPA Project 199206105) to partially address the loss of wildlife habitats within the Tribe's ancestral lands caused by construction and operation of the Albeni Falls Dam.

- IDFG's Kootenai River Resident Fish Mitigation (BPA Project 198806500) involves monitoring and evaluation activities associated with Kootenai sturgeon and burbot that help inform recovery planning, habitat restoration, Libby Dam operations for sturgeon and burbot, and evaluation and adaptive management in the Kootenai River. IDFG is also a partner to the Tribe on BPA Project 199404900, assisting with implementation of nutrient addition and monitoring the fish community at established monitoring sites throughout the basin.

- The Tribe actively coordinates with the Kootenai River White Sturgeon Recovery Team and the KVRI Burbot Conservation Technical Team, and also tracks progress of

the trans-boundary Upper Columbia River White Sturgeon Recovery Initiative Technical Working Group.

As part of the recent resident fish, data management and coordination review, the ISRP requested that the Tribe collaborate with IDFG to develop a synthesis of the Kootenai Tribe's and IDFG's research and monitoring results to date. The Tribe is currently working on development of an approach to completing the Tribal portion of this effort and will be coordinating with IDFG on a collaborative approach in the near term.

The Tribe is also developing a Kootenai subbasin scale adaptive management plan that is designed to link each of the projects within the Tribe's Fish and Wildlife Program as a means of tracking how those projects collectively contribute to ecosystem restoration in the Kootenai subbasin. This effort is focused primarily on tracking the impacts of the Tribe's programs; however, information from IDFG, BC Ministry, and MFWP will be incorporated into the process. The plan was initially slated for completion in the fall of 2012 but will be delayed somewhat to integrate this work with the research and monitoring synthesis requested by the ISRP and Council.

At the time this Step 2 document was being developed, the Independent Scientific Advisory Board (ISAB) had just completed a review of the Council's Draft Monitoring, Evaluation, Research, and Reporting (MERR) Plan for the Columbia River Basin (NPCC 2011). The MERR Plan is intended to assist the Council and other partners in the Basin with a variety of objectives. These include facilitating communication and collaboration among project proponents and funding agencies; tracking the status and trends of priority species and habitat characteristics, as well as the factors that affect them; reporting on project effectiveness in protecting, mitigating, and enhancing fish and wildlife resources; sharing research, monitoring, and evaluation information with the public; ensuring that M&E plans are integrated with other relevant guidance documents (e.g., biological opinions and recovery plans); and providing further context for the ISRP in its review of individual projects and the overall program. The Tribe will continue to track the progress of this effort and will incorporate guidance from the MERR Plan into the M&E plans for Kootenai sturgeon and burbot.

The Tribe is also participating in regional sturgeon coordination efforts including development of a comprehensive basin-wide planning framework to ensure that sturgeon research, and conservation projects are being implemented in a cost-effective and complementary manner.

5.3 Sturgeon M&E Plan Summary

The Sturgeon M&E Plan is designed to evaluate population status in the wild and the effectiveness of recovery actions, including aquaculture, flow, and habitat measures. Field monitoring components of this plan have been and will continue to be cooperatively implemented by the Kootenai Tribe, IDFG, BC Ministry, and MFWP. Broader program-level M&E is also addressed by the USFWS Recovery Plan (USFWS 1999), the current recovery implementation plan and schedule (KTOI 2005), and other

project-specific plans, including the Kootenai River Habitat Restoration Program Master Plan (KTOI 2009b).

The Tribe will be responsible for general program administration, hatchery production, and the execution of the ISMP and APR (described above in Sections 5.1.3 and 5.1.4) that will guide hatchery-based population restoration efforts. Personnel from IDFG and BC Ministry will conduct field sampling within their respective countries, and Cramer Fish Sciences (CFS) will assist by lending expertise regarding various aspects of M&E design, implementation, and critical uncertainty research, upon request. U.S. Geological Survey (USGS) and University of California Davis Genomic Variation Lab (UC Davis GVL) will provide specific expertise.

Program actions will be managed using data and information provided by M&E activities described in the plan and summarized below. M&E results will be used to determine whether program conservation goals are being achieved within the anticipated time frames.

The Sturgeon M&E Plan addresses five key monitoring components, including broodstock populations, aquaculture (pre-release), post-release, and natural spawning and recruitment. Coordination with existing monitoring programs is also an important part of the Kootenai Sturgeon M&E Plan, and the Tribe will continue to utilize data acquired by the ongoing Kootenai River Ecosystem Restoration Project (BPA Project 199404900), IDFG managed Kootenai River Resident Fish Mitigation Project (BPA Project 198806500), and Kootenai River Habitat Restoration Program (BPA Project 200200200) to help determine if habitat restoration has benefited restoration of the sturgeon population; and if so, how the habitat improvements positively affected sturgeon. The five key components of the M&E Plan include:

- Using sampling and telemetry to monitor wild broodstock populations and condition and collect broodstock
- Evaluating hatchery practices and production by monitoring survival and condition of broodstock, embryos, free embryos, exogenously feeding larvae, 6-month-old (Age-0), and 1-year-old juveniles held in the hatchery prior to release.
- Conducting sampling and telemetry to estimate post-release populations and analyze population structure, as well as survival, dispersal, and behavioral data needed to evaluate the status of the restoration over time.
- Monitoring natural spawning.
- Determining if natural recruitment is occurring, and if so, to what extent is natural recruitment contributing to rebuilding the population.

For each of these plan components, the following sections and accompanying tables present 1) the agencies that will be participating in monitoring, listed in the relative order of their responsibilities, 2) the M&E objectives, 3) the M&E activities, 4) the variables that will be monitored, 5) the metrics to be measured for each variable, and 6) an indication of how the information will be used in the ISMP. Additional discussion regarding the

selection of each element and detailed monitoring methods for each element can be found in Appendix B.

5.3.1 Broodstock Population

The sturgeon population monitoring program includes three primary sampling components: adult stock assessment, juvenile stock assessment, and telemetry of adults. Stock assessment monitoring has been conducted in approximately its current form since the early 1990s (Ireland et al. 2002). The monitoring program also employs egg and larval sampling and focused telemetry studies to evaluate the effectiveness of recovery specific actions and experiments. Details of sampling methods and annual results are documented in an extensive series of annual reports (e.g., Paragamian et al. 1996; Rust and Wakkinen 2009).

Table 5-2 presents the participating entities, M&E objectives, activities, variables, and metrics that will be used to characterize the wild broodstock population and the biological and reproductive health, condition, and behavior of individual fish used as spawners in the conservation aquaculture program.

Table 5-2. Broodstock population monitoring and collection.

Participating Entities	• Kootenai Tribe • IDFG • BC Ministry
M&E Objectives	1. Wild population (broodstock) monitoring: Sample and recapture adequate numbers of wild Kootenai sturgeon to accurately estimate or evaluate: • Survival • Growth • Biological condition • Abundance • Age class structure • Population status and trends • Tag retention Perform telemetry adequate to estimate: • Seasonal movements and migrations • General timing and locations of spawning • Effects of flow management • Effects of habitat restoration actions 2. Broodstock collection: • Maximize the temporal and geographic extent of annual broodstock capture to incorporate the maximum amount of genetic diversity into the annual production of families in the hatchery, and the recipient population over time

	• Meet program demographic and genetic objectives at annual and decadal scales • Maximize the inclusion of previously unspawned broodstock into the program breeding matrices
M&E Activities	• Collect broodstock to produce progeny groups • Perform visual examinations and/or gonadal biopsies to determine sexual maturity of male and female fish to determine broodstock suitability • Transport candidate broodstock to the hatchery • Telemetry system deployment, data collection, and analysis • Data analysis, annual reports, and ongoing communications with various agency, public, and stakeholder groups
Variables	• Reproductive maturation • Abundance • Survival • Size and condition • Behavior and distribution
Metrics	• Females – reproductive stage/ova development • Males – flowing milt • Total number of adults captured • Number of adult males and females captured • % of captured adults taken for broodstock (M&F) • Survival of captured adults, male, and female broodstock • Length, weight, age, condition factor (K), relative weight (Wr) • Location and timing of captures, distribution patterns from telemetered fish, % of tagged fish upstream from Bonners Ferry
ISMP Purpose	Resulting information will be used to update ISMP Steps 1-3.

5.3.2 Aquaculture (Pre-release)

Pre-release monitoring is arranged by life stage. Beginning with broodstock briefly held in captivity to spawn, proposed pre-release metrics evaluate spawning and the survival and condition of broodstock, embryos, free embryos, exogenously feeding larvae, 6-month-old (Age-0), and 1-year-old juveniles held in the hatchery prior to release. Participating entities and the M&E objectives, activities, variables, and metrics associated with pre-release aspects of the program are provided in Table 5-3.

Table 5-3. Aquaculture (pre-release) monitoring.

Participating Entities	• Kootenai Tribe • BC Ministry
M&E Objectives	Maximize survival and condition of captively held and/or reared: • Broodstock • Gametes • Embryos • Free embryos • Larvae • Age-0 juveniles • Age-1 juveniles in the hatchery prior to release to maximize the genetic diversity and resilience of annual release groups and program efforts in general
M&E Activities	• Assess broodstock maturation and reproductive condition • Develop and implement best annual spawning matrices • Measure success of in-hatchery life stages from spawning to release of Age-1 fish • Monitor survival, growth, condition, and general health of all life stages in hatchery • Identify causes of mortality and factors limiting growth and develop solutions these limitations
Variables (by life stage)	• Broodstock: holding • Spawning: gamete viability, fecundity, egg take, spawning matrix variables • Embryos: egg density, fertilization success, survival • Free embryos: survival • Larvae on feed: survival • 6-month juveniles: condition and survival • Age-1: condition and survival, tagging, genetic variables
Metrics	• Broodstock (holding): survival, final maturation • Spawning (gamete viability): Female germinal vesicle breakdown (CVBD), polarity index (PI) values; male sperm motility • Spawning (fecundity, egg take): number of eggs per female (fecundity), number of eggs used for spawning, total number of fertilized eggs, annual ovulation success rate (vs. atresia) • Spawning (matrix variables): number of broodstock spawned, number of males and females spawned, M:F ratios, number of families produced • Embryos (egg density): number of eggs per incubation jar (density) • Embryos (fertilization success): % fertilization • Embryos (survival): % survival • Free embryos (survival): % hatch, % survival

	• Larvae on feed (survival): % survival • 6-mo juveniles (condition and survival): % survival, length, weight, K and Wr • Age-1 (condition and survival) % survival, length, weight, K and Wr • Age-1 (tagging): pre-release tag retention • Age-1 (genetic variables): family contribution, effective populations size (Ne), number of breeders (Nb), diversity measures, genetic-based tagging
ISMP Purpose	Resulting information will be used to update ISMP Steps 1-3.

5.3.3 Post-release

Participating entities and the M&E objectives, activities, variables, and metrics associated with post-release aspects of the program are provided in Table 5-4. Collectively, these post-release variables and metrics will address the individual post-release growth, survival, and biological conditions of juveniles (≥ Age-1) and adult fish, and the effects of the program on age class structure and future population abundance trajectories.

Table 5-4. Post-release monitoring.

Participating Entities	• Kootenai Tribe • IDFG • MFWP • BC Ministry
M&E Objectives	Recapture adequate numbers of post-release hatchery produced fish to accurately estimate or evaluate: • Survival • Growth • Biological condition • Abundance • Age class structure • Population status and trends • Tag retention Perform telemetry adequate to estimate: • Seasonal movements and migrations • General timing and locations of spawning • Effects of flow management • Effects of habitat restoration actions
M&E Activities	• Monitor post-release survival, growth, condition, and general health of juveniles and adults as a function of release time and locations to optimize release strategies • Identify causes of mortality and factors limiting growth and survival, and develop solutions to these limitations

	• Monitor post-release genetic variables at individual, family, year class and population levels • Monitor age class and population genetic structure over time to evaluate success of attaining desired population trajectories and genetic signatures • Define and characterize seasonal habitat use, movements, and migrations to evaluate needs for natural spawning and recruitment
Variables	• Survival • Growth • Condition • Abundance • Future abundance trajectories • Age class structure • Genetic variables • Tag retention • Seasonal habitat use, migration and movement patterns, and spawning areas • Distribution • Sampling efficiency • Release locations, timing
Metrics	• Annual survival • Annual growth • Weight, length, biological condition factor, relative weight (Wr) • Juvenile and adult abundance • Modeled future juvenile and adult abundance trajectories • Length at age • Family contribution, effective population size (Ne), number of breeders (Nb), diversity measures, genetic based tagging • Tag retention, post-tagging survival, behavior, growth, and condition • % of tagged juveniles and potential spawners upstream from Bonners Ferry during spawning season • Annual capture probability • Growth, survival, movements as a function of release location and timing
ISMP Purpose	Resulting information will be used to update ISMP Steps 1-3.

5.3.4 Natural Spawning and Recruitment

The series of natural spawning and recruitment variables and metrics shown in Table 5-5 largely address the numbers of various naturally produce early life stages captured after spawning to determine their contribution to natural production and population recovery as a part of ongoing M&E activities.

Table 5-5. Natural spawning and recruitment monitoring.

Participating Agencies	• Kootenai Tribe • IDFG • USGS • BC Ministry
M&E Objectives	• Determine (quantify) when, where, and the extent of natural spawning of Kootenai sturgeon • Determine (quantify) when, where, and the extent of natural recruitment of Kootenai sturgeon
M&E Activities	• Telemetry of late-stage mature adults • Sample early eggs, embryos, larvae and juveniles • Extrapolate natural production data to estimate
Variables	• Spawning success • Recruitment success
Metrics	• Number of naturally-produced eggs/embryos captured • Number of naturally-produced free embryos captured • Number of naturally-produced larvae captured • Number of naturally-produced juveniles (>Age 1) captured • Contribution of natural production to population age class structure
ISMP Purpose	Resulting information will be used to update ISMP Steps 1-3.

5.3.5 Existing Kootenai Sturgeon M&E

The Kootenai Sturgeon M&E Program has been underway for over 20 years, and sections 5.1 through 5.3 above, accurately reflect the objectives, activities, variables, metrics and methods for each component of the M&E Plan presented in Appendix B. Section 5.2.1 provides information about sampling of broodstock and wild adults. Sections 5.2.2 and 5.2.3 provide information about pre-release and post-release phases, respectively. Section 5.2.4 describes natural spawning and recruitment investigations.

Table 5-6 lists the entities that currently participate in the program. These entities will continue to be involved in the future. Table 5-6 lists other ongoing sturgeon monitoring activities in the Kootenai River. Links to these studies are provided in Appendix C.

Table 5-6 Existing Kootenai sturgeon M&E activities.

Participating Entities	• Kootenai Tribe • IDFG • BC Ministry • MFWP • USGS • UC Davis-GVL
M&E Activities	• Adult sturgeon assessment • PIT tagging • Sonic telemetry • Juvenile sturgeon gillnetting • Artificial substrate mat sampling • Larval sturgeon sampling • Adult sturgeon movement modeling • Adult sturgeon mortality, abundance, and year class strength • Juvenile sturgeon survival analysis
ISMP Purpose	Data obtained through the habitat studies will not be used directly in the ISMP; however, ongoing monitoring and restoration activities will be used to update and evaluate ISMP Steps 1 – 3.

5.4 Burbot M&E Plan Summary

The M&E Plan for burbot is composed of eight primary monitoring elements: donor source, aquaculture production, tagging, sub-adults (release strategy and re-introduction), adults (release strategy and re-introduction), spawning and natural recruitment, and harvest. The quality and quantity of basin habitat will continue to be monitored under the ongoing Kootenai River Habitat Restoration to track changes and confirm that habitat actions are effective.

The critical components of the Burbot M&E Plan are to:

- Monitor the current broodstock donor source to ensure long-term viability for use in the future.
- Refine aquaculture techniques to improve survival, growth, and conditioning across life stages to increase potential for individual survival in the natural environment.
- Monitor in-hatchery production and practices.
- Develop, test, and analyze tagging methods that do not compromise survival and growth. The appropriate tagging methods will provide a means to determine origin (hatchery vs. wild) and also provide individual identification to evaluate survival and growth.

- Conduct annual sampling and telemetry projects that will provide population estimates and population structure, as well as, survival, dispersal, and behavioral data needed to evaluate the status of the restoration over time. This shall include analysis of sampling design in terms of sampling gear efficiency and spatial and temporal distribution of sampling effort.
- Monitor natural spawning.
- Determine if natural recruitment is occurring; and if so, to what extent is natural recruitment contributing to rebuilding the population.
- Continue to utilize data acquired by the ongoing Kootenai River Ecosystem Improvement Project (BPA Project 199404900) and IDFG's Kootenai River Resident Fish Mitigation (BPA Project 198806500).
- Determine if habitat restoration has benefited restoration of the burbot population; and if so, how did the habitat improvements positively affect burbot.

Several governmental and research entities will be participating in M&E activities for burbot. In addition to the Tribe, BC Ministry, IDFG, and CFS, these entities include UI-ARI and the Idaho Cooperative Fish and Wildlife Research Unit (ID-CFWRU). For each of the M&E elements shown in tables 5-7 through 5-14, the order of listing indicates the relative level of responsibility of each participating entity.

For each monitoring element, Tables 5-7 through 5-14 also present 1) monitoring objectives, 2) monitoring activities, 3) variables that will be monitored, 4) metrics to be measures for each variable, and 5) an indication of how the information will be used in the ISMP. Additional discussion regarding the selection of each element and detailed monitoring methods can be found in Appendix C.

