4.3 Study Design

The primary objective of the proposed study is the live-capture of broodstock for the proposed summer/fall Chinook salmon hatchery below Chief Joseph Dam. A secondary objective is to control the proportion of hatchery-origin fish spawning in the Okanogan and Similkameen rivers. This action is needed to meet the management goal of developing a locally adapted, self-sustaining and harvestable summer/fall Chinook salmon population.

To achieve both management objectives, researchers must be able to accurately determine the run size of different components of the run entering the Okanogan River, as well as their geographic distribution.

The study proposed below is designed to test the ability of different live-capture methods to collect 1130 adults for broodstock and control the ratio of hatchery to natural fish on the spawning grounds. The broodstock collection goals are presented in Tables 1 and 2, below.

Table 1. Early-arriving summer/fall Chinook salmon broodstock goal, assuming 1:1 sex ratio.

Program	Adults
Riverside Pond yearling	228
CJD Hatchery yearling	172
CJD Hatchery subyearling	112
Total	512

Table 2. Late-arriving summer/fall Chinook salmon broodstock goal, assuming 1:1 sex ratio.

Program	Adults
Omak Pond yearling	228
Omak Pond subyearling	166
CJD Hatchery yearling	114
CJD Hatchery subyearling	110
TOTAL	618

4.3.1 Permits and Coordination with Co-Managers

Prior to any broodstock collection effort, a Section 10 incidental take permit will be obtained from NOAA Fisheries for UCR steelhead trout. Broodstock collection efforts will comply with provisions set forth in the permit. If the authorized take of UCR steelhead trout is exceeded, broodstock collection operations will cease and NOAA will be contacted immediately for further direction.

If any of the traps require excavation of streambed material or placement of riprap, a joint permit will be required from the ACOE and WDOE for compliance with the Clean Water Act 404(b)(1).

A Shoreline Management Act permit would be obtained from the WDOE for gear types that attach to non-tribal shorelines. A tribal shoreline permit would be required for shorelines within the Colville Tribes jurisdiction (e.g., north shore of Lake Pateros, portions of east shore of Okanogan River, portions of Similkameen River). In addition, both the state and the Tribes may require a Hydraulic Project Approval permit, depending upon the jurisdiction of the attachment points, weir placement, etc. (pers. comm., Jerry Marco, Colville Tribes).

Broodstock collection efforts will be consistent with the Mid-Columbia Mainstem Conservation Plan and performance objectives identified in the CJDH HGMP.

WDFW conducts weekly foot and float surveys on the Okanogan and Similkameen rivers, enumerating summer/fall Chinook salmon spawning and identifying the origin of spawned out carcasses. Personnel will coordinate with the WDFW stream survey and carcass recovery program to evaluate hatchery-origin summer Chinook salmon adults in the natural spawning population and to recover fished tagged for purposes of evaluating long-term survival of different selective fishing gear.

Broodstock sampling standards of Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State for incidence of pathogens will be implemented. Salmon broodstock are typically sampled for enzyme-linked immunosorbent assay (ELISA) for incidence of *Renibacterium salmonarium*, the causative agent of bacterial kidney disease (BKD). Under current Wells Hatchery operations, broodstock are spawned at least two weeks after inoculation for BKD. If the same protocol is followed at CJDH, eggs cannot be taken at the fish collection sites.

4.3.2 Preliminary Data Collection

As indicated in the Site Review and Selection section, physical data will need to be collected from all potential fishing sites to determine optimal fishing sites, appropriateness of gear and gear design. Water temperature, flow, water depth, wetted width, substrate, and woody debris will be monitored at each site and recorded. In addition, local fisherman and landowners around fishing areas will be contacted regarding possible access, storage of equipment, and assistance with operations.

Results from adult radiotelemetry studies will be considered in narrowing the fishing window and potential sites. Ongoing remote-sensing thermal survey results will be consulted to identify the locations of hyporheic zones. Fish may congregate in these areas of cool water refugia. In addition to higher fish densities increasing catch efficiency, handling and holding fish in cooler water will result in better short- and long-term survival. Capturing and holding fish at such sites will also minimize the amount of time needed to acclimate the broodstock to the Chief Joseph Dam Hatchery water temperatures[1].

[1] The CJDH preliminary design calls for facilities capable of maintaining a wide range of temperatures in all rearing vessels.

4.3.3 Equipment

Several devices will be constructed to enable the broodstock to be transferred from the fish collection site to the transport tank *within water*. The Quinault Tribe has successfully used large PVC tubes adequate to hold a single Chinook salmon adult, with plywood ends on either side (pers. comm., Larry Gilbertson, Quinault Tribe). The tube is perforated to allow water to flow through while it is held within water, but maintains water in the tube if lifted out of the water. In addition to retaining the fish in water, the darkness keeps the fish calm and the tube prevents potentially injurious movement. The transfer tubes will need to be constructed to suit the transport tank. Given the high prevalence of diseases in the Okanogan basin, the use of wood is discouraged because it cannot be completely disinfected. The transfer tubes will be disinfected between uses following the CJDH protocols.

The fish wheels and floating trap-nets will either be constructed by researchers or purchased from suppliers, dependent on costs.

4.3.4 Fishing Gear Procedures

Lake Pateros and Okanogan River water temperatures will be monitored beginning in late June. Fishing efforts will not take place if stream temperatures exceed 65 °F. Handling salmonids during temperatures exceeding 65 °F will result in increased short and long-term mortality, and is strongly discouraged (Ross 1998).

4.3.4.1 Tangle Nets

Deep-water tangle net sites will use a crew of three people. One person will drive the boat and operate the net. Another person will record data. The third person will handle and tag fish. Local tribal gillnet fishers and biologists will be contacted to participate.

Fishing will be conducted between dusk and dawn, during which time fish have been found to migrate and water and air temperatures will be cooler. Prior to arrival of fish, deployment and retrieval of nets will be practiced at the fishing site during the day to gain gear and site familiarity and promote safety.

The use of a tangle net with a 2:1 hang ratio is recommended, but it is recognized that different ratios may need to be tested over time. During tangle net evaluations conducted on the Columbia River, spring Chinook salmon immediate mortality rates were found to be higher in nets with a 3:1 hang ratio (1.6% for 3.5-in mesh, and 8.3% for 4.5-in mesh) than in nets with a 2:1 hang ratio (0.0% for 3.5-in mesh and 1.1% for 4.5-in mesh).

The use of 3.5-in mesh and 4.5-in mesh tangle nets will be evaluated. The larger mesh size may reduce the catch of non-target species, while improving catch efficiency of summer/fall Chinook salmon. Length and depth of panel will depend upon the fishing site. Nets will be fished from the surface to the bottom contours of the river. Nets will be set perpendicular to the flow and allowed to drift with the current.

In deep-water sites, nets can be deployed and retrieved by hand or by a deck-mounted hydraulic reel in an open skiff. However, short sets will be impractical if deploying and

retrieving the nets by hand. Shorter soak periods have resulted in better fish condition upon capture and reduced mortality.

After deployment, the corkline will be monitored from one end of the net for any movement that would indicate the presence of a fish. The net will also be checked periodically to maintain a short soak time for any fish whose capture may have gone unnoticed and to clear debris.

Prior to redeploying the net, it will be checked for any tears in webbing and repaired. Tears in tangle net webbing have been found to increase incidences of fish caught by the gills, increasing potential for mortality (Vander Haegen et al. 2002).

4.3.4.2 Beach Seine

A crew of four people will initially be required to operate the beach seine. More or fewer people may be necessary depending on net length and site conditions. Prior to arrival of fish, deployment and retrieval of nets will be practiced at the fishing site to gain gear and site familiarity and promote safety.