5.4.1 Donor Source Populations

The primary objective in monitoring donor source populations is to estimate the number of spawning adults that may be available and utilized in the hatchery program without negative consequences to the wild donor population. Currently, Moyie Lake, located in British Columbia, provides all broodstock and gametes for hatchery production. Future production may utilize wild progeny from hatchery-reared burbot collected from areas of the Kootenai River and Kootenay Lake where natural recruitment has been restored.

Table 5-7. Donor source populations.

Participating Entities	• BC Ministry • Kootenai Tribe • UI-ARI • IDFG
M&E Objectives	• Provide mature adult burbot and fertilized eggs for conservation aquaculture operations • Describe donor stock population trends - age, growth,

	distribution and survival • Produce annual donor stock population estimates using mark-recapture • Utilize population indices and mortality factors to determine level of broodstock collection which still allows for successful recruitment and maintenance of fisheries on these systems • Determine the location and general habitat characteristics of burbot spawning locations
M&E Activities	• Annual fall trapping to provide captive broodstock and provide individuals for sonic tagging • Annual winter sampling to provide fertilized eggs for aquaculture operations, mark-recapture sample for population estimation • Telemetry system deployment, data collection and analysis (2013-2015) • Data analysis, annual reports, and ongoing communications with Technical Working Group
Variables	• Adult abundance • Mortality • Growth and condition • Fecundity and sperm motility • Behavior and distribution
Attributes/Parameters Estimated	• Donor source = Moyie Lake (Continual viability of donor population?) • Broodstock survival % (wild) • No. of broodstock used (Can donor population support aquaculture goals?) • No. of fertilized eggs (Are female fecundity and male sperm motility adequate and accurately characterized to estimate annual hatchery production?)
ISMP Purpose	Data will be used to update ISMP Steps 1 – 3.

5.4.2 Aquaculture

The quality of the fish produced at hatchery facilities depends on the fish husbandry protocols used in hatchery operations. Thus, all rearing phases of the hatchery program will be monitored using best-management practices outlined in a hatchery operations manual, which is being developed by UI-ARI and the Tribe. The hatchery will be operated to maximize survival at all life stages by implementing the most current fish health and disease prevention techniques.

Table 5-8. Aquaculture monitoring.

Participating Entities	• UI-ARI • Kootenai Tribe • IDFG • BC Ministry
M&E Objectives	• Optimize burbot culture in terms of quantity and quality
Research Activities	• Conduct laboratory studies to evaluate and define dietary needs of larvae and juveniles • Conduct laboratory studies to optimize feeding rates and rearing densities • Conduct laboratory studies to evaluate the role of gut flora to enhance health and survival of intensively reared larval burbot • Conduct studies to determine capacity for enhanced rearing of burbot in extensive/semi-intensive ponds at the Twin Rivers facility through replicated trials • Produce larvae to compare hatchery rearing, natural pond rearing, net pen rearing • Produce sentinel adults for conducting telemetry studies to determine dispersal, survival, habitat selection, and spawning by hatchery-reared burbot
M&E Activities	• Monitor survival across all life stages in hatchery • Identify causes of mortality and factors limiting growth and develop solutions these limitations • Monitor growth of fry, juveniles, and sub-adults
Variables	• Survival across all life stages • Growth and condition • Density
Attributes/Parameters Estimated	• Broodstock survival in hatchery • No. of fertilized eggs • % hatch success • % larval survival • % YOY survival (in-hatchery) • % Age-1 survival (in-hatchery)
ISMP Purpose	Data will be used to update ISMP Steps 1 – 3.

5.4.3 Tagging

Use of appropriate tags and tagging methods that do not compromise survival will be essential. Cost-effective batch marks are needed to determine fish origin (hatchery vs. wild). Long-term retention of tags with individual identification that do not compromise survival is also of paramount importance to future M&E efforts.

Table 5-9. Tagging.

Participating Entities	• UI-ARI • Kootenai Tribe • IDFG • BC Ministry
M&E Objectives	• Develop a genetic based tagging program • Continue evaluation of batch marking techniques for different life stages to accommodate large-scale hatchery production and evaluation of stocking strategy • Determine best tagging methods that provide individual identification with the least negative effects on survival, growth, and reproduction
M&E Activities	• Develop and Implement a genetic based tagging program • Conduct laboratory studies evaluating tag retention, survival, and growth at different life stages • Artificial batch markers (VIE) • Artificial marking techniques for individual identification (PIT-tag) • Genetic markers for origin identification and genetic diversity assessments
Variables	• Post-tagging survival • Post-tagging behavior • Post-tagging growth / condition • Tag retention
Attributes/Parameters Estimated	None; without proper tagging techniques, values for numerous parameters will be difficult to estimate with precision.
ISMP Purpose	Tagging data will not be used directly in the ISMP. However, without proper tagging techniques, much of the information needed for ISMP Steps 1 – 3 will not be available.

5.4.4 Sub-Adult Releases

Any restoration of a functionally extinct or extirpated sub-population of fish follows a progression or evolution over time that is predicated on initial survival of hatchery-reared or translocated individuals followed by adaptation to the environment that results in reproduction and recruitment. Currently, hatchery-reared burbot provide research subjects to evaluate distribution, movements, habitat use, food habitats, and effective sampling methods by life stage. UI-ARI production and tagging studies will be coupled with IDFG and BC Ministry population-level research and field monitoring of initial survival, growth, and maturation. Telemetry, fixed PIT-tag arrays and year-round sampling with multiple gears will initially provide survival, growth, and behavioral data, and then also recruitment data when natural spawning occurs. The Tribe will provide field support if requested, and will participate in data analysis and restoration strategy development. Experimental releases of burbot of various sizes will identify life stage limitations and provide information necessary to guide future habitat restoration efforts. Survival, growth, and maturation estimates will provide the quantitative basis to

estimate the appropriate scale of production and release strategies to meet long-term population restoration objectives.

Table 5-10. Sub-adult releases.

Participating Entities	• IDFG with ID-CFWRU • BC Ministry • Kootenai Tribe
Post-release M&E Objectives	• Survival • Growth / bioenergetics • Ecology • Habitat selection by life stage • Diet by life stage
Post-release M&E Activities	• IDFG - Early life stages of burbot sampling and gear efficacy study using Herzog (Missouri) trawls, electrofishing, and small-mesh traps --- collaboration with the Idaho Cooperative Fish and Wildlife Research Unit (ID-CFWRU; Dr. Michael C. Quist) • IDFG - Tributary spawning, rearing, habitat selection, and emigration of burbot by using fixed and mobile PIT-tag arrays --- collaboration with the Idaho Cooperative Fish and Wildlife Research Unit (ID-CFWRU; Dr. Michael C. Quist) • BC Ministry and IDFG - Telemetry of age 1-3 year old hatchery-reared burbot
Variables	• Annual survival • Growth / condition • Bioenergetics • Density • Behavior – dispersal and habitat selection
Attributes/Parameters Estimated	• % Age-0 survival in-river • % Age-1 survival in-river • % Age-2 survival in-river • % Age-3 survival in-river
ISMP Purpose	Data will be used to update ISMP Steps 1 – 3.

5.4.5 Mature Adults

Data collected by field M&E of hatchery-reared and wild burbot adults will be a critical component to evaluate program success. As discussed in Section 4.4 of the M&E Plan, hatchery-reared burbot are being released at eight different locations across a 130-km segment of the Kootenai River in Idaho and B.C. Currently this includes two tributaries, Boundary Creek and Goat River. Boundary Creek historically supported burbot spawning, and Goat River is believed to be the last spawning habitat for the remnant stock in the Lower Kootenai subbasin.

Table 5-11. Mature adults.

Participating Entities	• IDFG with ID-CFWRU • BC Ministry • Kootenai Tribe
M&E Objectives	• Quantify hatchery-reared, naturally-reared from hatchery origin, and remnant wild stock • Monitor behavior of each possible component • Determine whether donor stock sources support recovery goals • Provide population assessments to determine production goals • Determine if release strategy has been effective • Determine if natural recruitment is occurring • Estimate harvest • Set management regulations
M&E Activities	• Calculate population estimates using mark-recapture data • Population abundance trends and gear efficiency based upon CPUE • Annual survival rates • Spawning / recruitment • Monitor harvest • Using these population parameters, future population trajectories may be constructed which may then guide hatchery production and fisheries management decisions • Behavioral studies that focus on behavioral response to environmental changes, both negative and positive, and habitat selection • The Kootenai River KVRI Burbot Subcommittee and the Burbot Technical Working Group will evaluate re-introduction strategies based on data
Variables	• Abundance • Annual Survival • Growth / condition • Bioenergetics • Density • Behavior – movement and habitat selection • Harvest
Attributes/Parameters Estimated	• % annual survival Ages 4 – 10 • # of adults – river • # of adults - lake • Natural mortality • Fishing mortality • % harvest from Idaho • % harvest from BC (river) • % harvest from BC (lake)
ISMP Purpose	Data will be used to update ISMP Steps 1 – 3.

5.4.6 Spawning/Natural Recruitment

If this program successfully restores natural spawning, but has not rebuilt a sustainable population structure, natural-origin adults may be incorporated into the hatchery broodstock program. If so, Section 4.6 of the M&E Plan (Appendix C) will be updated to identify additional parameters to be estimated, similar to those listed in sections 5.3.1 and 5.3.2 of the M&E Plan (Appendix C). Further, as long as the restored population is comprised of hatchery and natural production, both will be incorporated into the predictive tools. Natural production attributes and parameters will be similar to hatchery parameters, and both components will be analyzed separately and in total to characterize the population.

Table 5-12. Spawning/natural recruitment.

Participating Entities	• IDFG with ID-CFWRU • BC Ministry • Kootenai Tribe
M&E Objectives	• Quantify total spawner abundance • Quantify contribution of hatchery-reared, naturally-reared from hatchery origin, and remnant wild stock to the spawning population • Monitor spawning behavior of each component • Determine number of spawning locations • Determine if natural recruitment occurs to larval and juvenile stages
M&E Activities	• Spawning population estimates based upon mark-recapture data or enumeration by visual counts or at fish weirs • Spawning site and microhabitat selection
Variables	• Annual spawner abundance • Composition of spawning population • Sex ratio • Fecundity and sperm motility • Spawning site selection • Egg fertilization • Egg hatch • Larval survival • Juvenile survival
Attributes/Parameters Estimated	• # of spawners • # of spawning locations • # of spawners per location • Natural egg fertilization • Natural egg hatch • Natural larval survival • Natural juvenile survival • Natural egg abundance • Natural larval abundance • Natural juvenile abundance
ISMP Purpose	Data will be used to update ISMP Steps 1 – 3.

5.4.7 Habitat

Section 8 of the KVRI Burbot Conservation Strategy points out that burbot declines are the result of an extended period of pervasive, large-scale changes in the Kootenai River and Kootenay Lake ecosystems, including the loss of physical habitat, ecological function, primary and secondary system productivity, and nutrient availability, as well as possible contaminant interactions and harvest. The Burbot Conservation Strategy (KVRI 2005) recognizes that addressing habitat needs is critical to burbot restoration. The Tribe's Burbot M&E Plan incorporates a range of projects that are already being conducted by the Tribe to monitor habitat metrics, as listed in Table 5-13, along with links to monitoring methods at www.monitoringmethods.org.

Table 5-13. Habitat.

Metrics	• KTOI - Bank erosion monitoring (ID: 1179) • KTOI - Biological Opinion compliance monitoring (ID: 1217) • KTOI - Browse evaluation (ID: 1184) • KTOI - Cover type mapping (ID: 1182) • KTOI - Disturbance observation monitoring (ID: 1186) • KTOI - Floodplain and channel morphology surveys (ID: 1178) • KTOI - Floodplain herbaceous vegetation composition and cover (ID: 1310) • KTOI - Floodplain substrate survey: volumetric bar samples (ID: 1180) • KTOI - Floodplain woody vegetation composition and percent cover (ID: 1183) • KTOI - Floodplain woody vegetation natural recruitment and regeneration (ID: 1311) • KTOI - Greenline photo monitoring (ID: 1187) • KTOI - Groundwater data collection (ID: 1214) • KTOI - Kootenai River White Sturgeon early life stage study (ID: 1211) • KTOI - Mainstem stage data collection (ID: 1215) • KTOI - Noxious weed mapping (ID: 1185) • KTOI - Percent cover woody vegetation on streambanks (ID: 1312) • KTOI - Side channel fish assemblage and population study (ID: 1212) • KTOI - Structure monitoring (ID: 1181) • KTOI - Substrate survey: underwater videography (ID: 1306) • KTOI - Survival monitoring (ID: 1308) • KTOI - Suspended sediment sampling (ID: 1213) • KTOI - Using fin ray geochemistry to assess historical Kootenai sturgeon life history movements in the Kootenai River (ID: 1218) • KTOI - Pebble counts (ID: 66) • KTOI - Model development and calibration (ID: 1216)

Variables Estimated	None at this time; however, each of the above-listed metrics may directly affect many of the parameters and the associated values, and as relationships become apparent, correlations and predictive models may be used to evaluate key assumptions and Decision Guidelines
ISMP Purpose	None; however, ongoing monitoring and restoration activities will be used to update and evaluate ISMP Steps 1-3.

5.4.8 Existing Monitoring in the Kootenai River

IDFG has been conducting burbot population surveys in the Kootenai River since 1979 (Partridge 1983). Further, the Tribe and IDFG have jointly managed the Kootenai Basin Biological Monitoring and Evaluation Program. Also, there are multiple habitat restoration projects within the project area that are expected to benefit burbot restoration efforts. Previously, IDFG investigated the effects of an altered hydrograph and thermograph on burbot behavior; it is likely this topic will be addressed during restoration of a viable population. Monitoring activities conducted by the Tribe and IDFG (Kootenai River Resident Fish Mitigation, BPA Project 198806500; or KRRFM) are listed, with links connecting to the monitoring methods (www.monitoringmethods.org).

Table 5-14 Existing monitoring in the Kootenai River.

Variables monitored during ecosystem restoration efforts	• KRRFM - Nutrient Dosing BMP (ID: 1103) • KTOI - Benthic Macroinvertebrate Sampling • KTOI - Nutrient Addition of N and P (ID: 1175) • KTOI - Periphyton Accrual and Biomass Sampling (ID: 1107) • KTOI - Periphyton Taxonomic Community/Density Sampling (ID: 1114) • KTOI - Water Chemistry (ID: 1123) • KRRFM- Fish Biomonitoring Data (ID: 1007) • KTOI - Benthic Macroinvertebrate Analysis (ID: 1137) • KTOI - Periphyton Accrual and Biomass Sample Analysis (ID: 1118) • KTOI - Periphyton Taxonomic Community/Density Analysis (ID: 1117) • KTOI - Water Chemistry Analysis (ID: 1136)
Attributes/Parameters Estimated	No specific attributes or parameters have been identified at this time; however, each of the above listed variables will directly affect many of the parameters and the associated values, and as relationships become apparent, correlations and predictive models may be used to evaluate key assumptions and Decision Guidelines.
ISMP Purpose	Data obtained through the habitat studies will not be used directly in the ISMP; however, ongoing monitoring and restoration activities will be used to update and evaluate ISMP Steps 1 – 3.

6 ENVIRONMENTAL COMPLIANCE

Under the Council's Step Review process for aquaculture facilities, project proponents are asked to describe the status of their comprehensive EA. This chapter provides an overview of the most significant environmental compliance steps undertaken during Step 2 of the program.

6.1 National Environmental Policy Act

An EA that assesses the environmental consequences of implementing the Kootenai River Native Fish Conservation Aquaculture Programs is being prepared by BPA to address the requirements of the NEPA. BPA has conducted a public outreach process to assist in identifying key issues to be being addressed in the environmental analysis. The process included a public workshop held in Bonners Ferry on May 30, 2012, which provided an opportunity for stakeholders to discuss the proposed Twin Rivers Hatchery with BPA and Tribal staff. The draft EA is scheduled for distribution in early August 2012. Following a 45-day comment period, BPA expects to issue a final EA in December 2012.

6.2 Endangered Species Act Compliance

The Kootenai Tribe has prepared a Biological Assessment (BA) to address the potential impacts of the proposed programs, including upgrades of the Tribal Sturgeon Hatchery and construction of the Twin Rivers Hatchery, on federally listed aquatic and terrestrial species under the protection of the USFWS. The Tribe has submitted the BA to BPA, which as the federal action agency, is coordinating consultation with the USFWS. The BA was submitted to BPA in July 2012.

6.3 Cultural Resources

Based on a cultural resources investigation of the Twin Rivers Hatchery site completed in 2009 (Dampf 2009), field surveys and shovel probes did not identify archaeological resources that would be eligible for listing in the National Register of Historic Places (NRHP). Design refinements during Step 2 modified the area to be affected by the project, so in June 2012, an additional survey was conducted at Twin Rivers and at the Tribal Sturgeon Hatchery. As with the original survey, no NRHP eligible properties were identified, and no further cultural resources work is recommended for the project (Dampf 2012). The Tribe intends to have a cultural resources monitor on-site during ground-disturbing construction activities. In the event that archaeological deposits are discovered during construction, ground-disturbing activities will be halted immediately, and the project manager will follow standard protocols for notification of appropriate agencies and the Kootenai Tribe.

6.4 Permitting

Developing the proposed aquaculture facilities will require various regulatory approvals from federal and State of Idaho agencies. Consistency of project construction and operation will be demonstrated with Section 401 of the Federal Water Pollution Control Act (Clean Water Act). The authority to review the programs for consistency with Section 401 is the responsibility of the Idaho Department of Environmental Quality. The Environmental Protection Agency (EPA) has determined that aquaculture production levels at Twin Rivers will be below the threshold that would trigger a National Pollution Discharge Elimination System (NPDES) permit for hatchery operation. A stormwater NPDES will be sought for construction activities at Twin Rivers.

Section 404 of the Clean Water Act regulates work in wetlands and waters of the U.S. The Kootenai Tribe performed a wetland delineation in 2011 and will submit a Joint Application for Permit to the U.S. Army Corps of Engineers (USACE), Idaho Department of Water Resources, and Idaho Department of Lands in July, 2012.

The Kootenai Tribe will lead state permitting efforts, which will be based on environmental and engineering analyses of potential project construction and operational effects. Permitting requirements will be verified during Step 2 planning and preliminary design; approvals sought during Step 3, final design. The Tribe has applied for both surface and groundwater rights to meet hatchery operation and residential needs at Twin Rivers. A water right permit was issued on February 8, 2012. In addition, the Tribe will request a stream channel alteration permit for construction affecting the Kootenai and Moyie rivers.

7 ENGINEERING AND DESIGN

7.1 Basis of Design and Design Criteria

This chapter summarizes information about the preliminary designs for the Tribal Sturgeon Hatchery improvements and the proposed Twin Rivers Hatchery. More detailed information about both hatcheries can be found in Appendix D (Basis of Design Report) and in the complete set of design drawings (provided under separate cover).

In addition to describing the base elements of the designs for the Tribal Sturgeon Hatchery and the new Twin Rivers Hatchery, this chapter briefly describes several alternate elements that are under consideration. Decisions about whether to include any or all of the alternate elements in the final design at Step 3 (or at a later date, contingent on program needs and funding) will be based on further analysis of the overall costs and benefits as design efforts proceed. The estimated cost of each of the alternate components is addressed in Chapter 8.

At the Tribal Sturgeon Hatchery, the proposed design calls for constructing an annex to the office building to provide additional living quarters for staff. An alternate component

of the project is a crew quarters building to house temporary staff during peak work periods and provide some extra office space.

At the Twin Rivers Hatchery, alternate elements include outdoor rearing ponds for burbot; adding a roof to the influent water sedimentation structure, adding access ramps to the influent and effluent sediment basins, and installing emergency generator load reduction capability to reduce the electrical loads connected to the generator to the minimum required to keep the hatchery operational.

The Tribe is also considering construction of a small visitor center (with amphitheater) that would be used as a space to provide public interaction, outreach, and education.

7.1.1 Sturgeon

The Kootenai Tribe intends to expand and improve the existing Tribal Sturgeon Hatchery near Bonners Ferry and to develop the new Twin Rivers Hatchery to allow for additional sturgeon production, as well as supporting the new burbot aquaculture program. Spawning and rearing of sturgeon at the Twin Rivers facility will also provide the opportunity to experimentally determine if fish can be induced to migrate into more favorable spawning habitats upstream from Bonners Ferry where they do not currently go. Upstream migration might be enhanced either by imprinting juveniles to water sources higher in the system or attracting adults to chemical cues in the hatchery discharge during ovulation and spawning of broodstock in the hatchery.

7.1.1.1 Overview of Sturgeon Facility Elements

Upgrades to the existing Tribal Sturgeon Hatchery will include the following (see Chapter 7.2 for additional details):

- Adding weather protection and de-icing systems to the sediment pond to allow year-round operation of the sediment pond and drum filter.
- Adding mechanical means to transfer broodstock from the dock in the Kootenai River to holding tanks (large broodstock are currently carried on stretchers up a steep bank to holding tanks several hundred feet away).
- Adding a new spawning room (broodstock holding tanks are currently in a separate building from the spawning room, so adult sturgeon must be moved manually between buildings during spawning activities).
- Developing additional feed, vehicle and boat storage areas.
- Upgrading buildings for safety, efficiency and sanitation.

Construction of new crew quarters is under consideration as an alternate component. This alternate will be considered further during final planning and design steps.

The proposed new facilities at Twin Rivers would include the following components:

- Wells for on source of the hatchery water supply.
- River water intakes, one on the Moyie River and one on the Kootenai River.

- Influent and effluent water settling basins.
- Site utilities including roads, parking lots, piping, sanitary drain field, electrical power, telephone and stormwater drainage.
- Water filtration, heating and cooling capabilities.
- Adult fish holding/spawning: round tanks with adequate cover for adult fish holding/spawning.
- Incubation: Incubator jars for sturgeon eggs mounted over small rectangular start tanks.
- Start tanks: Post-hatch sturgeon move volitionally out of the incubators into the start tanks, where they will be fed and closely monitored for disease as they grow to a size acceptable for transfer out of the start tank room.
- Rearing tanks: Circular tanks (8-foot-diameter) for sturgeon grow-out.
- Administrative and biological support facilities.
- A building for vehicle and boat storage and maintenance.
- Two new staff residences.
- Grading and resurfacing of the existing boat ramp on the Kootenai River, expanding and resurfacing the adjacent parking, and providing a temporary dock at the mouth of the Moyie River.

As mentioned in Chapter 4, the Tribe is considering several alternate components at the Twin Rivers Hatchery. These include:

- Construction of a small visitor center (with amphitheater).
- Outdoor rearing ponds for burbot.
- A roof over the influent water sedimentation structure.
- Constructing access ramps for influent and effluent sedimentation structures.
- Adding emergency generator load reduction capability.

7.1.1.2 Design Guidelines

The preliminary designs for the various upgrades and new facilities are based on the following Tribal design guidelines:

- Locate the expanded Kootenai sturgeon and burbot programs at a shared site to reduce the cost of functional elements such as site utilities, administrative areas and storage areas, and to achieve efficiencies in design, permitting, construction, and operations.
- Provide flexible facilities that accommodate future changes based on aquaculture research, allow for program modification as needed, and provide efficient fish production in support of restoration efforts.

- Improve facilities at the Tribal Sturgeon Hatchery near Bonners Ferry to enhance sanitation, handling and operations.
- Use the Twin Rivers Hatchery to:
  - Maximize program operational flexibility.
  - Expand Kootenai sturgeon conservation aquaculture program rearing capacity.
  - Allow for greater segregation of fish families.
  - Ensure low rearing densities.
  - Accommodate basic aquaculture research needs.

7.1.1.3 Design Biocriteria

Preliminary engineering design of fish culture facilities was preceded by development of bioengineering criteria (biocriteria) for each life stage of each cultured species. Program goals were developed and quantified (where possible) and biological requirements of the species were identified. This process resulted in a systematic quantification of life stage requirements organized by the functional or operational areas within the proposed facility. These functional areas include broodstock collection, brood-holding, egg-take, incubation, juvenile life phases, rearing, release, and disease management.

One of the important benefits of developing biocriteria is that it provides the framework for facility designers to consider a range of potential future operational scenarios. Neither Kootenai sturgeon nor burbot aquaculture protocols are as highly refined as salmonid culture protocols; therefore, planned facilities must be adaptable to the results of monitoring and evaluation. By addressing production uncertainties at this early design stage, considerations are incorporated that will accommodate modifications without significant cost increases or unanticipated space constraints.

The Tribe initiated a collaborative process to develop biocriteria in the early stages of project planning, with participation by hatchery staff, contracted and agency sturgeon biologists, and University of Idaho personnel. Biocriteria were developed for each life stage of sturgeon and burbot and organized by the operational functions within the proposed facility.

Biocriteria for the Tribal Sturgeon Hatchery and Twin Rivers Hatchery are shown in Table 7-1 and Table 7-2, respectively. The tables also present biocriteria for rainbow trout (used for live forage for sturgeon). The biocriteria were used to help identify and design specific elements of the facilities, including size of tanks, number of tanks, necessary flow, and other factors, as shown in tables 7-1 and 7-2. Space requirements and water budgets are also shown in these tables.

Table 7-1. Biocriteria for Kootenai sturgeon production at the Tribal Sturgeon Hatchery.

Aquaculture Function/ Life Stage	Broodstock (holding/collection)	Spawning and Fertilization	Incubation and Hatch	Early Rearing (Larvae onto feed)	Rearing (on feed, up to 4 -5 months)	Rearing (YOY through 18 months)	Release	Forage Fish Rearing
General	Adjacent broodstock holding / spawning areas (improve broodstock transport at boat ramp)	Spawning room with egg de-adhesion and fertilization area	NA	Hatched embryos transferred in water from hatching jars to fry rearing tanks	NA	Rearing space needed (each family is reared in 2 tanks to allow for variable growth)	Separate pre-release data collection and work-up area with data logging	Rainbow trout
Time/Months	February-June (year round if necessary)	May-June	May-July	July-September	September-November	November-November (year round)	October - December	February-June
Water Temp Range (ºC)	8 to 16° C	14 ± 2° C	14 ± 2° C	14 ± 2° C	Ambient river	Ambient river or heated; <16° during summer, ambient fall and winter or heated	Variable	Ambient
Other Water Quality Requirements	Silt and pathogen free river water	Silt and pathogen free (for river water)	Silt and pathogen free river water	Silt and pathogen free	Silt and pathogen free	Silt and pathogen free	Thermal tempering	Silt and pathogen free river water
Densities by Life Stage	< 5 broodstock per tank. 3 tanks w/ 3-4 females ea. 1 tank w/ 4-5 males ea. 2 isolation tanks (most sperm collected in field)	10,000 eggs per family; 20,000 per female	10,000 eggs / jar / family	Result of hatch success per family	2,000 fry / tank	1,000 four month-old fish/tank	NA	NA
Holding/ Production Goals (#) (average)	6 females / 12 males = 12 families	10,000 x 0.9 = 9,000 fertilized eggs per family	9,000 x 0.9 = 8,100 larvae per family	# Beginning = 8,100 # End of stage = 4,050 (per family)	# Beginning = 4,050 # End of stage = 2,025 (per family)	# Beginning = 2,025 # End of stage = 1,000 (per family)	500 - 1,000 fish/family X 12 families/year = 6,000 - 12,000	NA

Aquaculture Function/ Life Stage	Broodstock (holding/collection)	Spawning and Fertilization	Incubation and Hatch	Early Rearing (Larvae onto feed)	Rearing (on feed, up to 4 -5 months)	Rearing (YOY through 18 months)	Release	Forage Fish Rearing
Survival Assumptions by Life Stage (Average %)	99%	90%	90% (Family dependent)	50% (Family dependent)	50%	50%	NA	NA
Holding Unit Size and Description	15' dia. X 3' deep (4000 gal. ea.) 4' side wall	Not applicable to facility design	McDonald jar battery	Rectangular tanks (8'x2'x18" deep)	8' dia x 4' h (1,200 gal)	8' dia. tanks, 1,000 fish per tank	NA	10' dia x 4.5' h
Number of Tanks and Water Exchange/ Flow Rates	6 tanks, 6.6 hour exchange, 10 gpm/ tank-1 empty for ops flex (may expand at Twin)	Not applicable to facility design	24 jars (multiple batches)	24 tanks, R=2, Flow 2 gpm/tank	24 - 8' dia, @ 8 gpm	24 - 8' dia, @ 8 gpm	NA	(3) 10' x 4.5' h tank
Total Flow - GPM	60 gpm	1 gpm	48 gpm	48 gpm	8 gpm /tank (192 gpm total)	8 gpm /tank (192 gpm total)	NA	10 gpm / tank 30 gpm
Water Source	Kootenai River	Kootenai River	Kootenai River	Kootenai River	Kootenai River	Kootenai River	NA	Kootenai River
Water Treatment	Sediment filtration, ozone, UV, water tempering, proper fish densities	Egg disinfection (iodophore)	Sediment filtration, ozone, UV, proper egg densities, incubator flows	Sediment filtration, ozone, UV, proper fish densities	Sediment filtration, ozone, UV, chill, proper fish densities	Filtration, ozone, UV, proper fish densities	NA	Filtration, ozone, UV, proper fish densities

Table 7-2. Biocriteria for Kootenai sturgeon production at the Twin Rivers Hatchery.

Aquaculture Function/ Life Stage	Broodstock (holding/collection)	Spawning and Fertilization	Incubation and Hatch	Early Rearing (Larvae onto feed)	Rearing (on feed, up to 4 months)	Rearing (YOY through 18 months)	Release	Forage Fish Rearing
General	Adjacent broodstock holding spawning areas (improve broodstock transport at boat ramp)	Spawning room with egg de-adhesion and fertilization area	NA	Hatched embryos transferred in water from hatching jars to fry rearing tanks	NA	Rearing space needed (each family is reared in 2 tanks to allow for variable growth)	Separate pre-release data collection and work-up area with data logging	Rainbow trout
Time / Months	February-June	May-June	May-July	July-September	September-November	November-November (year round)	October - November	Year round
Water Temp Range (°C)	8 to 16° C	14 ± 2° C	14 ± 2° C	14 ± 2° C	Ambient river or heated; <16° during summer (chill), ambient fall and winter or heated	Ambient river or heated; <16° during summer (chill), ambient fall and winter or heated	Variable	Groundwater
Other Water Quality Requirements	Silt and pathogen free		Silt and pathogen free	Silt and pathogen free	Silt and pathogen free	Silt and pathogen free	Thermal tempering	Silt and pathogen free
Densities by Life Stage	≤ 5 broodstock per tank. 3 tanks w/ 3-4 females ea. 1 tank w/ 4-5 males ea. 2 isolation tanks (most sperm collected in field)	10,000 eggs per family; 20,000 per female	10,000 eggs / jar / family	Result of hatch success per family	2,000 fry / tank	1,000 four month-old fish/tank	NA	NA
Holding/ Production Goals (#) (average)	9 females / 18 males = 18 families	10,000 x 0.9 = 9,000 fertilized eggs per family	9,000 x 0.9 = 8,100 larvae per family	# Beginning = 8,100 # End of stage = 4,050 (per family)	# Beginning = 4,050 # End of stage = 2,025 (per family)	# Beginning = 2,025 # End of stage = 1,000 (per family)	500 - 1,000 fish/family X 18 families/ year = 9,000 - 18,000	NA

Aquaculture Function/ Life Stage	Broodstock (holding/collection)	Spawning and Fertilization	Incubation and Hatch	Early Rearing (Larvae onto feed)	Rearing (on feed, up to 4 months)	Rearing (YOY through 18 months)	Release	Forage Fish Rearing
Survival Assumptions by Life Stage (Average %)	99%	90%	90% (Family dependent)	50% (Family dependent)	50%	50%	Variable	NA
Holding Unit Size and Description	15' dia. X 3' deep (4,000 gal. ea.)	NA to facility design	McDonald jar battery (3 L volume)	Rectangular tanks (8'x2'x18" deep)	8' dia. x 4.5' h (1800 gal.)	8' dia. x 4.5' h (1800 gal.)	NA	No incubation trays
# Tanks and Water Exchange/ Flow Rates	6 tanks, 6.6 hour exchange- 10 gpm/tank 1 empty for operations flexibility (flexibility to hold males and hold broodstock for extended periods)	NA to facility design	36 jars R=1 / min; 2.5 GPM/ tank	36 tanks, R=2, flow 6 GPM/ tank	36 - 8' dia. 1 to 3 hour exchange, 10 GPM/ tank	36 - 8' dia. 1 to 3 hour exchange, 10 GPM/ tank	NA	(1) 10' dia in Sturgeon side and (1) 10' dia in burbot side
Total Flow - GPM	60 GPM	10 GPM	90 GPM	216 GPM	360 GPM	360 GPM	NA	10 GPM groundwater; 50 GPM surface water
Water Source	All Sources	All Sources	Ground and/or Kootenai River	All sources (priority Kootenai, Moyie)	All sources (priority Kootenai, Moyie)	All sources (priority Kootenai, Moyie)	NA	Groundwater preferred
Water Treatment	Filtration, ozone, UV, proper fish densities, tempering	Egg disinfection (iodophore)	Filtration, ozone, UV, proper egg densities, incubator flows	Filtration, ozone, UV, proper fish densities	Filtration, ozone, UV, proper fish densities	Filtration, ozone, UV, proper fish densities	NA	NA

7.1.2 Burbot

7.1.2.1 Overview of Burbot Facility Elements

The Tribe is proposing to include burbot aquaculture facilities as part of the new Twin Rivers Hatchery. The burbot holding, spawning and rearing tanks would be located in a separate wing of the new hatchery building, segregated from the Kootenai sturgeon wing to minimize potential pathogen transmission. Complete basis of design information is provided in Appendix D and design drawings. Components specific to burbot aquaculture include:

- Adult fish holding/spawning: Round tanks with adequate cover are required to hold adult burbot.
- Incubation: Burbot eggs are incubated in 1-liter Imhoff cones mounted over small circular start tanks.
- Start tanks: Post-hatch burbot volitionally move up through the water column out of the top of the incubators into the start tanks, where they will be fed and closely monitored for disease as they grow to a size acceptable for transfer out of the start tank room. Burbot hatchlings require live feed (rotifers and *Artemia*) that will be raised in an adjacent live feed culture room.
- Rearing tanks: 4-foot-diameter indoor circular tanks and 8-foot troughs will be used for burbot dry diet transition and grow-out.
- Burbot ponds: Six outdoor earthen ponds are planned for experimental larval and extended burbot rearing. Each pond will have a concrete harvest and water level control structure, supply, drain piping and predator barriers.

7.1.2.2 Design Guidelines

The preliminary designs for the new burbot facilities are based on many of the same Tribal guidelines used for sturgeon and listed above in Section 7.1.1.2. These include locating the sturgeon and burbot programs at a shared site to reduce cost and achieve efficiencies, maximizing functional and operational flexibility, and accommodating aquaculture research needs.