Prior to redeploying the net, it will be checked for any tears in webbing and repaired.

4.3.4.3 Floating Trap-Net

Floating trap-nets will typically use a crew of three people and one boat. However, initial set up may require additional personnel and a second boat. One person will drive the boat and the others will help deploy and retrieve the net. After the fish are crowded, one person will take care of the boat and net. Another person will record data. The third person will handle and tag fish. Local tribal fishers and biologists will be contacted to participate.

The trap will initially be monitored twice a day and more frequently if there are significant numbers of fish captured.

Coordination with tribal and state enforcement agencies to monitor the trap for vandalism would reduce manpower demands on the fisheries technicians.

4.3.4.4 Fish Wheel

Initial setup of the fish wheel may require two boats and up to six personnel at the Lake Pateros site. Heavy equipment and operators may be required to anchor the frame in place. After set-up, the fish wheel would require a crew of three to fish the trap at least two times a day. Depending on the catch rate, the trap may require more or less monitoring.

4.3.4.5 Dip-Net Combination

Initial setup of weirs and scaffolding may require several personnel, depending on site location and choice of weir and/or scaffolding. Heavy equipment and operators may be required to provide secure anchoring points for attaching scaffolding, platforms, or weir components.

It will require at least three personnel to dip-net, handle fish, and record data.

4.3.5 Fish Handling

Broodstock collection efforts will begin after temperatures fall below 65 °F to minimize stress. In addition to general survival, stress levels approaching physiological tolerance limits can impair reproductive success, growth, and resistance to disease (Wedemeyer et al. 1990).

Any incidentally captured UCR steelhead trout will have first priority for fish handling and release to minimize the stress from capture and holding. Any other non-target species, such as sockeye salmon, will be returned to the river. Dead fish of all species will either be given to participating fishermen or donated to local food banks.

Upon retrieval, captured fish will be placed in a freshwater tank supplied with oxygen and artificial fish slime or a Fraser-type recovery box supplied with flowing water (see Vander Haegen et al. 2004 for a detailed description of Fraser-type recovery boxes). It is recommended to have several recovery boxes on hand. Chinook salmon have been held in recovery boxes from 2 to 81 minutes (Vander Haegen et al. 2002). Moreover, reduced post-release survival may warrant longer holding periods. If using a tank, water will be refreshed between sets. Water temperature and dissolved oxygen (DO) levels will also be monitored and documented. If fish are fully recovered, they may also be held in the river within the transfer tubes. Data will be recorded as indicated below. Fish will be handled with extreme care to promote survival; contact with the gill area and holding fish by the caudal peduncle will be avoided.

It is likely that the slime layer of the fish is disturbed during capture from rubbing against the net or rolling in the net. This can lead to secondary fungal infections, which may reduce survival to the spawning grounds or hatchery. In addition to taking care in handling the fish during net retrieval, tagging, and biological data collection, artificial fish slime may be applied to fish while being held in recovery boxes and while being transported to the hatchery.

During initial years of testing, a subset of all *released* fish will be marked with easily identifiable tags to evaluate long-term post-release survival. A subset of the marked fish will be equipped with radio-tags to document behavior after tagging and resulting spawning areas. ESA-listed steelhead trout may or may not be tagged depending on the collection permits issued by WDFW and NOAA Fisheries.

All fish transported to the hatchery will be marked with easily distinguishable tags showing which gear type was used in their collection and identifying individual fish. After tagging, the fish will be placed into the transfer tubes and then placed into the recovery tank until revived. Fish will then be transferred from the recovery tanks using the tubes, transported to the hatchery transport truck, and driven to the hatchery. Travel time from the collection site to the holding facility will be documented[2]. During the trial transports, water temperatures in the tank will be monitored at the collection site and upon arrival at the hatchery; ambient air temperature will be noted as well.

[2] As the CJDH facility will not have been constructed at the time of this study, fish will either be taken to the Wells Hatchery or the Colville Trout Hatchery.

Dependent upon air and water temperatures present, fish may need to be acclimated prior to release into the hatchery holding ponds. It will be the responsibility of the hatchery manager to develop detailed transportation, acclimation, and disease protocols for the broodstock program.

Fish condition of all collected fish will be noted using the same categories as ongoing selective harvest evaluation studies being conducted in the lower Columbia River (see below). Condition 1 and 2 fish will be tagged and released immediately, while fish in Conditions 3-5 will be revived, tagged and released upon recovery. To facilitate tag recovery efforts, coordination will occur with WDFW personnel conducting spawning ground and creel surveys. Notices describing the tags and contact information will be posted at boat launches, recreational and tribal fishing areas, tribal meetings, and any fish collection sites upstream.

4.3.6 Data Collection

Catch location, crew members, time, weather conditions, air temperature, water temperature and set length (or fishing time) will be recorded for each set.

Fish species, including non-targeted bycatch, fork length, and sex of captured fish will also be noted for each set.

For tangle net gear, the method of capture for each fish will be recorded as indicated in the following bullets (Vander Haegen et al. 2002). This information will be used to determine correlation between immediate and delayed mortality and the manner in which the fish are caught in the net.

- Tangled by teeth or mouth
- Rolled in net
- Mouth-clamped (net wrapped around mouth, clamping it closed)
- Gilled (net around gills)
- Wedged (web around body further than gills)

For consistency with other selective fisheries evaluation studies (Vander Haegen et al. 2004), operators will document immediate mortality and condition of all fish captured and released using the following categories:

- Condition 1: vigorous
- Condition 2: vigorous and bleeding
- Condition 3: lethargic
- Condition 4: lethargic and bleeding
- Condition 5: no visible movement or apparent ventilation

Record tag numbers of all fish released and recovery time in recovery box, if applicable.

Record any additional observations related to the set.

Calculate catch per set, total CPUE, species-specific CPUE, and mortality rate per adult successfully captured for broodstock. This information will be used to refine fishing techniques and gear selection in following years.

4.3.7 Reporting

The finding of each year's broodstock collection activities will be summarized and presented in report format.

4.3.8 Study Costs

Costs for conducting the broodstock collection methods presented in this report are attached as Appendix A.

SECTION 5: DISCUSSION

Based on the literature review of existing selective fishing methods and the environmental conditions present in the Okanogan, it appears that hatchery broodstock may be successfully collected in both the Okanogan River basin, and the Columbia River with a minimum of mortality. However to minimize mortality rates, fishers must pay close attention to stream temperature at fishing sites, follow strict fish handling protocols, and be willing to use methods that may not be the most efficient, with respect to CPUE, for meeting hatchery broodstock needs.

The overall success of the broodstock collection effort should not be judged on CPUE, but rather on the mortality rates of the selected gear types on all species encountered. Fish collection methods that have lower efficiencies, but result in higher survival rates for listed steelhead trout, should be preferred.

The proposed study plan allows researchers to examine a range of broodstock collection techniques in various locations, both within and outside of the basin. As the literature review has shown, fishing success will depend not only on gear type, but also on the skill of the fishers. It is for this reason that we are suggesting that broodstock collection crews consist of both biologists and tribal members familiar with fishing sites and techniques. It is expected that both groups bring skills to the table that will maximize the success of the program, while reducing fish handling mortality.

We also suggest that more effort be expended on testing traditional fishing methods such as netting, construction of rock weirs, and traps, etc. The literature review indicates that the less fish are handled, the more likely they are to survive the capture process. Individual fishers stationed at key locations in the basin (rapids, falls, pools) should be able to quickly identify passing fish to species, thus allowing non-target species such as steelhead trout and sockeye salmon to pass. Additionally, if the fisher does collect a non-targeted fish, he will be able to quickly (within seconds) release the fish back to the stream.