Burbot are a challenging species to culture. Researchers have experienced relatively high mortality rates in cultured burbot due to the species' sensitivity to changes in water temperature and chemistry, pathogens, and the live feed requirements in their larval stage (Harzevilli et al. 2003, Jensen et al. 2008b). Design guidelines for the proposed facility were derived primarily from the experimental work performed at the UI-ARI, since very little burbot aquaculture occurs in the U.S. to draw upon for knowledge.

The Tribe, UI-ARI, and BC Ministry have collaborated since 2003 to successfully bring wild burbot into captivity and to develop rearing systems and hatchery methods. During the last 9 years, this work has advanced from an uncultured species to an experimental stage

where feed-trained burbot were released to the Kootenai River in 2009 - 2012 (Jensen et al. 2010b; Young, KTOI, unpublished data). This research provided the foundation for design and refinement of the burbot components of the Twin Rivers Hatchery. The design guidelines specific to burbot, listed below, are based on this recent research.

- Adult gender segregation and hormone analogs used to synchronize and control spawning.
- Development of adult capture and gamete collection techniques, egg fertilization, and transport in the field.
- Optimized egg incubator design.
- Burbot volitionally spawned in tanks.
- Use of defined screening criteria to retain eggs within the adult spawning tanks and embryos in rearing tanks.
- Use of defined protocols to wean larvae from live feed to a commercial diet.
- Defined live feed criteria using brackish rotifers followed by *Artemia.*
- Intensive and semi-intensive rearing methods that keep rearing tanks clean when a commercial diet is introduced in order to increase juvenile survival.

7.1.2.3 Design Biocriteria

The biocriteria for burbot and live feed aquaculture are based on the experimental burbot program at UI-ARI and the Tribe's experience with the aquaculture program at the existing Tribal Sturgeon Hatchery. The collaborative process of developing the burbot biocriteria is the same as described in Section 7.1.1.3 for sturgeon. This process requires facility designers to consider a range of potential future operational scenarios, especially important given the absence of models for burbot aquaculture. Facility planning must be adaptable based on tested procedures and monitoring and evaluation outcomes. By addressing production uncertainties at this early design stage, considerations are proactively incorporated that will accommodate modifications without significant cost increases or space constraints.

Table 7-3 identifies biocriteria for various burbot life stages proposed to be cultured. These criteria were used to develop water budgets and treatment requirements, site and space planning, and the related support facilities proposed for the Twin Rivers Hatchery (described in Section 7.3).

Biocriteria for the fry live feed program are also shown in Table 7-3. Live feed, including rotifer and *Artemia* cultures, is needed to support the early life stages (fry) of burbot until they are mature enough to be transitioned to a commercial dry food diet. Burbot broodstock also require live feed in the form of young rainbow trout.

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Table 7-3. Biocriteria for burbot and live feed.

Aquaculture Function/Life Stage	Broodstock (collection, holding)	Spawning and Fertilization	Incubation and Hatch	Larval Rearing	Fry Rearing (on feed, up to 4 months)	Rearing (YOY) Fingerling	Rearing (juveniles-Age 1+)	Pond	Live Feed*	
									Rotifers for Production	*Artemia* GSL 90+
Time / Months	Collect from donor source, hold 3 to 12 months.	January-March (currently 100% field collection)	January-April	March-June	June-August	August-January	January-December	April-November	March-June	April-July
Water Temp Range (°C)	Year-round range: 2-20˚C	2-4˚C	4-6˚C (below 5˚C for incubation)	6-10˚C (increase to 8 or above for feeding)	10-20˚C	Ambient; but less than 20˚C	Ambient; but less than 20˚C	8-20˚C	18-25˚C	28˚C
Other WQ Requirements	pH 8-8.5, DO ≥ 6 ppm, Buffering capacity @ ARI > 150 ppm CaCO3	As above	As above	2 ppt NaCl	As above	As above	As above	> 6 ppm DO, pH 7-9	pH 7-8 salinity 15 ppt	pH 7-8 5-30 ppt seawater
Densities by Life Stage	Minimize, 15 adults/tank	Minimize, 15 adults/tank	100K-300K per incubator; hatch holding at 1500/L	<1,000/L Recommended	10-250/L	5-10/L	1-10/L	100-1,000/m^2 (older than 45 d on live feed)	Variable	Variable
Production Goals (weight)	0.5-3.0-kg fish should be mature	NA	NA	<0.1 g/fish	0.1-1.5 g/fish	1.5-25 g/fish	25-250 g/fish	TBD	up to 300 mil/day up to 25x/day	up to 100 mil/day up to 5x/day
Average Survival Assumptions by Life Stage	90%	Fertilize eggs within 5 minutes of collection	60 ± 10%	20 ± 5%	25 ± 5%	70 ± 20%	80 - 90%	Dependent on life stage at time of stocking	NA	NA

Aquaculture Function/Life Stage	Broodstock (collection, holding)	Spawning and Fertilization	Incubation and Hatch	Larval Rearing	Fry Rearing (on feed, up to 4 months)	Rearing (YOY) Fingerling	Rearing (juveniles-Age 1+)	Pond	Live Feed*	
									Rotifers for Production	*Artemia* GSL 90+
Average Number of Eggs or Fish	60 males/30 females - (Portion may be field collection of gametes)	200,000 eggs/female x 30 females = 6,000,000 eggs	6,000,000 x 60% = 3,600,000 hatchlings	720,000	180,000	126,000	48,000 (Assuming 50% of 6-mo. juv. stocked and 50% retained to Age-1)	Dependent on no. stocked and life stage at time of stocking	Maintain 1,000-1,500/ml	NA
Holding Unit Size and Description	Fiberglass circular tanks 1800 L (6 ft. dia. X 3 ft. deep)	NA	1-L Imhoff cones or larger (may change in future)	Insulated circular tanks 500 L, low flows required, 400-micron mesh screening required	Insulated circular tanks 500 L, low flows required, 400 micron mesh required	Circular tanks 900 L	Circular tanks 900 L	TBD at time of final design.	400 sq ft.	200 sq ft.
Holding Unit Quantity	(6) 6 ft. dia. x 3 ft. deep, including egg collection provisions (i.e. water level alarm)	NA	60 jars	(30) 3 ft. dia x 2.5 ft. deep	(30) 3 ft. dia x 2.5 ft. deep	(32) 4 ft. dia. x 2.5 ft. deep (tranistion into larger tanks)	(32) 4 ft. dia x 2.5 ft. deep	6 outdoor ponds	At least primary and backup systems	Hatchers and holding tanks
Water Exchange/Flow Rates	R = 1/hr; 10 GPM/tank		500 ml/min. ea. (may increase in future) R = 2 min/L	R = 1 minimum; 0.5-1.0 L/min or ~30-60 L/hr.	R = 2-8 L/min	R =8 L/min (will change to R = 1 or less)	R=1; 900L tanks flow need ~15 L/min	TBD at time of final design.	Access to fresh and saltwater; 200 GPD	Access to fresh and saltwater; 200 GPD
Total Flow - GPM	60 GPM	NA	7 GPM	up to 45 GPM		45-100 GPM	100 GPM	TBD at time of final design.	See above	See above

Aquaculture Function/Life Stage	Broodstock (collection, holding)	Spawning and Fertilization	Incubation and Hatch	Larval Rearing	Fry Rearing (on feed, up to 4 months)	Rearing (YOY) Fingerling	Rearing (juveniles-Age 1+)	Pond	Live Feed*	
									Rotifers for Production	*Artemia* GSL 90+
Water source	Moyie/Kootenai River water	Moyie/Kootenai River water and (Ground Water at time of spawning if volitional spawning in tank used.)	Groundwater	Groundwater	Ambient groundwater, introduce surface water toward end	Ambient river or ground water to Each Tank	Ambient river or ground water to Each Tank	Unfiltered/untreated Kootenai or Moyie River water for filling/ground water for tempering	Groundwater RO, Rearing system recycling 600-800%/d. 5 GPM/ recirc system Acclimating-stagnant-100 L /d Washing-1000 L / d, salt water reservoir up to 1000G	Groundwater RO, Rearing system recycling 600-800%/d. 5 GPM/ recirc system Acclimating-stagnant-100 L /d Washing-1000 L / d, salt water reservoir up to 1000G
Water Treatments	Ambient temps for holding; chill as needed to induce spawning	Filter, iodine disinfect and chill	De-gas, chill, hydrogen peroxide during incubation and hatch	De-gas and chill, possible hydrogen peroxide treatments and salinity for live feed (salinity for larvae stage only)		Blend rw/gw, filter and disinfect	Blend rw/gw, filter, disinfect and heat	alum, aeration	Chill or Heat, oxygen supp. and LP air	Chill or Heat, oxygen supp. and LP air
Other		A portion of gamete collection to occur at Moyie Lake. Proportion will likely vary over time.		Automated feed delivery	Automated feed delivery	Automated feed delivery	Automated feed delivery	Predator netting, shading/greenhouse, otter control	Water storage tank 500-1000 Gal for filtered water plumbed to areas, oversized floor drains, forced air.	Lighting 2000 lux or 200 ft-candles. Photo-period 16 light:8 dark. In room separate from rotifers. Forced air.

*Note: Forage fish tankage and flows are shown under sturgeon water budget

7.2 Tribal Sturgeon Hatchery Modifications

7.2.1 Tribal Sturgeon Hatchery Site Analysis

The existing Tribal Sturgeon Hatchery is located on Tribal lands about 2 miles west of Bonners Ferry. The site is relatively flat bottomland surrounded by agricultural fields that are isolated from the Kootenai River by a 10 to 20-foot-high levee.

Existing facilities include a main hatchery and incubation building, two rearing sheds, an administration building, storage sheds, and water treatment facilities that were constructed between 1990 and 2007. The existing hatchery has a reliable surface water supply and good boat access. As a result of emergency upgrades completed in 2008, the facility also has limited water treatment, tempering, and controls systems in place. The incubation and rearing facilities are in good condition and have many years of service life remaining.

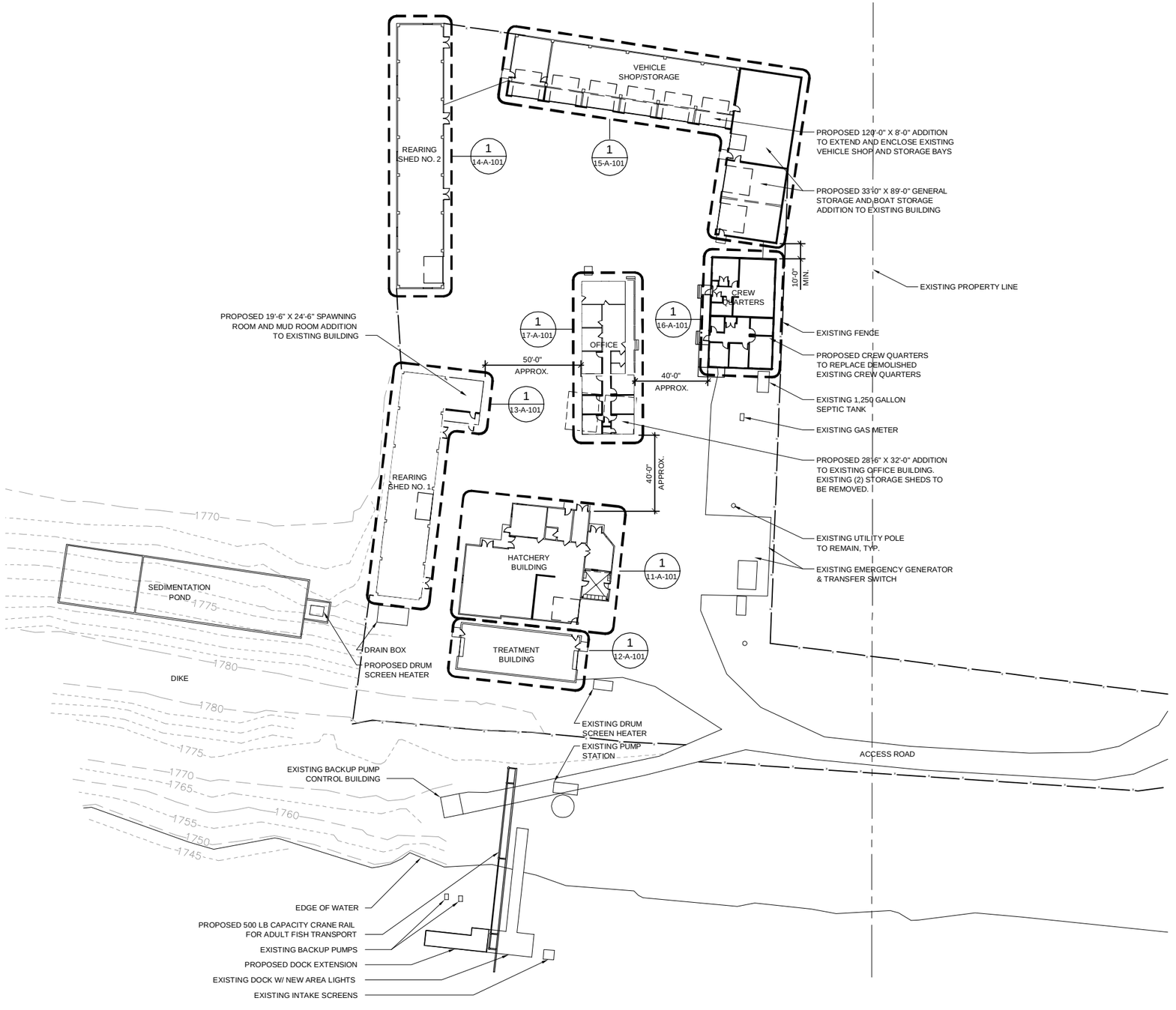
The existing facility has several amenities that make it attractive for continued aquaculture operations; however, it also has two major constraints that prevent it from meeting new program goals as the sole production facility. The first constraint is water supply, the quality of the groundwater supply is poor, and there is limited capability to control water temperature. The second constraint is space, only a small amount of space is available within the existing footprint for additional infrastructure.

7.2.2 Water Supply

The Tribal Sturgeon Hatchery will continue to use treated Kootenai River water for all fish culture activities. Water supply treatment improvements were completed in 2008 that reduce turbidity and improve temperature and pathogen control, although more temperature control is necessary to meet summer and winter rearing temperature requirements. No increase in water supply is proposed at this site.

7.2.3 Proposed Modifications to Existing Tribal Sturgeon Hatchery Facilities

Proposed modifications to the existing Tribal Sturgeon Hatchery are shown in Figure 7-1 and described in the sections below.



1 SITE PLAN
SCALE: 1"=30'

PLAN NORTH

0 15' 30' 60'
SCALE: 9/256" = 1'-0 "

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9 MARCH 2012

MARK	DATE	DESCRIPTION	BY
A	2012-02-24	30% QA SET	
B	2012-03-09	30% SUBMITTAL	

KOOTENAI TRIBE OF IDAHO
BONNERS FERRY, ID

KOOTENAI-STURGEON BURBOT HATCHERY
TRIBAL HATCHERY SITE

SITE PLAN

Project No.:	135-3750004
Designed By:	MMB
Drawn By:	AJD
Checked By:	LFE

FIG 7-1

Bar Measures 1 inch

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7.2.3.1 Adult Handling and Transport

Presently, Kootenai sturgeon broodstock are captured in the Kootenai River and transported by boat to a dock. At the dock, the large fish are placed on a stretcher and manually carried from the boat up a steep ramp and over the levee to the holding tanks several hundred feet away. This method of transport is difficult and dangerous for hatchery staff, as well as being stressful for the fish. The new fish transport system will consist of a crane rail from the existing dock to a landing on the pump building service access road. The crane rail will be supported using the existing piles at the dock, a new pile at the water line, and a new foundation supported column adjacent to the access road. The crane rail will be designed for a 750-pound combined live and dead load. The rail will be electrically operated with a lifting hoist and a cogged rail attached to the support beam. The rail will be controlled with a pendant mounted controller. In addition, the dock will be expanded to provide additional workspace and accommodate docking of additional boats.

7.2.3.2 Adult Holding/Spawning, Rearing Shed 1

The existing broodstock holding tanks are in a separate building from the spawning room; therefore, large adult Kootenai sturgeon must be moved manually between buildings during spawning activities. The Tribe is proposing to add a new spawning room to the existing broodstock holding shed to improve adult fish handling and spawning efficiency. Improvements to this building will also include a fire alarm, lighting efficiency upgrades, insulated doors, wall insulation, cleanable wall panels, natural day-lighting, and upgrades to heating and ventilation systems.

7.2.3.3 Water Treatment Building

The water treatment building will be improved through upgrades to the water temperature systems and the control systems. Improvements to this building will also include a fire alarm, lighting efficiency upgrades, and insulated doors.

7.2.3.4 Sediment Pond Weather Protection

A concrete settling pond and drum screen were constructed at the Tribal Sturgeon Hatchery in 2007 to reduce the sediment load in the hatchery's water supply from the Kootenai River. A cover was subsequently installed, but has not provided adequate protection from ice build-up on the pond surface and the drum screen during extended cold periods. The current design calls for installation of a heater on the drum screen filter to ensure that the sediment pond is operable during cold weather periods. The power source for the heater will be a spare circuit in the treatment building.

7.2.3.5 Vehicle Storage Shed Addition

The existing vehicle storage building is oriented east to west. It is open to the south and provides little protection from weather to the vehicles stored within the building. Upgrades for this building include expanding the building 8 feet to the south, providing

new overhead doors on the south face of this addition, and adding a new storage facility adjacent to the east end of this building. This storage building addition will allow the removal of temporary storage sheds from the site. The existing maintenance bay will be insulated and weather-proofed, and a damaged portion of the concrete floor will be repaired.

Planned utility upgrades include replacing the existing electrical feed from the office service with a new feed from the new housing facility. This will provide a more direct route for the feeder and free some capacity on the existing office service. A new fire alarm system is planned for the vehicle storage and shop facilities.

7.2.3.6 Rearing Shed 2 Improvements

Rearing Shed 2 is a pre-engineered metal building. The sprayed-on insulation system is falling off and could be hazardous to the fish stock. Improvements in this building include phased removal of the existing insulation, installation of new batt insulation with a vapor barrier, the addition of an 8-foot tall fiberglass reinforced plastic wainscot to facilitate cleaning, and installation of translucent clerestories for natural light.

Utility improvements for Rearing Shed 2 will include a new fire alarm system, heating upgrades and ventilation upgrades.

7.2.3.7 Office Addition

The existing office building will be expanded to the south to provide a new conference room and three additional staff offices. These facilities will be ADA accessible. The existing window air conditioning units will be replaced with wall-mounted variable refrigerant flow (VRF) heat pump units to provide primary heating and cooling. The current baseboard heating system will be retained for use as a secondary source of heat. Operable windows will be installed to provide outdoor air in the conference room and offices.

Utility improvements will include a new fire alarm system for the entire office building. Also included will be the replacement of the primary electrical feed.

7.2.3.8 Hatchery Building Improvements

The hatchery building is an older pole building that has been retrofitted for its current use. The facility includes rearing and incubation tanks for sturgeon and a forage tank, an office and storage mezzanine. The interior finish of the tank room exterior walls is comprised of polyisocyanurate panels with taped joints nailed to horizontal wood girts between the primary columns. The proposed improvements include:

- An internal dividing wall between the forage and sturgeon tanks.
- Conversion of an unused and unfinished room into a mudroom.

- Removal of approximately three-fourths of the metal panels on the exterior wall to install polyisocyanurate insulation and a weather barrier, followed by re-installation of the existing metal siding.
- Addition of fiberglass reinforced plastic wainscot on the walls in the tank rooms up to 8 feet above finished floor to improve ease of cleaning the room.

Utility improvements will include selected lighting upgrades for improved efficiency, new exterior doors and keypad entry locks, a new fire alarm system, and upgraded heating and ventilation systems.

7.2.3.9 New Hatchery Housing and Staff Offices

Housing will be constructed for hatchery personnel to ensure that staff is in close proximity at all times during operations. The proposed housing unit consists of a 1-bedroom unit attached to a small office annex. The staff office annex has space for four staff, with a small kitchenette and ADA accessible restroom. The facilities will be ADA accessible. Housing and office spaces will each be provided with an independently metered, gas-fired furnace.

7.3 Twin Rivers Hatchery

7.3.1 Twin Rivers Hatchery Site Analysis

The Kootenai Tribe purchased the Twin Rivers RV Resort in 2008 to construct the proposed Twin Rivers Hatchery. The site is located on a floodplain terrace at the confluence of the Moyie and Kootenai rivers, about 10 miles east of Bonners Ferry and about 15 miles upstream of the Tribal Sturgeon Hatchery. Much of the site is currently maintained as lawn, with a scattering of large conifers and cottonwoods. An unpaved single-lane road traversing the steep slope that borders the east side of the site provides access from State Route 2.

This site is suitable for the proposed sturgeon and burbot hatchery because of available high quality, pathogen-free water sources from groundwater and surface water from both the Moyie and Kootenai rivers. The site also has sufficient space to accommodate the proposed facilities without the need for extensive earth work, and low bank shoreline access on two rivers. In developing site concepts for the proposed hatchery buildings, support facilities, staff housing and access roads, the Tribe emphasized the following design criteria:

- Existing resort operations should be preserved to the greatest degree possible without compromising aquaculture functions.
- All new facilities should be well above flood elevation (approximately elevation 1,786 feet) to prevent water damage and allow gravity drainage of hatchery tanks and ponds.
- Mature trees are to be retained to the greatest degree possible.

- Available groundwater should be used to provide pathogen-free water.
- Hatchery facilities must be secure, with controlled public access and enforced security measures.
- Sturgeon culture facilities must be relatively isolated from burbot culture facilities to minimize pathogen vectors.
- Operator housing should be available on site or nearby.

Based on these criteria, the new hatchery facilities (Figure 7-2) would be located primarily in open areas of the site that are currently occupied by lawn, approximately 3 to 5 feet above flood elevation. Building and rearing pond locations have been laid out to minimize the removal of trees, maintain as many campsites as possible, and preserve access to the river and fishing/swimming pond for resort guests.

7.3.2 Water Budget and Supply

Water supply for the Kootenai sturgeon program at the Twin Rivers Hatchery will be shared with the burbot program, as described in Section 7.1.2.4. A combination of water sources (tempered and ambient river water) will be used for the different aquaculture activities. Total flow rates for sturgeon, burbot, and forage feed production range from about 170 gallons per minute (gpm) during winter (December and January) up to nearly 1,250 gpm during June. The water treatment systems will include a heat exchanger and pumping system to optimize energy usage associated with heating and chilling.

An existing 60-gpm potable water well at the Twin Rivers site was tested in 2008 and found to be pathogen-free and suitable for aquaculture (results are presented in Appendix C of the Master Plan). Based on this information, two additional wells were drilled near the proposed hatchery facilities to provide water for hatchery operations. Testing indicates these wells will produce approximately 400 gpm for hatchery operations.

River water to be used in the proposed Twin Rivers Hatchery will come from both the Moyie River and Kootenai River. The Moyie typically does not experience the high turbidity events seen in the Kootenai because fine sediments are trapped and settled in the reservoir behind Moyie Dam, located about a mile upstream from the Twin Rivers property.

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B	2012-03-09	30% SUBMITTAL	

KOOTENAI TRIBE OF IDAHO
MOYIE SPRINGS, ID

KOOTENAI-STURGEON BURBOT HATCHERY
TWIN RIVERS HATCHERY SITE

AQUACULTURE FACILITIES PROPOSED AT TWIN RIVERS

Project No.:	135-3750004
Designed By:	-
Drawn By:	EGN
Checked By:	SLK

FIG 7-2

Bar Measures 1 inch

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7.3.3 Twin Rivers Hatchery Sturgeon Facilities

7.3.3.1 Building Design Criteria and Space Planning

Hatchery production and support spaces will be constructed of cost effective, durable materials designed for the anticipated climate and industrial conditions of aquaculture operations. All buildings will be designed to comply with the current standard building codes. Table 7-5 identifies the preliminary square footage estimated for each major element to be included in the Twin Rivers Hatchery building. The Tribe will conduct an internal value engineering process at the start of the final design process to identify functional alternatives in each operational area that would reduce the size of the building as much as possible.

Table 7-5. Twin Rivers Hatchery space requirements [1]

Building Component	Space Required
Administration and Shared Space	
Private Office	129 SF
3 Staff Offices (open office)	370 SF
Conference Room	305 SF
Men's Restroom & Showers	228 SF
Women's Restroom & Showers	228 SF
Lockers	182 SF
Mud Room/Janitor Closet/Vestibules	590 SF
Misc. Storage	30 SF
Dry Work Room	238 SF
Wet Lab	1,540 SF
Subtotal	3,840 SF
Sturgeon	
Sturgeon Rearing	5,400 SF
Sturgeon Incubation	2,511 SF
Sturgeon Broodstock	3,050 SF
Sturgeon Forage	203 SF
Sturgeon Work Area	502 SF
Sturgeon Dry Storage	356 SF
Clean Room	180 SF
Subtotal	12,202 SF
Services	
Water Treatment	616 SF
Chemical Storage	100 SF
Boiler	336 SF
Chiller	553 SF

Building Component	Space Required
Sand Filtration	760 SF
Shop	605 SF
Electrical Room	386 SF
Communications Room	72 SF
Mechanical Room	955 SF
Stair	110
Heat Exchange	539
Subtotal	5,032 SF
Circulation (all)	2,323 SF
Building Total (w/o Burbot Space)	24,123 SF (gross)
Outdoor Facilities	
Generator	400 SF
Chiller	400 SF
Water Treatment Sediment Pond	8,000 SF
Effluent Treatment	1,000 SF
Burbot Ponds (alternate component)	21,000 SF
Subtotal	30,800 SF

1 Space requirements for burbot are listed in Table 7-6.

Two primary buildings are proposed at the hatchery site to support ongoing hatchery operations. The hatchery building will house administrative functions and facilities to accommodate visitors and meetings, as well as operations and maintenance functions and crew facilities. The vehicle storage building will house vehicles and boats. One bay of this building will be heated and ventilated to accommodate light duty vehicle maintenance.

The hatchery building will be a single story 33,360-square-foot structure located north of the primary entrance and offices. Road access will be controlled by the location of the campground office, and the fenced and gated enclosure around the hatchery grounds will control unescorted pedestrian access. The site area south of the building will be developed for employee and visitor parking.

The vehicle storage building will be a single story 7,260-square-foot structure that will house boats and vehicles used by hatchery staff. It will consist of eleven 33- by 20-foot bays, with one bay enclosed, insulated and heated for use as a minor vehicle repair shop.

7.3.3.2 River Intakes

Intake structures are proposed on both the Kootenai and Moyie rivers to supply aquaculture operations at Twin Rivers. Based on biocriteria developed for Twin Rivers Hatchery, the anticipated flow rate through the hatchery during full production periods will be approximately 1,300 cubic feet per second (cfs). Intake screens, pumps, valves,

and pipelines will be designed to supply 1,500 cfs to the hatchery. Each of the intakes will have two complete and separate systems to provide a backup in the event one of the systems requires maintenance work.

Design of the intake structures for both the Moyie and Kootenai River intakes will meet all current state and federal design criteria for intake screens. Design criteria for the intake screens include:

- Approach Velocity: Less than 0.4 feet per second
- Screen Material: Corrosion resistant and durable stainless steel
- Opening Size: 3/32-inch circular holes or 3/32-inch diagonal for square holes or 1/16-inch slots
- Open Area: Minimum open area of screen material equals 27%
- Screen Type: Actively cleaned screen since design flow greater than 3 cfs
- Cleaning Frequency: Every 5 minutes during high debris periods.

Juvenile fish must be able to swim away from the intake screen face when it is located in the river or inside a pump station. At the Kootenai River intake, the screen will be anchored in the active river channel, which will allow the fish to swim away from the screen in any direction. At the Moyie River intake, an overflow bypass pipe and open channel will provide a return route back to the river.

At the Kootenai River intake, the river channel is about 200 feet wide and fairly uniform in cross-section. Layout of the Kootenai River intake structure includes a concrete base with two cone screens and a pipeline to the pump station. In this section of the Kootenai River, the north bank of the channel has a very gradual slope forcing the intake structure base and screens to be located approximately 80 feet from the water's edge at low flow. This distance is needed to locate the intake in at least 4 feet of water depth to maintain at least 18 inches of water above the top of the cone screen.

Two cone screens will be provided, each capable of providing the design flow rate of 3.3 cubic feet per second (cfs). The screens, which are 5.5-feet in diameter and 2 feet high, will have 50% open area (1/16th-inch wedge-wire with 1/16th-inch spaces). Approach velocity at the design flow rate is 0.12 feet per second (ft/sec) with a slot velocity of 0.246 ft/sec. The Tribe anticipates that both screens will be in service during operation, thereby reducing these velocities by half.

At the Moyie River intake, the river channel is located at the base of a bedrock outcrop with a deep scour hole located at the toe of the bedrock and a hydraulic control downstream to maintain the water surface elevation. Layout of the Moyie River intake structure includes an intake vault and trash rack, a gravity pipeline, and a combined pump station and intake screen.

Dimensions of the concrete vault will be 13 feet long by 6 feet wide by 11 feet high and will be positioned with the top at or near the 10-year average flood flow water level. The top of vault has grated openings for access into the intake vault for maintenance activities. On the river side of the vault, a trash rack will be installed to keep rocks and large wood material from entering the intake structure.

A 20-inch diameter HDPE pipeline will convey flow from the concrete vault to the pump station. Estimated water velocities in the HDPE pipeline at the design flow rate is approximately 1.5 ft/sec.

Two cone screens will be installed within the pump station, each capable of providing the design flow rate of 3.3 cfs. The design for the Moyie intake cone screens will be the same as the design for the Kootenai intake cone screens. In addition, a bypass weir and pipeline will allow any fish that enter the pump station to return to the Moyie River by gravity flow.

7.3.3.3 Groundwater

Groundwater will be used in the hatchery to provide a pathogen-free supply for incubation, make-up water for the live feed program, and for temperature control of river water at certain times of the year. Groundwater demand will range seasonally from 15 to 250 gpm. Two new on-site wells have been installed to provide a sustained 400 gpm of groundwater to the hatchery. An existing well will continue to be used to supply potable water to the RV Resort.

Groundwater pipelines are sized to maintain water velocities less than 5 fps at peak flows. Pipe material is proposed to be PVC pressure pipe per ASTM C900 DR 25. The main supply pipeline from the well head to the hatchery building is sized at a nominal 6-inch diameter with water velocities estimated to be 3.2 fps at 300 gpm.

7.3.3.4 Influent Water Supply and Treatment

River water pumped from the Kootenai River and Moyie River intakes will first be routed through sediment ponds to remove solids that can be settled out. After initial settling, particulates in the river water will be removed using a drum filter. Booster pumps will then be used to convey the water into the hatchery building where it will be further treated with sand filters and then disinfected with UV units.

Disinfected water will be routed either directly to the hatchery headbox for use as ambient water or to heat exchangers to adjust the water temperature. All water supplies will be gas-stabilized at the head box prior to use in the hatchery.

Removal of the sand and silt in the river water that passes through the intake screens will be completed using an influent sedimentation tank. The sedimentation tank will be divided into two separate settling bays, each 30 feet wide, 120 feet long, and an average depth of 5.1 feet (the floor slopes 1.5% to the downstream end). Having two separate sedimentation bays will allow one bay to be cleaned while the other bay remains in

service. At the design flow rate of 1,500 gpm, a single bay will provide approximately 1.5 hours of detention time.

Alternate components of project design involve installing a roof on the structure to provide shade, maintain cool water temperatures, and prevent algae growth; and constructing a ramp to provide access into and out of the sediment tank for cleaning. The ramp would be cast-in-place concrete, 10 feet wide, with slopes of 15% to 20% to accommodate a small front-end loader tractor.

Two stainless steel drum filters will be installed to remove the remaining suspended sediment in the flow from the influent sedimentation tank. The filter panels are constructed using a polyester fabric on a polyethylene grid for removal of the smaller particles from the water column. At this time, it is anticipated that the filters for the Twin Rivers hatchery will be rated for the removal of 30-micron material.

Booster pumps will supply the hatchery with filtered river water at sufficient pressure to allow further treatment of the water (sand filtration, UV disinfection, heating/cooling, etc.) prior to use.

Process water cooling and heating systems have been designed to raise or lower temperatures of groundwater or river water for optimum sturgeon and burbot incubation and rearing. Cooling is accomplished with a closed loop chiller system that uses chillers, pumps and piping to circulate mechanically chilled glycol-water solution through separate heat exchangers for the cooling of groundwater and river water. Heating is accomplished with a closed loop hot water system that uses boilers, pumps and piping to circulate treated hot boiler water through separate heat exchangers for the heating of groundwater and river water.

7.3.3.5 Sturgeon Incubation and Hatch Room

Sturgeon embryos will be incubated in upwelling flow-through jars mounted on fiberglass rearing troughs. Upon hatching, free embryos will follow the flow up and out of the jar and into the trough where they will remain through their early rearing period. Following hatch, free embryos and subsequent life stages will be exposed to Kootenai River water to imprint them to natal water chemistry for future reproductive homing purposes.

The 36 start tanks for free embryo and larval rearing will be 2 feet by 8 feet and 1.5 feet deep. The tanks will be mounted in pairs with access for feeding, cleaning and inspection from only one side. The downstream end of the start tanks will have a short screened-off portion to contain the fish in the tanks. An outlet from each tank will be used to transfer the fish to rearing tanks or to a truck for transport elsewhere. While in the start tanks, larvae will be fed by hand.

7.3.3.6 Sturgeon Rearing

Sturgeon larvae will be transferred from the start tanks to one of 36 8-foot-diameter round tanks for the next phase of rearing. Floor trenches with drain piping will be spaced

regularly in the concrete slab of this room. Ambient river water typically will be used to supply these tanks, though some provision for tempered water will be included. Baffles and substrate may be included in each tank to mimic natural flow patterns and habitat.

7.3.3.7 Forage Fish Facilities

Rainbow trout will be incubated and reared at the Tribal Sturgeon Hatchery for use as feed for the Kootenai sturgeon and burbot production programs. Rainbow trout will be delivered to the site as fingerlings and reared on site to the proper size for feeding.

7.3.3.8 Biological Laboratory

A small laboratory will be located in the Twin Rivers Hatchery office area. The laboratory area will provide space to store chemicals and equipment needed to perform various biological and chemical analyses. This area will also facilitate the efficient processing, shipping, and receiving of live feed, water quality and fish health diagnostic samples, and any observational fish health diagnostics as needed. Limited space for small laboratory equipment will also be provided in the burbot spawning area.

7.3.3.9 Effluent Treatment Facilities

Treatment of hatchery effluent will be an important water quality protection measure for both the Kootenai and Moyie rivers. The primary pollutant targeted in fish hatchery effluent is total suspended solids, which is made up of fish feces and uneaten feed.