The broodstock capture program should also be integrated with harvest activities in the basin. This approach should significantly reduce costs associated with broodstock capture, as these fishers will be able to provide staff for handling fish and also security for the traps. In addition, because of high water temperatures, and expected losses no matter how well fish are handled, having tribal fishers participate in the program will allow these fish (mortalities) to be utilized.

In order to meet natural spawning escapement and hatchery broodstock goals, estimates are required of total run size and composition. The summer/fall Chinook salmon run observed at Wells Dam includes fish originating from downstream of the Okanogan River (mainly the Methow River), as well as late- and early-running fish from the Okanogan/Similkameen and the Columbia River upstream of the Okanogan. Each of these components includes both hatchery- and natural-origin fish.

The objective of the run size assessment is to provide early and accurate abundance estimates of the late-running natural-origin and hatchery-origin components in order to direct broodstock collection activities so that both natural escapement goals (in numbers and hatchery to natural composition) and broodstock requirements can be met. Broodstock should be collected randomly throughout the full run.

Initial estimates of run size and composition need to be obtained from Wells Dam. As results from the planned radio tagging study become available, it may be possible to predict the proportion of naturally produced fish observed at Wells that are destined for the Okanogan. From observation at Wells Dam, preliminary estimates of the weekly natural-origin return of Okanogan fish can be obtained.. The preliminary estimates will be used to determine the number of natural fish needed for natural escapement and for hatchery broodstock[3].

The preliminary estimates from Wells Dam of the natural-origin (NORs) and hatchery-origin returns (HORs) of late summer/fall Chinook salmon would then be used to update the composition of the returns to the Okanogan. This update is needed to achieve sufficiently precise estimates to direct the management of both hatchery and natural escapements through selective capture of NORs and HORs in the Okanogan and Similkameen rivers. Ideally, from a management perspective, a weir would be installed and operated near the mouth of the Okanogan River that could intercept 100 percent of the returning adults. However, this would interfere with the upstream migration of Chinook salmon, listed steelhead trout, and sockeye salmon causing migration delays and unnecessary mortality risks. A better solution would be to intercept a portion of the run at random in a live-trap or other live-capture apparatus that could be operated continuously throughout the run. The question is, what trapping efficiency would be required to obtain a sufficiently precise estimate of run composition. This type of study could be conducted once gear types and methods are determined.

As an example, suppose we estimate the percent NORs entering the Okanogan River weekly by trapping N fish each week. If we further suppose that we want the coefficient of variation of the estimate to be less than 25 percent, then the question is, how many fish (N) must be trapped each week. The number N depends upon the true percent NORs as shown in Table 3.

The recommended procedure would be to obtain weekly estimates of Okanogan River returns from Wells Dam observations, including an approximate estimate of the percent NORs. These values would be used to update total Okanogan River run size and to determine the weekly sampling goal for the lower Okanogan trapping operation. The estimated composition from the trap would then be used to (1) refine the broodstock and natural escapement goals, (2) schedule the removal of natural returns for broodstock for the week, and (3) schedule the selective removal of HORs to achieve the natural escapement composition goal.

[3] Estimate of survival from broodstock capture to viable egg would be obtained from the hatchery operation. Based on these estimates the number of natural-origin broodstock that must be captured can be determined with an appropriate correction for prespawning mortality.

Table 3. Weekly trapping goal as a function of expected percent natural-origin returns (NORs) entering the Okanogan River each week. The required trapping efficiency depends upon the total return to the river.

Percent NOR	No. Trapped per Week
10%	182
20%	82
30%	50
40%	33
50%	24

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APPENDIX A- BROODSTOCK COLLECTION COST ESTIMATE

The estimated cost of the broodstock collection study is summarized in Table A-1. The following assumptions were used in developing study costs:

1) Researchers will purchase and test all gears described in the study plan over a single migration season. The accuracy of this assumption will not be known however until the results of the proposed adult radio-tagging study is completed 1-year prior to the first broodstock collection effort.
2) Field staff will be seasonal employees recruited to conduct the study. Thus, costs for hotels and food need to be accounted for in the budget. These costs can be reduced significantly, or possibly eliminated, if researchers are able to hire locally based field technicians.
3) The trucks needed to haul captured adults to holding facilities, and the holding facilities themselves, will be provided by state, tribal or federal agencies. Therefore, no monies have been allocated to these items.
4) Fuel costs and labor to operate transport trucks are included in the cost estimate.
5) Colville tribal biologists or fishers would be available to assist in the broodstock collection effort. Colville staff and equipment (boats, trucks, etc) are needed to help in the placement of traps and fish wheels, assist in adult capture activities, and to identify key fishing areas.
6) Hourly rates are based on typical consulting firm rates for the level of staff proposed.

Appendix A-1. Budget Summary For Colville Hatchery Broodstock Collection

Equipment

Type	Units	Cost Per Unit	Total
Fish Wheel (Variable Wheel Depth)	1	$75,000	$75,000
Tangle Net(s)	5	$5,000	$25,000
Picket Weir (Metal)	1	$15,000	$15,000
Floating Trap	1	$50,000	$50,000
Dip Nets/Misc Netting	10	$250	$2,500
Holding and Transfer Tanks	5	$500	$2,500
Misc. Equipment	1	$1,500	$1,500
Boat and Truck Rental	4	$2,000	$8,000
Reward (Tags)	250	$10	$2,500
Total			$182,000

Field Labor Costs

Staff	Units	Hours	Rate	Total
Senior Biologist	1	80	$135	$10,800
Lead Field Biologist	1	1000	$85	$85,000
Technician	3	1000	$50	$150,000
Hatchery Staff Assistance (Transport)	1	400	$50	$20,000
Total				**$265,800**

Travel/Per Diem

Type	Units	Cost Per Unit	Total
Housing	500	$40	$20,000
Food	500	$25	$12,500
Auto Mileage	5000	$0.35	$1,750
Total			**$34,250**

Report Writing/Data Analysis

Staff	Units	Hours	Rate	Total
Senior Biologist	1	40	$135	$5,400
Lead Field Biologist	1	100	$85	$8,500
Total				**$13,900**

Grand Total **$495,950**

A DETAILED RESEARCH PLAN TO ASSESS BEHAVIOR OF ADULT SUMMER/FALL CHINOOK UPSTREAM OF WELLS DAM USING RADIO-TELEMETRY TECHNIQUES

Submitted To:

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Final Draft
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SECTION 1: INTRODUCTION

With the completion of construction on the Grand Coulee Dam in 1942, upstream migration of adult salmonids beyond that location came to an end. As part of the agreement to construct the dam, the Federal Government authorized mitigation actions to offset the loss in anadromous fish production. However, due to the onset of the Second World War, those mitigation measures were never completed. Mitigation actions have been renewed in recent years, and the Colville Tribes have proposed the construction of the Chief Joseph Dam Hatchery as a tool to help offset losses of anadromous fish, particularly summer-fall Chinook.

In order to establish baseline information for locating, designing and managing the proposed hatchery, the Colville Tribes, in concert with the Northwest Power and Conservation Council is participating in a 3-Step Planning Process. One goal that emerged from that process was to establish a summer/fall Chinook salmon hatchery to supplement populations in the Okanogan and Columbia rivers in accordance with the Hatchery and Genetic Management Plans developed by the Colville Tribes and fishery co-managers. Targeting the collection of the appropriate genetic unit for use in the hatchery is an important issue. Two or perhaps more population components comprise the summer/fall Chinook stock upstream from Wells Dam. Fish bound for either the Okanogan/Similkameen or Methow rivers are included in that mixture. Also, some fish destined for Wells Hatchery or mainstem spawning areas below that dam may overshoot that site and appear in the admixture upstream from the dam. Finally, it has been suggested that some fish may spawn in the mainstem Columbia River downstream from Chief Joseph Dam. Since one hatchery strategy is to supplement the Okanogan/Similkameen population, then acquiring brood stock from that genetic component is critical. Knowing where and when these fish migrate and where they congregate, and the extent to which they are spatially separated from other population components in the upper Columbia will assist in devising a strategy for collecting brood stock. The Colville Tribes also need to know if the timing of passage over Wells Dam is related to timing and location of subsequent spawning. This is critical to the brood stock protocol and subsequent acclimation of progeny.