All effluent from the hatchery, as well as the discharge of the burbot pond drainage pump station and the backwash flow from the drum filters will be routed to the effluent sedimentation tank. The effluent sedimentation tank will be divided into two separate settling bays, each 19 feet 6 inches wide, 40 feet long, with an average depth of 5.2 feet (the floor slopes 1.5% to the downstream end). Having two separate sedimentation bays will allow one bay to be cleaned while the other bay remains in service. At the design flow rate of 1,500 gpm a single bay will provide approximately 0.35 hours of detention time. If both bays are in service, the detention time will be 0.7 hours.

Like the influent sediment tank described above, an access ramp is also being considered as an alternate project component for the effluent treatment facilities. The access ramps would be 10 feet wide and slope at 15% to 20% to allow small front-end loading equipment to access the tank for cleaning.

An 18-inch diameter HDPE pipeline will be attached to the outlet channel of the effluent sedimentation tank and combine with the 18-inch diameter HDPE overflow line from the influent sedimentation tank. From this junction near the northwest corner of the effluent sedimentation tank, the combined 18-inch diameter HDPE effluent pipeline will then be routed at a moderate slope (0.74 %) to an outfall location along the Moyie River, a distance of approximately 540 feet from the effluent sedimentation tank.

7.3.5 Twin Rivers Hatchery Burbot Facilities

Construction of the proposed Twin Rivers Hatchery structures (buildings, water supply network, wastewater treatment, and utilities) will support both burbot and sturgeon aquaculture operations. Of the total 33,360 square feet of indoor space included in the main hatchery building, 8,142 square feet will be dedicated to the burbot program (Table 7-6).

The Tribe is considering six outdoor burbot ponds as alternate design features that may be constructed in the future. These features would occupy an additional 21,000 square feet. Although not shown in Table 7-6, these ponds are described below, along with other hatchery features needed specifically for burbot.

Table 7-6. Spatial requirements for the burbot program.

Building Component	Space Required
Burbot Broodstock/Spawning	1,050 SF
Burbot Incubation	1,890 SF
Burbot Rearing (Indoors)	2,436 SF
Burbot Forage	313 SF
Burbot Spawning	237 SF
Cryo/Disinfect/Necropsy/Lab	446 SF
Dry Food	313 SF
Burbot Live Feed/Feed Preparation	550 SF
Burbot Mechanical/Electrical	199 SF
Circulation	234 SF
Burbot Subtotal (net)	**7,688 SF**
Burbot Subtotal (gross)	**8,142 SF**

7.3.5.1 Water Supply

A special requirement of burbot is their need for very cold water (in the range of 2-4° C) during late winter or early spring egg take, fertilization, incubation, and hatch. Also, as mentioned above, burbot larvae require a live diet. Facilities to supply and treat water used in burbot aquaculture will be the same as those described for Kootenai sturgeon in Section 7.2.2.

7.3.5.2 Burbot Broodstock Holding Tanks

Burbot broodstock will be held in six 10-foot-diameter, 3-foot-deep round tanks supplied with ambient river water.

7.3.5.3 Spawning and Egg-Take Facilities

The Twin Rivers Hatchery will include burbot spawning and egg-take areas. Spawning tables and sinks will be located in the same room as the burbot broodstock holding tanks.

7.3.5.4 Incubation and Rearing Facilities

Burbot incubation will occupy a separate room in the burbot portion of the hatchery building. Burbot eggs will be incubated in Imhoff cones mounted over 3-foot-diameter fiberglass round tanks or troughs that will collect the young as they hatch. The grated floor decking in the incubation area will cover below-grade trenches designed to accommodate different types of tanks, depending on fish culture needs.

Burbot will be reared (to release or ponding size) indoors, in tanks located in the burbot portion of the hatchery building. The proposed design calls for 32 4-foot-diameter fiberglass tanks.

The incubation room is slightly oversized In order to maximize potential production capabilities and provide for future program flexibility.

The Tribe Initially proposed six outdoor earthen ponds for experimental larval or extended burbot rearing, but at the current time, the ponds are considered as alternate elements of the hatchery design. The decision to include the ponds in the final hatchery design (Step 3) will be made based on additional analysis of space, water supply capacity, and cost. If constructed, each pond would have a water surface area of approximately 1,100 square feet, and would be protected with predator fencing, netting, and/or shade cloth. Construction of all six ponds would occupy a total area of about 21,000 square feet.

7.3.5.5 Live Feed

Larval burbot from about age 10 to 50 days post-hatch will be fed *Artemia* and rotifers that will be cultured on site in an approximately 600-square-foot area. *Artemia* will be reared in artificial seawater (without flow-through) in small vats or cones. Temperature-controlled recirculating water systems on 30-inch-diameter tanks will be used for rotifer production, with a master culture maintained in a 20-gallon aquarium. Well water treated with a reverse osmosis filter will be used for make-up water to the live feed area. A small amount of freezer storage space is needed for the rotifer feed and cold cyst storage of *Artemia*. Special lighting and low-pressure air systems will also be included in the live feed area.

7.3.4 Twin Rivers Hatchery Infrastructure

Infrastructure components at the Twin Rivers Hatchery will support both the proposed sturgeon and burbot programs. These include access roads, utilities (power, water, sewer, and telephone), an administration building, staff housing, storage buildings, and a combined vehicle storage building and shop.

7.3.4.1 Access Roads

The 2-mile access road from State Route 2 to the Twin Rivers Hatchery site appears adequate to accommodate the types of vehicles that will be used in hatchery construction and operation. Roads and parking areas in the immediate vicinity of the

hatchery will be paved to reduce airborne dust and prevent dirt from being tracked into buildings.

7.3.4.2 Potable Water

An existing well currently meets the potable water requirements for RV Resort administration, management, and visitor use. A connection to one of the two new wells recently drilled for hatchery production will be added to the final design (Step 3). This connection will provide a back-up water supply for hatchery and resort use.

7.3.4.3 Power

The site is presently served with single-phase power by Northern Lights Power. Three-phase power is available near State Route 2 and would require a 1.5-mile overhead power line upgrade.

For the new hatchery facility, 3-phase power service will be required for the hatchery building and Moyie River intake. Due to the distance between the hatchery building and Kootenai River intake, a separate 3-phase power service will be installed to the Kootenai River intake site. In addition to the 3-phase service installation, new utility transformers will also have to be installed.

Emergency power diesel generators will be installed at both the hatchery building and Kootenai River intake sites to keep the hatchery operational during power outages. Each generator will be located adjacent to the hatchery building or Kootenai intake in its own weatherproof, sound-attenuated enclosure. The fuel tank will be located beneath the generator and will have dual-wall construction with leak detection. The tank will be large enough to carry the expected load for 3 days.

An alternate component of the project is to implement emergency generator load reduction. This alternative would reduce the electrical loads on the generator to the minimum required to keep the hatchery functioning.

7.3.4.4 Telephone Service

Telephone service to the site is currently provided by Frontier Communication (formerly GTE). During construction, conduits will be installed to provide telephone services for all of the new facilities. Recent communication with Frontier Communications revealed that high speed internet service is available at the hatchery site. Telephone and data outlets will be provided in each office and laboratory space.

7.3.4.5 Sanitary Sewer

The Kootenai Tribe intends to retain most of the existing resort facilities (most campsites, RV sites, water faucets, electrical outlets and sanitary sewer) and will continue to manage the resort for recreation. New hatchery facilities will require the expansion of on-site wastewater treatment or the installation of a separate system. Sewage requirements from the hatchery are expected to be relatively low due to the

small number of plumbing fixtures. Incorporating the new staff residences into the new wastewater treatment system will require the installation of one or more septic tanks and drain fields.

7.3.4.6 Irrigation System

Temporary automated irrigation systems will be used to establish landscape plantings for the first year or two after construction. No permanent irrigation systems are planned.

7.3.4.7 Drainage

Best management practices will be incorporated in the design of stormwater systems for the new facilities. The general approach will be to sheet flow run-off from paved areas into vegetated swales or filter strips to remove pollutants prior to discharge or infiltration. Water from roof drains can be infiltrated or captured for irrigation use.

7.3.4.8 Administration Building

The main hatchery building will include open office space for three full-time staff and a private office for the hatchery manager. A conference room will be provided for staff and other hatchery meetings. Crew accommodations will include a pair of restrooms with showers and lockers, a wet gear disinfection room, and a storage area.

7.3.4.9 Storage, Garage and Shop Facilities

The primary feed storage area will be located in the main hatchery building to accommodate pallets of bagged food. Sturgeon broodstock and various life stages of burbot are sustained with live feed or forage fish. Juvenile sturgeon and trout (to be used as live feed) require pelletized food that will be stockpiled in the dry feed storage area.

The hatchery building will also contain areas for water treatment, a boiler for heating water, a chiller for cooling water, and other mechanical equipment. It will also provide an area to be divided into a carpentry shop, a welding shop, and dry storage.

A garage will provide secure parking for vehicles and space for maintenance and repair.

7.3.4.10 Staff Housing

Two houses will be built adjacent to the Twin Rivers Hatchery site for full time employees to be present year-round.

8 SUMMARY OF ESTIMATED COSTS AND HISTORY OF EXPENDITURES

This chapter presents a summary of the estimated project costs, explains the basis for their development, and describes how they have been refined during the planning and design process. A tabular summary of project costs is provided in Section 8.1.2. Updates to the cost estimates for land acquisition, facility planning and design, construction, acquisition of capital equipment and environmental compliance are presented for the proposed hatchery facilities in sections 8.2 through 8.6. Updates to operations and maintenance and monitoring and evaluation are discussed in sections 8.7 and 8.8. Section 8.9 presents a 10-year summary of all costs projected from FY 2012 through FY 2022.

8.1 Basis of Cost Estimates

Project costs discussed below are based on the proposed programs and preliminary designs presented in chapters 2 and 7. Consistent with the Council's requirements for Step 2 (NPCC 2006), they reflect the best estimates of costs by hatchery function, covering the preliminary phase of the project. Cost estimates provided in each functional area are qualified with appropriate assumptions.

The approach used to estimate future costs for construction, capital equipment, operations and maintenance, and M&E from Step 1 through this Step 2 submittal have generally followed the principals for inflation and cost escalation described by the Independent Economic Analysis Board (IEAB) in their white paper on Project Cost Escalation Standards (NPCC 2007).

The design and associated cost estimates for the proposed facilities and operations incorporate best management practices for culture of sturgeon and burbot. Due to the experimental nature of some aspects of the proposed programs, preliminary designs for facilities and infrastructure were approached in a manner that accommodates cost effective operational flexibility in each functional area (i.e., egg take, incubation, rearing, and release). This approach will allow the Tribe to adapt the facilities to future changes based on new information obtained through experimental work and/or M&E.

Cost estimates are provided for all program areas from FY 2012 through FY 2022. Cost estimates for operations, maintenance and M&E are escalated at 3% annually from FY 2012 through FY 2022. Although these types of costs tend to be more stable historically, the estimates may be high or low in any given year depending on the state of the economy. The costs shown were reasonable at the time this document was developed.

Construction costs can fluctuate significantly from year to year, as shown in the Engineering News Record Construction Cost Index (http://enr.com), which has recorded costs since 1913. The fluctuation range of average construction costs from 1997 through 2012 has been between -0.1% and +9.1%. Currently, construction costs are escalated to a new start of mid-2013, based on completing construction in 2014 (see section 8.4).

8.1.1 Cost Sharing with Other Organizations and Entities

Cost sharing will be an important aspect of funding the proposed programs. Preliminary costs take into consideration the extensive amount of cost sharing that is part of the current program and that is expected to continue in the future.

Many of the cost shares identified for the Tribe's aquaculture conservation program are associated with M&E. Cost sharing includes both direct funding and in-kind support. Table 8-1 shows the types and amounts of cost sharing between the Tribe and entities such as BC Ministry, FFSBC, University of California at Davis, the University of Idaho, the USFWS Dworshak Fish Health Center, and the Bureau of Indian Affairs (BIA). A significant cost sharing source related to capital funding is a grant of $190,000 received by the Tribe from the BIA for improvements to the Tribal Sturgeon Hatchery.

In-kind contributions are not shown as direct deductions from the budgets presented in this document, but were considered when developing annual operations and monitoring and evaluation cost estimates. The BIA grant is shown as a direct deduction from estimated construction costs for Tribal Sturgeon Hatchery (Table 8-3).

Table 8-1. Summary of cost sharing for Kootenai aquaculture programs.

Funding Source or Organization	Item or Service Provided	Cash or In-kind Contribution	Status	FY 2010 Estimated Value	FY 2012 Estimated Value
BC Ministry	Kootenay River and Lake Management	In-Kind	Confirmed	$61,800	$60,000
Freshwater Fish Society of British Columbia	Fish culture services	In-Kind	Confirmed	$72,100	$92,000
University of California, Davis	Information transfer about sturgeon culture issues	In-Kind	Confirmed	$5,150	$5,150
University of Idaho, Moscow	Research support and oversight for White Sturgeon Iridovirus and Burbot Culture	In-Kind	Under review	$27,038	$26,250
USFWS Dworshak Fish Health Center	Disease testing	In-Kind	Confirmed	$10,300	$10,300
Bureau of Indian Affairs	Grant for construction of facilities	Cash	Confirmed	NA	$190,000
			Totals	**$176,388**	**$383,700**

- **Notes and Assumptions:**
- Figures provided are consistent with the FY 2011 and FY 2012 Kootenai Proposal
- Estimates are provided in 2012 dollars
- Estimated cost share support is accounted for in program areas presented

8.1.2 Program Areas and Major Milestones

Completing the Council's Step Project Review process often requires 3 to 5 years. This process requires considerable effort in planning, design, environmental compliance and analysis of alternatives. A generalized list of program areas and a preliminary timeline linking costs to planning, construction, capital equipment, environmental compliance, operations and maintenance, and M&E for FY 2009 through FY 2022 is presented in Figure 8-1. A cost summary by program area is shown in Table 8-2. Cost estimates for each program area are presented in the year in which they are expected to occur and are shown in Table 8-10; costs are escalated from FY 2010. Though the requirement for the Council's review process is to provide cost estimates for 10 years, we are providing the costs back to 2009 to reflect the planning and land acquisition expenditures that occurred during Step 1.

Figure 8-1. General timeline for key milestones and expenditures, Kootenai aquaculture programs.

Program Area	Occurrence	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022
Planning and Design Step 1	One Time														
Planning and Design Step 2 (and Environmental Compliance)	One Time														
Planning and Design Step 3 (Final Design)	One Time														
Construction	One Time														
Capital Equipment	One Time														
Land Purchases, Leases and Easements	One Time														
Annual Operations and Maintenance	Annual	EXISTING OPERATIONS						EXPANDED OPERATIONS							
Monitoring and Evaluation	Annual	EXISTING M&E							EXISTING AND POTENTIAL EXPANDED M&E PROGRAMS						

Notes and Assumptions:

- Assumes an efficient design / build or other similar contracting and construction approach going into Step 3
- Assumes construction starting as early as possible in spring of 2013 (about an 18 month schedule, dependent on spring 2013 start)
- Assumes no environmental compliance issues are identified beyond what is described in the Chapter 6
- Expanded O&M expenditures will likely start during the last phases of construction allowing for training and handoff of new facilities and equipment to Kootenai Tribal Staff
- Expanded M&E expenditures will likely start after the last phases of construction are complete

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Table 8-2. Summary of key expenditures by program area, Kootenai aquaculture programs.

Program Area	Estimated Cost	Occurrence	Level of Certainty
Planning and Design Step 1*	$590,000	One Time	Estimated budget from Project budget 198806400 (Step 1 development)
Planning and Design Step 2**	$1,626,387	One Time	Estimated budget from Project budget 198806400 (Step 2 development started in 2011)
Planning and Design Step 3***	$1,357,631	One Time	Estimated budget from Project budget 198806400 (Step 3 development will be started in 2012)
Construction (Base Components)	$15,320,280	One Time	Preliminary (+/- 35% to 50%) (escalated to 2013 dollars)
Construction (Base and Alternate Components)	$16,630,933	One Time	Preliminary (+/- 35% to 50%) (escalated to 2013 dollars)
Capital Equipment	$565,466	One Time	Preliminary (+/- 25 %) (escalated to 2013 dollars)
Environmental Compliance Step 2 (Permitting, EA, Other)	$176,483	One Time	Preliminary (+/- 25%), completed during Step 2 (2012 dollars)
Land Purchases, Leases and Easements****	$1,200,000	One Time, Annual	Twin Rivers
Annual Operations and Maintenance / Future Tribal Sturgeon Hatchery Program*****	$1,050,900	Annual	Refined Preliminary (+/- 25%) estimated cost once new Twin Rivers Program is implemented (2014 dollars)
Annual Operations and Maintenance / Proposed Twin Rivers Program*****	$1,236,592	Annual	Refined Preliminary (+/- 25%) estimated cost once new Twin Rivers Program is implemented (2014 dollars)
Monitoring and Evaluation*****	$812,988	Annual	Refined Preliminary (+/- 25%) estimated cost once new Twin Rivers Program is implemented (2015 dollars)

Notes and Assumptions:

- * Shows estimated expenditure for FY 2007, 2008, 2009, 2010 (this is an estimated figure from the total project budget for Project 198806400)
- **Shows estimated expenditure from FY 2010 - FY 2012 (this is an estimated figure from the total project budget for Project 198806400)
- ***Shows estimated expenditure from a projected FY 2012 and FY 2013 budget (this is an estimated figure from the total project budget for Project 198806400)
- **** Land purchases, leases and easements
- *****Annual O&M and M&E costs are based on efficiencies from implementing the new Twin Rivers programs
- Budget figures assume that work would proceed on the timeline shown in Figure 8-1

8.2 Land Acquisition, Purchases, Leases and Easements

The Kootenai Tribe purchased property at the confluence of the Kootenai and Moyie rivers in late 2008 and currently holds title to it. A portion of this site will be used for the proposed Twin Rivers Hatchery. The approximate purchase price for this land was $1.2 million.

8.3 Facility Planning and Design

The Kootenai Tribe solicited input from a range of experts during Step 2 preliminary design in order to avoid significant changes in final design and planning during Step 3, and as a means of promoting consistency and continuity through the planning process. The Tribe also sought to validate the program, design criteria, and cost estimates to the maximum extent possible through comprehensive early reviews (see section 4.1). The Tribe intends to continue to solicit input and review by a team of knowledgeable individuals throughout the Step 3 process.

8.3.1 Updates Since Step 1 Conceptual Planning and Design

The total budget for the conceptual planning and design work was about $590,000 (Table 8-2). This figure includes conceptual planning, engineering, development of the Step 1 Master Plan, and responses to the ISRP review of the Master Plan.

8.3.2 Step 2 Preliminary Planning and Design

The preliminary planning and design stage, intended to meet the Council's Step 2 requirements, is designed to identify any major difficulties or concerns with the program and facility designs. Step 2 design work should provide sufficient detail and specifics to assure that the intent and scope of Step 1 conceptual design work can be met and to further refine the cost estimates. Step 2 includes refinement of scientific information, environmental compliance and ESA reviews.

With the participation of a knowledgeable team, the Kootenai Tribe implemented an internal value analysis process (also known as value engineering) during the development of Step 2 planning and design presented in this document (see Section 4.1). Information generated during the value engineering analysis will be used to complete the Step 3 final design process.

An estimated $1.6 million was expended to complete Step 2 preliminary planning, environmental compliance, site investigations and engineering design (Table 8-2). Initiation of this work started in FY 2010. This budget included costs for drilling test wells, surveying, and other investigative geotechnical work.

8.3.3 Step 3 Final Planning and Design

Refinement of the estimated planning and design costs to complete Step 3 occurred as part of Step 2. The Step 3 final planning and design stage is estimated at $1.36 million (Table 8-2).

Step 3 planning work will begin in August of 2012 pending approval from the Council to proceed.

The cost estimates provided for planning and design assume that facilities for both the sturgeon and burbot programs will be developed on the timeline shown in Figure 8-1. Should the project be delayed and/or phased over a number of years, costs for planning and design will likely increase.

8.4 Construction

The cost estimates provided are actual construction cost estimates and can be considered as preliminary estimates for this project. The current estimate for capital construction is based on the descriptions of facilities and infrastructure provided in Chapter 7, and the assumption that the work to upgrade the Tribal Sturgeon Hatchery and construct the new Twin Rivers Hatchery will be completed as a single project, rather than taking a phased approach.

8.4.1 Tribal Sturgeon Hatchery

The Tribal Sturgeon Hatchery was originally built in 1991 to conduct experimental programs for Kootenai sturgeon. Facilities to expand operations have been added over time and the hatchery currently includes a main hatchery and incubation building, two rearing sheds, an administration building, storage sheds, and water treatment facilities. Chapters 2, 4 and 7 describe the need for and preliminary design of the facility upgrades proposed here. Proposed modifications (Section 7.2) will allow safer and more efficient handling of Kootenai sturgeon. In addition, improvements include hatchery building remodel and improvements, increased and improved equipment and vehicle storage, office building addition and general site access and improvements. The planned work also addresses increased water quality and temperature control functions, additional feed storage, improvements to support rearing isolation and disease control, replacement of existing rearing tanks as well as acquisition of new tanks, new water pump, fire protection/alarm system, lighting and insulation upgrades, and improved ventilation.

Construction at the existing Tribal Sturgeon Hatchery site will be confined to upgrading the existing facilities as summarized above. Table 8-3 presents an overview of the costs associated with these modifications. The estimated construction budget for this work is $1.1 million (FY 2013 dollars). This includes the construction of a spawning room. The cost share from BIA of $190,000 will cover this portion of the construction and is reflected in Table 8-3, bringing the revised estimated construction cost to $905,000. These estimates are based on the preliminary design presented in this Step 2 document. A 15% contingency has been built into overall costs to accommodate the level of uncertainty associated with preliminary design.

Table 8-3. Summary of estimated construction costs, base components, Tribal Sturgeon Hatchery.

DESCRIPTION	TOTAL
Critical Upgrades	
Hatchery Building Remodel	$153,900
*Spawning and Mud Room Addition / Remodel	$160,200
Rearing shed No. 2 Remodel	$69,600
Vehicle Shop and Storage Building Addition	$233,400
Office Building Addition	$146,700
Site Work Improvements	$188,800
Construction Cost Subtotal	$952,600
Contingency (15%)	$142,890
Total Estimated Cost	$1,095,490
*Matching Funding BIA Grant	($190,000)
Total Funding Required	**$905,490**

Notes and Assumptions:

- Estimates include contractor overhead, taxes and an escalation figure of 1.5% assuming a mid-point construction date of August 2013
- * BIA Grant provided for Spawning and Mud Room Addition / Remodel

An alternate component of the project is a crew quarters building to house temporary staff during peak work periods and provide extra office space. The estimated construction cost for this component is shown in Table 8-4. As with the main construction budget, a 15% contingency is applied and costs are escalated to a mid-point of 2013.

Table 8-4. Summary of estimated construction costs, alternate components, Tribal Sturgeon Hatchery.

DESCRIPTION	TOTAL
Crew Quarters Building	$220,043
Construction Cost Subtotal	$220,043
Contingency (15%)	$33,006
Total Estimated Cost	**$253,049**

Notes and Assumptions:

- Estimates include contractor overhead, taxes and an escalation figure of 1.5% assuming a mid-point construction date of August 2013

8.4.2 Twin Rivers Hatchery

The Tribe is seeking to maximize efficiencies by combining the Kootenai sturgeon and burbot aquaculture facilities at the new Twin Rivers Hatchery. However, differences in spawning timing and water temperature requirements and best management practices for disease

control require isolation of the two species, and thus, some separate hatchery components. Table 8-5 summarizes probable costs for each component of the proposed Twin Rivers Hatchery.

The estimated construction budget for the Twin Rivers Hatchery (without alternate components) is $14.4 million. These estimated costs do not include land purchase or lease, as the Kootenai Tribe is using land purchased in 2008 for this new facility. As with the Tribal Sturgeon Hatchery, these estimates are based on the current preliminary design and include a contingency of 15% to accommodate the level of uncertainty at this stage. Costs are escalated to a mid- point of 2013, at which time the Tribe is proposing to initiate construction.

Table 8-5. Summary of estimated construction costs, Twin Rivers Hatchery.

DESCRIPTION	TOTAL
Critical Upgrades	
New Hatchery Building	$6,224,200
Vehicle Storage and Shop Building	$602,100
Crew Quarters with Garage (two required)	$471,200
Sedimentation Basin and Building	$1,636,100
Kootenai Intake and Pump Station	$704,600
Redundant Chiller	$100,000
Effluent Sedimentation Basin	$307,200
Boat Ramp Improvements	$279,700
Moyie Intake Pump Station	$567,100
Site Work Improvements	$1,642,400
Construction Cost Subtotal	$12,534,600
Contingency (15%)	$1,880,190
Total Estimated Cost	**$14,414,790**

Notes and Assumptions:

- Estimates include contractor overhead, taxes and an escalation figure of 1.5% assuming a mid-point construction date of August 2013

As with the Tribal Sturgeon Hatchery improvements, some hatchery components are identified as alternates. These components may be built at the beginning of the project or in subsequent years contingent on funding. For the purposes of developing Step 2 cost estimate, these components are being included for the preliminary through final design stages. As described in Chapter 7, these components include:

- Outdoor rearing ponds for burbot
- Visitor center with amphitheater
- Roof on influent water sedimentation structure
- Access ramps for influent and effluent sediment basins
- Emergency generator load reduction

Table 8-6 shows an estimated cost of $1.05 million for these components.

Table 8-6. Summary of estimated construction costs, alternate components, Twin Rivers Hatchery.

DESCRIPTION	TOTAL
Hatchery Components (Burbot Ponds -6)	$385,600
Construction Cost Subtotal	$385,600
Contingency (15%)	$57,840
Subtotal	$443,440
Visitor Center With Amphitheater	$210,400
Construction Cost Subtotal	$210,400
Contingency (15%)	$31,560
Subtotal	$241,960
Roof on Sedimentation Structure	$210,555
Construction Cost Subtotal	$210,555
Contingency (15%)	$31,583
Subtotal	$242,138
Access Ramps for Sediment Basins	$83,100
Construction Cost Subtotal	$83,100
Contingency (15%)	$12,465
Total Estimated Cost	$95,565
Emergency Generator Load Reduction	$30,000
Construction Cost Subtotal	$30,000
Contingency (15%)	$4,500
Subtotal	$34,500
Total Estimated Cost	**$1,057,603**

Notes and Assumptions:

- Estimates include contractor overhead, taxes and an escalation figure of 1.5% assuming a mid-point construction date of August 2013

8.4.3 Summary of Probable Construction Costs

Table 8-7 summarizes the estimated Step 2 construction costs for both primary and alternate components for the Tribal Sturgeon Hatchery and the Twin Rivers Hatchery. The total construction cost for the Twin Rivers Hatchery is presented with and without the alternate components to allow for comparison; however, the Kootenai Tribe considers these alternate components to be important to the success of the program. The total estimated cost without alternate components is $15.3 million and with alternate components is $16.6 million.

Several cost reduction measures are being considered and will be addressed in the Step 3 planning and design process. These measures, which include modifying the hatchery building configuration and boat ramp design, could reduce overall costs by $500,000 to $800,000.

Table 8-7. Summary of total estimated construction costs for Tribal Sturgeon and Twin Rivers hatcheries.

AREA	ESTIMATE
Twin Rivers Hatchery Site	
Primary Construction Contract	$14,414,790
Burbot Ponds (alternate component)	$443,440
Visitor Center With Amphitheater (alternate component)	$241,960
Roof on Influent Sedimentation Structure (alternate component)	$242,138
Access Ramps for Influent and Effluent Sediment Basins (alternate component)	$95,565
Emergency Generator Load Reduction (alternate component)	$34,500
Tribal Sturgeon Hatchery Site	
Critical Upgrades	$905,490
Crew Quarters Building (alternate component)	$253,049
Total Tribal Sturgeon Hatchery and Twin Rivers (without alternate components)	$15,320,280
Total Tribal Sturgeon Hatchery and Twin Rivers (with alternate components)	**$16,630,933**

Notes and Assumptions:

- Estimates include contractor overhead, taxes and an escalation figure of 1.5% assuming a mid-point construction date of August 2013

8.5 Capital Equipment

Both the Tribal Sturgeon Hatchery and Twin Rivers Hatchery will require acquisition of new equipment. The new Twin Rivers Hatchery will require investment in various types of equipment, from office furniture and laboratory equipment to water systems. Less capital equipment will be needed for the Tribal Sturgeon Hatchery, since the design calls for upgrading the existing facility rather than completely new construction. At Step 1, capital equipment was estimated to be $549,000 in 2012 dollars. This figure is still considered to be reasonable and is escalated to $565,000 in FY 2013 dollars. Other than escalation at 3% annually to the year costs would likely occur, there are no identified increases since Step 1. Table 8-8 lists the potential types of equipment needed and their probable costs. In some cases, equipment can be shared by the two facilities, resulting in overall cost savings.

8.6 Environmental Compliance Costs

Both the Kootenai sturgeon and burbot programs have incurred costs for environmental compliance. Kootenai sturgeon are listed as endangered under the ESA; burbot were proposed for listing in 2000 but are not currently listed. Sturgeon are also listed as endangered under the Canadian Species at Risk Act. The programs and facilities proposed in the Master Plan and this Step 2 document will need to comply with the ESA, NEPA, Sections 404/10 of the Clean Water Act and other laws and regulations, as discussed in Chapter 6.

Table 8-8. Capital equipment costs by facility / hatchery functional area, Tribal Sturgeon and Twin Rivers hatcheries.

DESCRIPTION	TOTAL COST (FY 2012 Dollars)	TOTAL COST (FY 2013Dollars)	COMMENTS
Office Equipment	$5,200	$5,356	Office / administrative at Twin Rivers
Computers / Printers	$12,600	$12,978	Office / administrative at Twin Rivers
Office Furniture and Cabinets	$18,200	$18,746	Office / administrative at Twin Rivers
Communications Equipment	$17,228	$17,745	Twin Rivers
Housing Equipment and Furniture / Permanent Staff Housing	$7,000	$7,210	Two houses / Twin Rivers
Housing Equipment and Furniture / Temporary Staff Housing	$0	$0	N.A. at this time
Shop Equipment	$18,968	$19,537	Twin Rivers
Buildings / Facilities Needs	$5,000	$5,150	Twin Rivers
Transportation	$0	$0	Assume use of leased pick-up trucks
Water System Operation	$10,000	$10,300	Misc. equipment Twin Rivers
Brood Collection / Hatchery and Remote	$101,000	$104,030	Shared Equipment / Tribal Sturgeon Hatchery and Twin Rivers (boats)
Eggtake	$5,000	$5,150	Shared Equipment / Tribal Sturgeon Hatchery and Twin Rivers
Incubation	$12,200	$12,566	Shared Equipment / Tribal Sturgeon Hatchery and Twin Rivers
Fish Transport	$120,500	$124,115	Shared Equipment / Tribal Sturgeon Hatchery and Twin Rivers (Transport trucks and equipment)
Rearing at Hatchery	$11,700	$12,051	Twin Rivers
Rearing at Remote Ponds	$16,200	$16,686	Remote Rearing Burbot or Sturgeon
Tagging	$9,800	$10,094	Placeholders for pit tagging detectors
M&E Equipment	$16,100	$16,583	Shared Equipment / Tribal Sturgeon Hatchery and Twin Rivers
Technical / Lab Equipment	$11,200	$11,536	Twin Rivers
Disinfection Equipment (Other Disease and Pathology Needs)	$12,600	$12,978	Twin Rivers
Other	$138,500	$142,655	Twin Rivers (on-site utility equipment, snow removal, front loader, ATV, other
Totals	$548,996	$565,466	

Notes and Assumptions:

- Costs shown in 2013 dollars
- Expenditures will occur in FY 2013 and potentially FY 2014
- Costs should be considered preliminary (+/- 25%)
- Items are not duplicated in the capital construction and operating budgets

Table 8-9 presents a comparison of Step 1 estimated costs of $164,000 (2011 dollars) and Step 2 (escalated at 3% to 2012 dollars) for permits and other environmental compliance activities identified in Chapter 6. At Step 2, costs to meet all requirements are estimated to be approximately $176,000.

Table 8-9. Estimated cost of environmental compliance, Kootenai aquaculture programs.

Project Area / Permit / Requirement	Estimated Cost to Complete (2011 dollars)	Estimated Cost to Complete / Step 2 (2012 dollars)
Water Supply / Quality		
NPDES Discharge (EPA / IDEQ)	$5,941	$6,119
Water Quality Certification for Aquaculture (EPA)	$7,638	$7,868
NPDES General Construction Stormwater (EPA)	$4,244	$4,371
Storm Water Pollution Prevention Plan (SWPPP)	$4,244	$4,371
Surface Water Right (Dept. of Water Resources)	$11,246	$11,583
Groundwater Right (Dept. of Water Resources	$2,758	$2,841
In-stream Work		
Corps Section 404 / 10	$19,096	$19,669
In-stream Alteration Permit (ID Dept. Water Resources)	$7,638	$7,868
Navigational Encroachment Permit (ID Dept. of Lands)	$5,198	$5,354
Flood Zone District Approval – Boundary County	$3,607	$3,715
Planning Approvals		
Fugitive Dust Control / Idaho DEQ	$0	$0
Boundary County Special Use Permit	$3,819	$0
NEPA EA and Record of Decision	$74,263	$81,491
USFWS Concurrence or Biological Opinion	$7,214	$9,431
Section 106 Clearance	$0	$3,934
Construction		
Boundary County Commercial Building Permits	$4,244	$4,371
Boundary County Road and Bridge Permits	$3,395	$3,497
Totals	**$164,546**	**$176,483**

Notes and Assumptions

- Costs escalated at 3%
- Expenditures are occurring in 2012 through 2014
- Costs should be considered preliminary (+/- 25%)
- Items are not duplicated in the capital construction and operating budgets

8.7 Operation and Maintenance Costs

8.7.1 Annual Operating Costs

Annual operating costs for the Tribal Sturgeon Hatchery and Twin Rivers Hatchery are shown in Table 8-10 and 8-11, respectively. Expenses include such items as payroll, utilities, vehicles, supplies, maintenance, and subcontracted support services.

At Step 1, the Tribe estimated that the annual budget for operations and maintenance for the existing Tribal Sturgeon Hatchery would be $990,000 annually (2012 dollars) with consideration of sharing resources with the proposed Twin Rivers program. This estimate was escalated from 2012 to 2014 dollars (when Twin Rivers operations will start), showing about $1.05 million annually (Table 8-10). Note the estimated annual cost of $1.42 million (2012 dollars) shown in Table 8-10, without consideration of sharing resources with Twin Rivers O&M. Significant O&M efficiencies will be gained by sharing personnel and services between the Tribal Sturgeon Hatchery and Twin Rivers Hatchery. As noted in Step 1 sharing of equipment and staff is expected to reduce the annual operating cost by approximately 30% from the estimated cost of operating the facilities as separate entities.