Part of the planning process requires the acquisition of some basic biological information about migratory behavior. This research plan identifies the approach to describe important adult migratory characteristics of summer/fall Chinook salmon through the upper Columbia Basin upstream from Wells Dam. Results from this research will provide information to better manage the proposed Chief Joseph Dam Hatchery, as well as identify the preferred location to collect adults from specific population components.

SECTION 2: STUDY OBJECTIVES

The objectives of the proposed research are to:

1. Identify the locations and arrival time of summer/fall Chinook salmon spawning in the upper portion of the Columbia Cascade Province, relative to their time of passage at Wells Dam.

2. Describe the migratory patterns of Chinook salmon as they approach Chief Joseph Dam and determine the final destinations of fish that encounter the dam.

SECTION 3: METHODS

To accomplish the study objectives, we will use radio-telemetry techniques to describe the migratory behavior of adult summer/fall Chinook upstream from Wells Dam.

3.1 Sample Size and Distribution of Tagged Fish

A total of 300 adult summer/fall Chinook will be collected, tagged and released at Wells Dam. Tagged fish will be evenly distributed over the entire migration period (Figure 1), to minimize any temporal bias in our sampling program. A target of 100 fish will be allocated to the early, middle and late segments of the upstream migration (Table 1). Tagging will commence on or about 29 June and terminate near 10 November.

The distribution of tagged fish within each of the three run segments is dictated by the shape of the run distribution within each separate segment, using the average distribution over the years 2001-2003. The proportion of the total run within each segment that passed the project during each weekly time block was used to calculate the number of tagged fish to be liberated each week. A maximum of 26 fish will be collected and tagged during any given week (Table 1). In an effort to maintain the predetermined tagging schedule, if weekly tagging quotas are not met at the project, the deficit will be made up the following week.

The rationale for proposing the use of 300 radio tags in this study is based on previous information obtained by Stuehrenberg et al. (1995). They observed 133 radio-tagged summer/fall Chinook passing Wells Dam. Of those, 14.3% were last detected at the tailrace of Chief Joseph Dam, and 60% in the Okanogan and Similkameen rivers. However, their estimates are based on last detections, and may not represent the total number of fish that migrate upstream to Chief Joseph Dam, only to later migrate downstream and spawn elsewhere. Using their estimates as a general guide, then it is reasonable to anticipate that at least 43 of the 300 fish tagged for this study should approach and arrive at Chief Joseph Dam. We think this number is reasonable and adequate for describing migratory patterns en route to and near the dam, an area the fishery managers deem critical with respect to assessing options for the collection of brood stock for the hatchery.

3.2 Fish Capture

Summer/fall Chinook will be trapped at the Wells Dam brood-stock collection facility located within the fishway on the east shore. The brood-stock collection facility is located at Pool 40, approximately half way up the fish ladder. The trap is operated by placing a barrier fence across the entire width of Pool 40. When the trap is in operation, all fish ascending the left bank ladder are blocked by the barrier fence and are forced to ascend the off-ladder trap via a steep pass denil which leads to an upwell enclosure. Once inside the upwell enclosure, fish are attracted down a sorting chute by jets of water introduced into the upwell enclosure, located near the top of the sorting chute.

As the fish slide down the sorting chute, they are identified and a decision is made to either divert the fish into the holding tank or to allow the fish to pass upstream of the trap.

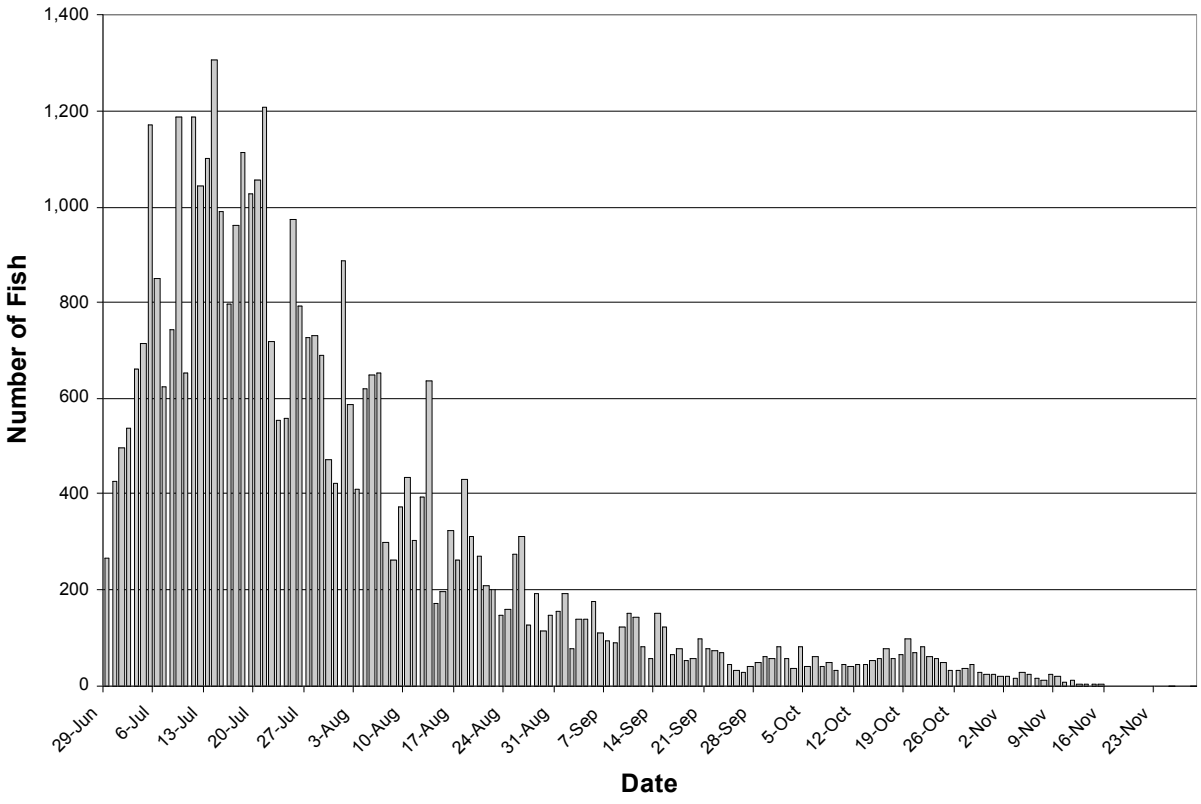

Figure 1. The daily average ladder counts of summer/fall Chinook migrating past Wells Dam, 2001-2003. The 29th of June is the official standard date for indexing the beginning of the summer/fall Chinook migration at Wells Dam.

Table 1. The proportion of summer/fall Chinook observed on a weekly basis within the early, middle and late migration periods (2001-2003) and the weekly tagging targets for those periods. The first date in week #1 is 29 June.