At Step 1, the Tribe estimated that the annual budget for O&M for the Twin Rivers Hatchery would be $980,000 annually (2012 dollars) with consideration of sharing resources with the existing Tribal Sturgeon Hatchery (Table 8-11). This estimate was escalated from 2012 to 2014 dollars, showing about $1.24 million annually in FY2014 dollars (Table 8-11). Based on the estimates for the Tribal Sturgeon Hatchery (Table 8-10), the Tribe expects that operating the Twin Rivers Hatchery in isolation, i.e., not sharing staff and facilities, could increase costs by about 30%.

Table 8-10. Annual operating expenses, Tribal Sturgeon Hatchery.

Expense Area	Estimated Operations Cost Tribal Sturgeon Hatchery (without Twin Rivers) (2012 dollars)	Estimated Operations Cost Tribal Sturgeon Hatchery (with Twin Rivers) (2012 dollars)	Estimated Operations Cost Tribal Sturgeon Hatchery (with Twin Rivers) (2014 dollars)
Payroll / Fringe	$393,665	$401,950	$426,429
Indirect	$232,263	$237,150	$251,593
Travel Costs (Mileage, Lodging, Per Diem)	$15,605	$10,927	$11,593
Professional Services	$8,086	$4,371	$4,637
Vehicles, Boats, Equipment, Transportation (Fuel, Oil, Maintenance, Mileage)	$26,335	$24,005	$25,467
Program Supplies (Office)	$3,976	$3,278	$3,478
Program Supplies (Fish Food, Aquaculture & Facility Chemicals, Hatchery Supplies)	$71,793	$21,308	$22,606
Equipment & Building Maintenance	$220,718	$43,709	$46,371
Utilities (Electrical, Telephone, Natural Gas, Water), Insurance	$68,581	$57,915	$61,442
Subcontracted Services	$379,196	$185,960	$197,285
Totals	**$1,420,218**	**$990,574**	**$1,050,900**

Notes and Assumptions:

- Costs for 2012 are shown without and with consideration of sharing resources with the proposed Twin Rivers Hatchery
- Costs are escalated from 2012 to 2014 dollars at 3% annually
- Estimated costs for existing operations program do not include M&E costs
- Estimated costs assume both Tribal Sturgeon Hatchery and planned Twin Rivers programs are operating in 2014
- Subcontracted services include; gamete preservation, aquaculture techniques, data analysis and statistics, and public relations

Table 8-11. Annual operating expenses, Twin Rivers Hatchery.

Expense Area	Estimated Annual Operating Expenses (with Existing Tribal Sturgeon Hatchery 2012 dollars)	Estimated Annual Operating Expenses (with Existing Tribal Sturgeon Hatchery 2014 dollars)
Payroll / Fringe	$401,950	$426,429
Indirect	$237,150	$251,593
Travel Costs (Mileage, Lodging, Per Diem)	$9,835	$10,433
Professional Services (Data Base, Information System)	$4,371	$4,637
Vehicles, Boats, Equipment, Transportation (Fuel, Oil, Maintenance, Mileage)	$24,005	$25,467
Program Supplies (Office)	$3,278	$3,478
Program Supplies (Fish Food, Aquaculture & Facility Chemicals, Hatchery Supplies)	$21,308	$22,606
Equipment & Building Maintenance	$43,709	$46,371
Utilities (Electrical, Telephone, Natural Gas, Water), Insurance	$48,080	$51,008
Subcontracted Services	$185,960	$197,285
Totals	**$979,647**	**$1,236,592**

Notes and Assumptions:

- Estimated costs assume both Tribal Sturgeon Hatchery and planned Twin Rivers programs are operating in 2014
- Estimated costs for existing operations program do not include M&E costs
- Costs are escalated from 2012 to 2014 dollars at 3% annually
- Subcontracted services include; gamete preservation, aquaculture techniques, data analysis and statistics, and public relations

8.7.2 Projected 10-Year Operating Expenses

Operating expenses from 2012 to 2022 are shown in Table 8-12 (escalated at 3% annually in all expense areas). The estimated costs of existing operations at the Tribal Sturgeon Hatchery (Table 8-10) are shown from FY 2012 through FY 2013. The combined costs of operating both Tribal Sturgeon Hatchery and Twin Rivers Hatchery programs are shown starting in FY 2014. As noted in section 8.7.1, costs to operate the Tribal Sturgeon Hatchery could drop as much as 30% if equipment, staff, facilities, and support services are shared between the two hatcheries.

Table 8-12. Ten year projection of annual operating expenses, Tribal Sturgeon and Twin Rivers hatcheries.

EXPENSE AREA	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022
	Tribal Sturgeon Hatchery / Existing	*Tribal Sturgeon Hatchery / Existing*	*Tribal Sturgeon Hatchery and Twin Rivers*	*Tribal Sturgeon Hatchery and Twin Rivers*	*Tribal Sturgeon Hatchery and Twin Rivers*	*Tribal Sturgeon Hatchery and Twin Rivers*	*Tribal Sturgeon Hatchery and Twin Rivers*	*Tribal Sturgeon Hatchery and Twin Rivers*	*Tribal Sturgeon Hatchery and Twin Rivers*	*Tribal Sturgeon Hatchery and Twin Rivers*	*Tribal Sturgeon Hatchery and Twin Rivers*
Payroll / Fringe	$393,665	$405,475	$852,857	$878,443	$904,796	$931,940	$959,898	$988,695	$1,018,356	$1,048,907	$1,080,374
Indirect	$232,263	$239,230	$503,186	$518,281	$533,830	$549,845	$566,340	$583,330	$600,830	$618,855	$637,421
Travel Costs (Mileage, Lodging, Per Diem)	$15,605	$16,073	$22,026	$22,687	$23,368	$24,069	$24,791	$25,534	$26,300	$27,089	$27,902
Professional Services (Data Base, Information System)	$8,086	$8,329	$9,274	$9,552	$9,839	$10,134	$10,438	$10,751	$11,074	$11,406	$11,748
Vehicles, Boats, Equipment, Transportation (Fuel, Oil, Maintenance, Mileage)	$26,335	$27,125	$50,934	$52,462	$54,036	$55,657	$57,327	$59,046	$60,818	$62,642	$64,521
Program Supplies (Office)	$3,976	$4,096	$6,956	$7,164	$7,379	$7,601	$7,829	$8,063	$8,305	$8,555	$8,811
Program Supplies (Fish Food, Aquaculture & Facility Chemicals, Hatchery Supplies)	$71,793	$73,947	$45,212	$46,568	$47,965	$49,404	$50,886	$52,413	$53,985	$55,605	$57,273
Equipment & Building Maintenance	$220,718	$227,339	$92,742	$95,524	$98,390	$101,342	$104,382	$107,513	$110,739	$114,061	$117,483
Utilities (Electrical, Telephone, Natural Gas, Water), Insurance	*$68,581*	$70,638	$112,450	$115,823	$119,298	$122,877	$126,563	$130,360	$134,271	$138,299	$142,448
Subcontracted Services	$379,196	$390,572	$394,571	$406,408	$418,600	$431,158	$444,093	$457,416	$471,138	$485,272	$499,831
Totals	**$1,420,218**	**$1,462,825**	**$2,090,207**	**$2,152,913**	**$2,217,500**	**$2,284,025**	**$2,352,546**	**$2,423,123**	**$2,495,816**	**$2,570,691**	**$2,647,811**

Notes and Assumptions:

- Estimated costs are escalated at 3% annually in all operational areas
- Cost of existing operations (Tribal Sturgeon Hatchery) shown from FY 2012 through FY 2013 (See Tables 8-9 and 8-10)
- Combined costs of operating both Tribal Sturgeon Hatchery and Twin Rivers programs shown starting in FY 2014

8.8 Monitoring and Evaluation Costs

This section provides estimated preliminary costs for M&E activities associated with the combined aquaculture conservation programs and associated program elements.

8.8.1 Annual Monitoring and Evaluation Costs

The costs associated with M&E are summarized in Table 8-13. At Step 1 the Tribe estimated that the annual budget for M&E activities would be about $702,000 annually (2010 dollars, not shown). Estimated expenses for FY 2012 (Step 2), which are currently being incurred, are about $745,000. These expenses are not expected to increase with the addition of the Twin Rivers Hatchery facility. As shown in Table 8-13, costs would be $813,000 if these current costs were escalated at 3% to FY 2015, when Twin Rivers' production may be in full operation.

The majority of the current costs are for subcontracted services, which include genetics monitoring, contaminants analysis, gamete preservation, burbot aquaculture techniques, data analysis, and associated statistical analysis. Subcontracted services costs comprise about 70% of the budget. In summary, cost estimates have not been increased at this time except by escalation.

Table 8-13. Annual monitoring and evaluation expenses, Kootenai aquaculture programs.

EXPENSE AREA	Estimated Annual Expenses (2012 dollars)	Estimated Annual Expenses (2015 dollars)
Payroll / Fringe	$140,173	$153,041
Indirect	$82,702	$90,294
Travel Costs (Mileage, Lodging, Per Diem)	$6,283	$6,860
Professional Services (Data Base, Information System)	$5,027	$5,488
Vehicles, Boats, Equipment, Transportation (Fuel, Oil, Maintenance, Mileage)	$4,222	$4,610
Program Supplies (Office)	$1,257	$1,372
Program Supplies (Field, Other)	$10,053	$10,976
Equipment & Building Maintenance	$0	$0
Utilities (Electrical, Telephone, Natural Gas, Water), Insurance (allocated to M&E)	$7,540	$8,232
Subcontracted Services	$487,375	$532,116
Totals	**$744,631**	**$812,988**

Notes and Assumptions:

- Estimates shown in 2012 dollars
- Subcontracted services include genetics monitoring, contaminants analysis, gamete preservation, Burbot aquaculture techniques, data analysis and statistics

8.8.2 Projected 10-Year Monitoring and Evaluation Costs

Estimated monitoring and evaluation expenses for all Kootenai aquaculture programs are shown from 2012 to 2022 in Table 8-14. As discussed in section 8.8.1 above, M&E costs are not expected to increase after the Twin Rivers facility comes on line in FY 2014. Cost estimates for O&M and M&E are escalated at 3% annually from FY 2012 through FY 2022.

Table 8-14. Ten-year projection of monitoring and evaluation expenses, Kootenai aquaculture programs.

EXPENSE AREA	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022
Payroll / Fringe	$140,173	$144,378	$148,709	$153,171	$157,766	$162,499	$167,374	$172,395	$177,567	$182,894	$188,380
Indirect	$82,702	$85,183	$87,738	$90,371	$93,082	$95,874	$98,750	$101,713	$104,764	$107,907	$111,144
Travel Costs (Mileage, Lodging, Per Diem)	$6,283	$6,472	$6,666	$6,866	$7,072	$7,284	$7,502	$7,728	$7,959	$8,198	$8,444
Professional Services (Data Base, Information Systems)	$5,027	$5,177	$5,333	$5,493	$5,657	$5,827	$6,002	$6,182	$6,367	$6,559	$6,755
Vehicles, Boats, Equipment, Transportation (Fuel, Oil, Maintenance, Mileage)	$4,222	$4,349	$4,479	$4,614	$4,752	$4,895	$5,042	$5,193	$5,349	$5,509	$5,674
Program Supplies (Office)	$1,257	$1,294	$1,333	$1,373	$1,414	$1,457	$1,500	$1,546	$1,592	$1,640	$1,689
Program Supplies (Field, Other)	$10,053	$10,355	$10,665	$10,985	$11,315	$11,654	$12,004	$12,364	$12,735	$13,117	$13,511
Equipment & Building Maintenance	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Utilities (Electrical, Telephone, Natural Gas, Water), Insurance (allocated to M&E)	$7,540	$7,766	$7,999	$8,239	$8,486	$8,741	$9,003	$9,273	$9,551	$9,838	$10,133
Subcontracted Services	$487,375	$501,996	$517,056	$532,568	$548,545	$565,001	$581,951	$599,410	$617,392	$635,914	$654,991
Totals	**$744,631**	**$766,970**	**$789,979**	**$813,679**	**$838,089**	**$863,232**	**$889,129**	**$915,802**	**$943,276**	**$971,575**	**$1,000,722**

- **Notes and Assumptions:**
- Estimated costs are escalated at 3% annually in all expense areas
- Assume M&E expenses do not increase with the addition of Twin Rivers in 2014

8.9 Summary of 10-Year Cost Estimates

Estimated 10-year costs to operate the conservation aquaculture programs at the Tribal Sturgeon Hatchery and Twin Rivers Hatchery from FY 2010 through FY 2020 are presented in Table 8-15. All estimated costs are allocated to the fiscal year in which the expense will likely occur (section 8.1.2). This estimated cost summary assumes that remaining planning and implementation of new facilities for both the burbot and sturgeon programs would occur in 2012 through 2014. Note that the FY 2010 through FY 2020 out-years are shown to reflect a history of expenditures rather than just reflecting the current FY 2012.

As previously noted, consistent with Step 2 of the Council's Three-Step Process, cost estimates at this stage are preliminary. The Kootenai Tribe will refine these estimates during the Step 3 planning phase. This 10-year estimated cost summary is designed to be a planning tool and will be updated as costs are refined.

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Table 8-15. Ten year summary of future costs, FY 2012 – FY 2022, Kootenai aquaculture programs.*

PROGRAM AREA	FISCAL YEAR										
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
A. Planning and Design											
A.1. Step 1: Conceptual Engineering, Planning	$590,000										
A.2. Step 2: Preliminary Engineering, Planning and Environmental Compliance		$1,138,471	$487,916								
A.3. Step 3: Final Engineering, Planning			$1,221,868	$135,763							
B. Construction											
B.1. Existing Site Estimated Construction Costs				$905,490							
B.2. Twin Rivers Estimated Construction Costs				$10,811,093	$3,603,698						
B.3. Estimated Tribal Sturgeon Hatchery and Twin Rivers Estimated Construction Costs (Alternate Components)					$1,310,653						
C. Capital Equipment											
C.1. Capital Equipment				$565,466							
D. Environmental Compliance											
D.1. Environmental Compliance	$17,648	$35,297	$105,890	$17,648							
E. Land Purchases, Leases and Easements											
E.1. Land Purchases, Leases and Easements	$1,200,000										
F. Operations and Maintenance											
F.1. Sturgeon Program (Existing Tribal Sturgeon Hatchery)	$1,338,692	$1,378,853	$1,420,218	$1,462,825							
F.2. Sturgeon and Burbot Program (Existing Tribal Sturgeon Hatchery and Twin Rivers)					$2,090,207	$2,152,913	$2,217,500	$2,284,025	$2,352,546	$2,423,123	$2,495,816
G. Monitoring and Evaluation											
G.1. Monitoring and evaluation program	$701,886	$722,943	$744,631	$766,970	$789,979	$813,679	$838,089	$863,232	$889,129	$915,802	$943,276
Total Estimated Capital Costs	$1,807,648	$1,173,767	$1,815,674	$12,435,460	$4,914,350	$0	$0	$0	$0	$0	$0
Total Estimated O&M Costs	**$2,040,578**	**$2,101,796**	**$2,164,850**	**$2,229,795**	**$2,880,186**	**$2,966,592**	**$3,055,589**	**$3,147,257**	**$3,241,675**	**$3,338,925**	**$3,439,093**
Total Estimated Costs	$3,848,227	$3,275,563	$3,980,523	$14,665,255	$7,794,536	$2,966,592	$3,055,589	$3,147,257	$3,241,675	$3,338,925	$3,439,093

Notes and Assumptions:
*Future costs shown from FY 2010 through FY 2012 to reflect past expenditures in Step 1 and 2

- A.1. Step 1 Planning (based on estimated expenditures some are previous to FY 2010)
- A.2. Step 2 Planning (based on estimate in FY 2012 budget, assume 70% of expenses in FY 2011 and 30% in FY 2012)
- A.3. Step 3 Planning (based on estimates put together for the FY 2012 and FY 2013 budget, assumes 80% of expenses in FY 2012 and 20% in FY 2013)
- B.1. Existing Site Estimated Construction Costs (escalated from 2012 dollars to mid-2013 dollars)
- B.2. Twin Rivers Estimated Construction Costs (escalated from 2012 dollars to mid-2013 dollars)
- B.3. Twin Rivers Estimated Construction Costs, Alternate Components (budget shown was escalated from 2012 dollars to mid-2013 dollars)
- C.1. Capital Equipment, estimated lump sum for equipment items not shown in construction estimate (escalated from 2010 to 2014 dollars)
- D.1. Environmental Compliance Costs (assumes 10% of expenses in FY 2010, 20% of expenses in FY 2011, 60% in 2012 and 10% in FY 2013)
- E.1. Land Purchases, Leases and Easements, Tribe's purchase of the Twin Rivers site in 2008 (shown in 2010 for reference only)
- F. O&M costs escalated at 3% annually. Increased costs for expanded production is assumed to start in FY 2012
- F.1. Sturgeon and Burbot Program (Existing Tribal Sturgeon Hatchery program; operations sharing with new site starts in FY 2014)
- F.2. Sturgeon and Burbot Program (Existing Tribal Sturgeon Hatchery; Twin Rivers Hatchery starts in 2014)
- G.1. Monitoring and evaluation program (costs escalated at 3% annually, increased costs for expanded production is assumed to start in FY 2012

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Kootenai River Native Fish Conservation Aquaculture Program Step 2 Document