Early Migration			Middle Migration			Late Migration		
Week	**Proportion**	**Number**	**Week**	**Proportion**	**Number**	**Week**	**Proportion**	**Number**
1	5.4%	5	8	19.9%	20	15	13.9%	14
2	19.0%	19	9	26.6%	26	16	17.5%	17
3	23.6%	24	10	18.7%	19	17	16.1%	16
4	20.0%	20	11	12.9%	13	18	17.0%	17
5	15.4%	15	12	11.8%	12	19	22.6%	23
6	13.1%	13	13	8.1%	8	20	12.9%	13
7	3.4%	4	14	2.1%	2	---	---	---
Total:		100			100			100

When a summer/fall Chinook is observed in the chute, a technician will activate a pneumatic gate, and the fish will be diverted into a 600-gallon holding tank. Non-target species and small summer/fall Chinook will be shunted back to the ladder upstream of the trapping barrier. The fish ladder supplies the holding tank with freshwater at a rate of 30 to 40 gallons per hour to maintain adequate dissolved oxygen and temperature levels.

3.3 Tag Description

For this study, we propose to use a digitally-encoded transmitter developed by Lotek Engineering, which can be encoded to omit a signal on any 1 of 5,300 unique channel/code combinations. The transmitter, model MCFT-7A weighs 29 grams in air, 13 grams in water, has a diameter of 16 mm, and a length of 83 mm. For this transmitter with a burst rate of one pulse every five seconds, the typical operational life is 296 days. However, for this study we recommend that the transmitters be programmed to cease functioning after 6 months of use to minimize potential conflict with other telemetry studies. This model of transmitter has been used extensively in other telemetry studies of adult Chinook salmon.

Prior to identifying specific tag channels and codes, it will first be necessary to conduct on-site tests of ambient background electrical noise at Chief Joseph Dam. Because ambient noise produced at the dam may coincide with potential channels and codes within the desired transmission bandwidth, it is necessary to identify which channels and codes are most problematic, and exclude them from use in the study. Doing so simplifies data analysis, and reduces the likelihood of lost data. We recommend using three different channels for this study, and allocating one each to the early, middle, and late run segments.

3.4 Tagging Techniques

After collection, test animals will be transported to an anesthetic vessel containing a buffered solution of tricaine methanesulfonate (MS-222) at a concentration of 80 mg/L. After anesthetization, each fish will be weighed (kg) and the fork length recorded (cm). Tags will be implanted while the fish is in the anesthetic vessel. The transmitter will be implanted gastrically using a PVC pipe as a trochar. The transmitter antenna will be fed through the trochar, and the transmitter will be inserted into the esophagus until the transmitter passes the sphincter muscle of the stomach. The trochar will then be removed, and the antenna will be bent backwards at the corner of the mouth. The fish will then be transported to a recovery/transport vessel supplied with fresh river water to recover. Each tagged fish will be held a minimum of 2 hours to recover prior to release.

3.5 Release of Tagged Fish

Following recovery, tagged fish will be released approximately 0.25 to 0.5 km upstream of Wells Dam to minimize fallback. Since tagged fish will be collected in the left (east) bank ladder of Wells Dam, they will be released near the east shoreline. There is no access road to the proposed release site; therefore it will be necessary to transport fish by boat to the release location. At this time we

presume the Colville Tribe can facilitate arrangements to provide a suitable vessel and transport tank. Perhaps the use of a Douglas County PUD vessel could be secured for this task.

3.6 Monitoring

The migration of summer/fall Chinook within the study area will be assessed using two radio-telemetry techniques; mobile surveys and fixed-telemetry monitoring stations. The study area will extend from Wells Dam to areas within the Methow and Okanogan River basins that have been documented as spawning locations, and up the Columbia River to Chief Joseph Dam. All monitoring activities will continue for one month after the last tagging date (end of November).

Mobile surveys: These will be conducted using both fixed-wing aircraft and a boat. Aerial surveys will be conducted weekly. Information from aerial surveys will be used to plot the migration routes in weekly time steps and identify final destinations of tagged fish. Furthermore, this information will be useful in documenting the week when the fish first arrive at the spawning sites.

Boat surveys will be conducted on the mainstem Columbia River from the confluence of the Okanogan River to the Chief Joseph Dam tailrace. The purpose of the boat surveys is to provide a greater spatial resolution regarding the positions and routes of tagged fish as they migrate through this zone. This information will supplement data collected by the fixed monitoring stations. Surveys using the vessel will be conducted once a week.

Fixed Monitoring Stations: A series of fixed-telemetry monitoring stations will be deployed within and near the tailrace of Chief Joseph Dam, as well along the Columbia River between the Okanogan River mouth and the Highway 17 Bridge, and at strategic locations on the Methow and Okanogan rivers. The purpose of these transects is to document whether either shore is the preferred route to the dam, to locate areas where fish might congregate, and describe movement patterns near the dam.

Equipment: For all telemetry systems, we propose the use of the new Orion receiver developed and manufactured by Grant Systems Engineering (GSE). The model currently available has a single port, is DSP compatible, and is capable of monitoring a 1 MHz bandwidth with a range of 148 to 170 MHz. Being DSP compatible, all frequencies within the specified bandwidth are monitored simultaneously. Therefore, there is no receiver scan time (i.e., the monitoring of specific frequencies sequentially for a specified period of time), which can lead to missed detections of a tagged fish. Furthermore, this system is capable of monitoring aerial antennas, which prior to the development of this system was not possible with conventional DSP systems. It should be noted that GSE is currently planning the release of a multi-port Orion system near the end of 2004. If this should occur, it may provide opportunities to eliminate some equipment, and better monitor some areas of interest. It should also be noted that the Orion systems are still in the developmental stage. Should these systems not be available at the time the study is conducted, alternative receivers manufactured by Lotek can be used. This may increase the cost of the project slightly. All telemetry systems will be powered by either a 110 volt power supply or a solar panel, and backed up with a 12 volt RV

battery to ensure continuous operation. The following describes each of the telemetry systems and the mobile surveys in detail.

3.6.1 Methow and Okanogan Rivers - monitoring stations

Fixed-telemetry sites will be deployed within both the Methow and Okanogan rivers at a location downstream of known spawning grounds, where possible. Within the Okanogan River, most if not all spawning occurs primarily upstream of the town of Malott (Mark Miller, BioAnalysts, Inc. personal communication). There is the opportunity to establish a site near the town. Within the Methow basin, fish have been observed spawning over a long expanse of river and can extend downstream to near the town of Pateros at the confluence with the Columbia (Mark Miller, BioAnalysts, Inc. personal communication). Positioning a telemetry station below the lowermost spawning areas may be more difficult.

To avoid signal collision among tagged fish and the undue loading of the receiver's memory, receivers should not be located in areas where fish naturally congregate for extended periods of time. Thus, the need to place stations downstream from spawning areas but not near suspected holding areas.

The purpose of locating the fixed-telemetry stations in the tributaries is to identify the tributary selected by individual fish, and to establish the time of entry into that river. Should some spawning occur downstream of the fixed-site, data collected during aerial surveys will provide a coarser assessment of when fish enter the tributary. Currently, fixed-telemetry sites are located within the Methow and Okanogan rivers at Rkm 2.4 (Rm 1.5) and Rkm 9.0 (Rm 5.6) as part of a bull trout evaluation conducted by Chelan, Douglas and Grant PUDs. It is likely that these locations will be adequate for this study.

Each fixed-telemetry site will consist of two 3-element Yagi antennas, with one pointed downstream and the other upstream. They will be aimed 40 degrees off the shore to maximize detection of tagged fish as the pass the location. The antennas will be combined together, and monitored as a single detection field. Both systems will be monitored by a single Orion receiver.

3.6.2 Columbia River – monitoring stations

On the Columbia River, three monitoring transects will be established approximately 1.0, 3.0 and 5.0 km downstream of Chief Joseph Dam. The purpose of these transects is to describe migratory routes through this zone. Since fish are expected to migrate near-shore (Bjornn and Peery 1992), we will concentrate the detection fields near-shore. Each transect will consist of two underwater antenna arrays across the river from each other. Each antenna array will consist of six equally spaced bared-coax underwater antennas attached to a weighted rope that extends about 125 feet from, and perpendicular to the shore. The antennas will rest on the river bottom, and are designed to detect tagged fish as they move upstream past the antenna array while following the shoreline. The actual location of the downstream transects will depend on acquiring access to private land on both sides of the river at a secured location. Another consideration is the depth of the river in the vicinity of

the arrays, with shallower depths (<40') being best to ensure satisfactory coverage. Even so, the length of the antenna array can be lengthened to accommodate increased or variable depth in bathymetry.

Optional site: In order to document the proportion of the population that falls back at Wells Dam, telemetry systems should be deployed in the tailrace of that dam. We recommend the installation of two aerial systems; with one being on each side of the river, and consisting of a single 6-element Yagi antenna and Orion receiver at each location.

3.6.3 Chief Joseph Dam Powerhouse

The Chief Joseph powerhouse will be partitioned into two broad detection zones; one near turbine unit 27 and the other extends from turbine Unit 5 to Unit 15. Based on Tribal fishing effort near Unit 27, it appears that summer/fall Chinook tend to congregate in that area (Anna Ruddell, COE personal communication). Therefore, the placement of a fixed-telemetry site at that location does not appear to be practical due to the likelihood of signal collision associated with a large number of tagged fish within a detection area. However, the monitoring of this area will be accomplished using triangulation techniques with a hand-held antenna during regular visits to the dam to check and download receivers. Detection of fish in this area will be recorded on field datasheets, and will be entered into the main database.

The detection zone from Unit 5-15 will be monitored by a fixed-telemetry system (Figure 2). This system will be comprised on four 3-element Yagi antennas spaced 200 feet apart beginning at the upstream edge of turbine unit 6, and extending approximately to the upstream edge of turbine unit 13. The antennas will be mounted to the parapet wall along the downstream powerhouse roadway, and will suspended approximately 5 feet below the top of the parapet wall to shield the antennas from potential electrical noise from the powerhouse. The antennas will be aimed downstream at an angle of 40 degrees off the face of the structure. All four antennas will be combined together, and monitored as a single detection field by one Orion receiver. Due to the difficulty of providing 110 volt power to the receiver (due to Gantry crane rails and the power being on the opposite side of the roadway), it is likely this system will be powered by a solar panel.

3.6.4 Chief Joseph Dam Spillway

To identify fish approaching the spillway tailrace area, a single monitoring system will be deployed on the spillway deck (Figure 2). It will span most of the breadth of the structure, but avoid the ends where fish have been observed to congregate (Anna Ruddell, COE personal communication). A total of three 3-element Yagi antennas will be mounted to the trunion bridge that spans the spillway at 200 foot intervals. The antennas will be suspended approximately 5 feet below the parapet wall of the trunion bridge, and will be aimed perpendicular to the structure.

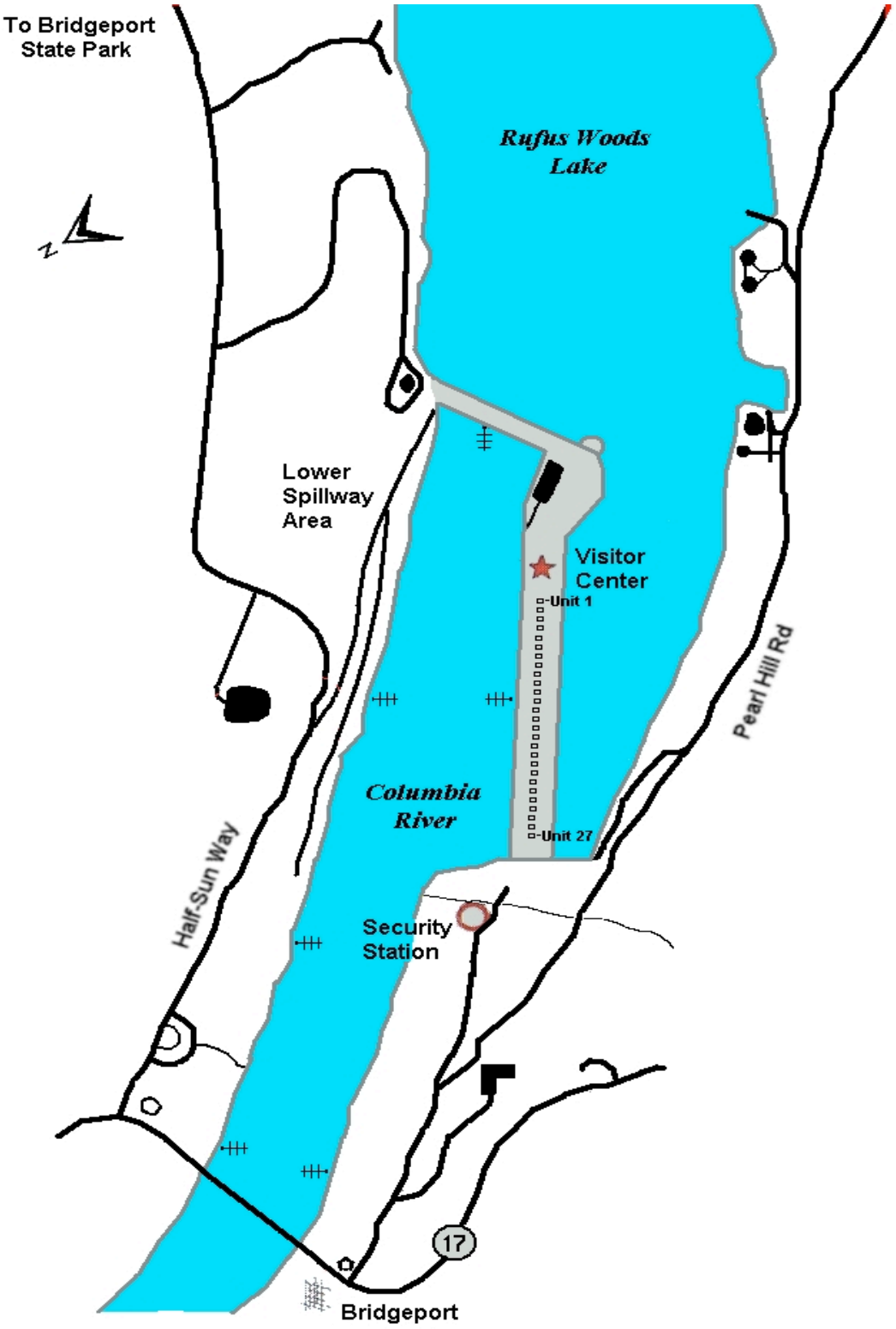

Figure 2. The proposed locations of fixed-site telemetry systems in the tailrace area of Chief Joseph Dam. Individual arrays are denoted by an antenna symbol, and do not represent the actual number of antennas to be deployed.

Antennas will be directed downward toward the tailrace to minimize detection from more distant locations. Antennas will be combined together and will be monitored as a single detection field by an Orion receiver.

3.6.5 Tailrace –South Shore

A fixed-telemetry station will be installed downstream of Chief Joseph Dam on the south shore between the Highway 17 Bridge and Foster Creek (Figure 2). It will consist of a singe 6-element Yagi antenna mounted on a 10 foot mast supported by a tri-pod. The antenna will be aimed perpendicular to the shoreline, and vertically to maximize detection range across the river. If practical, this system will be located approximately half way between Foster Creek and the Highway 17 Bridge. However, access, power options, and security among other factors will determine the actual location.

Optional Site: A small rock island exists between Foster Creek and the Highway 17 Bridge. This island is located near the south shore, and creates a channel approximately 30 m wide between the island and the south shore. As such, this channel may provide an opportunity to collect adult summer/fall chinook as brood stock should they migrate through the channel. The aerial telemetry system described above is not capable of addressing this issue. Therefore, in addition to the aerial system described above we propose a secondary system at this location. This system would consist of underwater antennas attached to a weighted rope that would span the channel. The antennas would be spaced approximately 25 feet apart, would be combined together, and would be monitored as a single antenna lead by an Orion receiver.

3.6.6 Tailrace – North Shore

Three fix-telemetry monitoring stations will be deployed along the north shoreline just below the dam (Figure 2). The most downstream station will be located directly across the river from the system across the river. The second telemetry site will be located at the approximate location of the proposed hatchery, and the third site will be located approximately at the proposed hatchery ladder outfall location. The second and third sites will provide information as to: 1) how far tagged fish migrate upstream along the right bank; 2) the extent tagged fish are detected in the area of the proposed hatchery ladder outfall; and 3) generally, how do tag fish move within the tailrace of the dam.

All three sites will be configured similar to the left bank system. The two upstream stations will be adjusted to detect tagged fish at a depth of approximately 6 meters out to a distance of 100 meters. However, the downstream site will be adjusted to maximize detection range across the river. This and the companion system on the left bank will then be attenuated to provide a similar signal strength with a test tag deployed mid-channel at a depth of 5 meters. By doing so, it will be possible based on signal strength to identify which side of the river a tagged fish approaches the dam.

3.6.7 Boat Surveys

Boat surveys will be conducted on a weekly basis during the study period, and will extend between the confluence of the Okanogan River and the Chief Joseph Dam tailrace. The boat will be outfitted with two 6-element Yagi antennas, with one mounted to each side of the boat on a 10 foot mast. The antennas will be aimed approximately 30 degrees off the mid-line of the boat to maximize the detection field, and will be combined together and monitored by a single Orion receiver.

During each survey, the tracking vessel will travel parallel to a shoreline approximately _ of the way across the river. The survey will continue in this fashion the length of the survey area. After completing the survey area, the tracking vessel will make a return trip along the opposite shore. Once a tagged fish is located, its general position will be determined using triangulation techniques, and latitude and longitude will be recorded. Accuracy of this method depends on a number of factors, primarily the depth of the tagged fish, but generally is accurate to within 100 feet. Additionally, fish location can be ascertained more precisely (< 25 feet) by using an underwater antenna, but takes considerably more time to accomplish. We will attempt this only if time permits. Records of all fish detections will be entered into the master database, and will include latitude and longitude, date and time of detection, and the channel/code combination of the tracked fish.

An additional task associated with the boat surveys that should be considered is the tracking of individual fish within the tailrace of Chief Joseph Dam over a several hour period. During a typical boat survey, after a fish is detected its position is not recorder again during that survey. However, it would be possible to record multiple positions over time for a given fish during the tailrace survey. Doing so would provide detailed movements of a number of fish during the course of the study within the tailrace. Should this task be conducted, we recommend locating the fish with underwater antennas to better define their locations.

3.6.8 Aerial Surveys

Aerial surveys will be conducted on a weekly basis throughout the study period. Surveys will be conducted within the Okanogan basin, and will include areas of known spawning. This will likely include the Okanogan River between its confluence and the town of Oroville (Zosel Dam), and the Similkameen River from its confluence to Enloe Dam located approximately 5 miles upstream of the confluence. While we have not proposed the surveying of the Methow basin, the fixed telemetry site on that tributary will provide information as to fish that enter that system. Also, that site, in conjunction with boat surveys and other fixed-telemetry sites will provide information as to whether fish that enter the Methow basin exit that system and migrate elsewhere. Should other parties express an interest in monitoring the Methow basin for other telemetry studies, it might provide an opportunity to cost-share surveys of that location. Should this occur, we suggest monitoring between the mouth of the Methow River and approximately 2 miles upstream of the town of Winthrop.

Aerial surveys will be conducted using a fixed-wing aircraft with a 3-element Yagi antenna mounted to each wing strut. The antennas will be aimed downward and approximately 20 degrees to the side of the aircraft; and the forward angle of the antennas will be approximately 15 degrees. The antennas will be combined together and monitored by a single receiver that will receive data from a GPS unit. Therefore, each tagged fish that is detected will have corresponding GPS coordinates of its position. Based on consecutive detections of a given fish, it will be possible to identify the location of spawning, and the date that fish arrived at the spawning location. Since surveys will be conducted once a week, the date of arrival will be accurate to within a one week period. Accuracy of the spawning location is expected to be within 300 meters (results based on tests conducted by BioAnalysts, Inc. for Chelan PUD).

SECTION 4: DATA ANALYSIS

Data Processing: Data processing and construction of the operational database will by conducted by Skalski Statistical Services. Field data will be imported into their computer program, which is designed to process telemetry data. The program has been used to successfully analyze six major telemetry studies in recent years, evaluating the complex detection histories of over 7,000 fish.

Analytical Approach: The objectives of the research plan are to:

1. Identify the locations and arrival time of summer/fall Chinook salmon spawning in the upper portion of the Columbia Cascade Province, relative to their time of passage at Wells Dam.

2. Describe the migratory patterns of Chinook salmon as they approach Chief Joseph Dam and determine the final destinations of fish that encounter the dam.

Strategy: Generally the approach for accomplishing these objectives is to describe the distribution, timing and final fates of tagged fish upstream from Wells Dam. More specifically we will identify:

- Key holding areas in the mainstem prior to fish entering tributaries.
- The timeframe fish enter the tributaries.
- Holding areas within the Okanogan and Similkameen rivers.
- Dates of arrival on spawning grounds.
- The proportion of the tagged population destined for specific spawning areas.
- The final destination or disposition of tagged fish.
- Shoreline orientation as fish approach Chief Joseph Dam
- Extent of cross-over between shorelines for fish migrating to Chief Joseph Dam.
- Movement of tagged fish within the Chief Joseph tailrace.

Another important aspect is to determine if there is a relationship between the time of passage at Wells Dam and the final destination of the spawners. This will assist in determining whether population components are temporally separated as they migrate through the study area. This information can be important in determining if there are opportunities to target the collection of specific population components based on migration timing at strategic sites.

We expect to observe and document the following fate categories for tagged fish; those entering and remaining within the Methow or Okanogan rivers, those last observed in the mainstem downstream from the Highway 17 Bridge, those last observed near Chief Joseph Dam (between the bridge and the dam), fallbacks at Wells Dam, and finally any harvested fish (we recommend a reward system to recover transmitters from harvested fish). Using fish designated to the first category we will describe the previous migration history for the Methow and Okanogan populations. Knowledge as

to where and when these fish migrate through, or congregate within the study zone is useful in assessing the opportunity to target these populations separately for collection as brood stock.

Water temperatures in the Okanogan River have been recorded as high as 26.7 °C in July and August (Hatch et al. 1993). Temperatures in excess of 21.1°C are considered to create a thermal barrier for Chinook salmon (EPA and NMFS 1971). Furthermore, temperatures between 21 to 22 °C are considered the incipient lethal limit (Coutant 1970), and the upper lethal limit for Chinook salmon is 25 °C (Bell 1991). High water temperatures restrict access into the Okanogan River for as much as three months after early arriving summer/fall Chinook pass Wells Dam (Chapman et al. 1994). During this period, it is likely that tagged fish may be attracted to cooler water upstream of the Okanogan River confluence. The 10-year average tailrace temperature at Chief Joseph Dam for the period of 1994 to 2003 peaks on 31 August at 18.96 °C, and declines rapidly after the second week of September (University of Washington, Columbia River DART Webpage). Therefore, we anticipate that fish bound for tributaries (primarily the Okanogan basin) may hold in the mainstem Columbia River for some time, perhaps at the base of Chief Joseph Dam.

The fixed telemetry stations deployed along the river approaching and around the dam afford the ability to describe details regarding when and where fish migrate through, and congregate within this area; determine if there is a preference to migrate along a particular shoreline; and document the population components that comprise the mass of fish congregating in this area. The hatchery is to be located at the base of the dam, and a ladder entrance location for returnees is already proposed. Knowing the stock mixture at the base of the dam is critical for developing a collection strategy for specific population components. Depending on the outcome of the study, an alternative collection site may be a consideration. For example, if some Methow-bound fish hold and mix with Okanogan stock in the vicinity of the tailrace and ladder entrance throughout the collection period, this may be problematic. Under such conditions the mixed stock may enter the hatchery in unknown proportions. This may be unacceptable and alternatives required.

SECTION 5: REPORT WRITING

The report will be prepared by BioAnalysts Inc., with input from Dr. John Skalski. At this time we envision preparation of an initial draft that will be submitted to the Colville Tribes for internal review. A second draft, edited to reflect comments provided by the Colville Tribes, will be submitted approximately two weeks later for distribution to outside parties. Upon receipt of comments on the second draft, we will prepare the final report. At this time, delivery dates for the initial, secondary and final reports have not been defined, and will therefore, be identified at a later date.

SECTION 6: PROJECT BUDGET

The attached budget has been prepared assuming that BioAnalysts, Inc. would perform the proposed research project. This was necessary to identify the required level of expertise, and the associated rates for project participants to conduct the study. However, we recognize that an alternative contractor may be selected. As such, the overall project budget may vary depending ultimately on the selection of the project contractor.

Additionally, other factors may affect the actual budget to perform the proposed research. This budget assumes essentially the "worst case scenario". That is, all work would be performed by the contractor, and that all equipment used in the study would be purchased. It is our recommendation that the selected contractor seek opportunities to integrate Tribal biologists and technicians into the project, which may reduce the overall cost of the project. Also, we recommend that the selected contractor seek opportunities to borrow or rent telemetry equipment where possible. Should high end items such as receivers be borrowed, it would significantly reduce the cost of the project.

SECTION 7: REFERENCES

Bell, M. 1991. Fisheries handbook of engineering requirements and biological criteria. Fish Passage Development and Evaluation Program, Corp of Engineers, North Pacific Division, Portland, OR.

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Stuehrenberg, L. C., and seven other authors. 1995. Migrational characteristics of adult spring, summer, and fall Chinook salmon passing through reservoirs and dams of the mid-Columbia River, Final Report. Coastal Zone and Estuarine Studies Division, National Marine Fisheries Service. Seattle, WA.

Budget Summary for Chief Joseph Dam Adult Summer/Fall Chinook Telemetry Study, 2005

Personnel (Attachment A)	**Units**	**Cost**	**Total**
A. Giorgi	180	$ 142.00	$ 25,560
J. Stevenson	520	$ 67.00	$ 34,840
D. Snyder	1,042	$ 51.00	$ 53,142
J. Reeves	928	$ 43.00	$ 39,904
GIS Technician	80	$ 52.00	$ 4,160
Administrative Support	200	$ 38.00	$ 7,600
		Personnel Subtotal:	**$ 165,206**

Expenses (Attachment B)	**Units**	**Cost**	**Total**
Meals	244	$ 30.00	$ 7,320
Lodging	178	$ 56.00	$ 9,968
Aerial Surveys	22	$ 870.00	$ 19,140
Air Fare	0	$ 450.00	$ -
Mileage	1,000	$ 0.37	$ 365
Boat	25	$ 150.00	$ 3,750
Vehicle	120	$ 50.00	$ 6,000
Laptop Computer	5	$ 250.00	$ 1,313
GPS	44	$ 10.00	$ 440
		Expenses Subtotal	**$ 48,296**

Equipment Purchases	**Units**	**Cost**	**Total**
Telemetry Equipment (Attachment C)			$ 77,398
Radio-Transmitters	300	$ 221.00	$ 66,300
		Equipment Subtotal	**$ 143,698**

Miscellaneous		**Total**
Sub-Contractor (Skalski Statistical Services)		$ 30,000.00
Overhead on Sub-Contractor (10%)		$ 3,000.00
Phone, FAX, Data Transmission, Postage		$ 150
Publications, Reprints, Photocopies, Maps		$ 50
Miscellaneous Field and Surgical Supplies		$ 1,000
	Miscellaneous Subtotal:	**$ 34,200**
	Project Sub-Total:	**$ 391,399**
	Washington State B&O Tax:	**$ 5,871**
		$ 397,270

Attachment A. Summary of personnel time by task for the Chief Joseph Dam summer/fall Chinook evaluation.

Task	Giorgi	Stevenson	Snyder	Reeves	GIS Technician
Planning/Noise Eval.	24	80	80	16	0
Setup	0	44	80	80	0
Capture/Tagging	60	60	482	432	0
Mobile Surveys	0	0	360	360	0
Decommision	0	0	40	40	0
Analysis	32	160	0	0	80
Reporting	64	176	0	0	0
Total Hours	**180**	**520**	**1,042**	**928**	**80**
Billable Rate	**$142.00**	**$67.00**	**$51.00**	**$43.00**	**$52.00**
Individual Personnel Cost	**$25,560.00**	**$34,840.00**	**$53,142.00**	**$39,904.00**	**$4,160.00**

Overall Total: $157,606

Attachment B. Summary of expenses by task for the Chief Joseph Dam summer/fall Chinook evaluation.

Task	Meals	Lodging	Aerial Survey	Air Fare	Mileage	Boat	Vehicle I	Laptop Computer	GPS
Planning/Noise Eval.	4	0	0	0	0	0	2	0	0
Setup	25	22	0	0	250	2	10	0	0
Capture/Tagging	125	114	0	0	750	0	59	3	0
Mobile Surveys	80	36	22	0	0	22	44	2.25	44
Decommision	10	6	0	0	0	1	5	0	0
Analysis	0	0	0	0	0	0	0	0	0
Reporting	0	0	0	0	0	0	0	0	0
Total Hours	**244**	**178**	**22**	**0**	**1,000**	**25**	**120**	**5.25**	**44**
Billable Rate	**$30.00**	**$56.00**	**$870.00**	**$450.00**	**$0.365**	**$150.00**	**$50.00**	**$250.00**	**$10.00**
Individual Personnel Cost	**$7,320**	**$9,968**	**$19,140**	**$0**	**$365**	**$3,750**	**$6,000**	**$1,313**	**$440**

Overall Total: $48,296

Attachment C. Summary of equipment expenses for the Chief Joseph Dam summer/fall Chinook evaluation.

Item	Units	Cost per Unit	Total
Orion System (1 port)	17	$ 2,750.00	$ 46,750.00
Receiver Boxes	16	$ 450.00	$ 7,200.00
12-Volt R.V. Battery	16	$ 85.00	$ 1,360.00
Solar Panel	16	$ 450.00	$ 7,200.00
Regulator	16	$ 75.00	$ 1,200.00
2-Way Combiners	4	$ 50.00	$ 200.00
3-Way Combiners	1	$ 75.00	$ 75.00
6-Way Combiners	7	$ 125.00	$ 875.00
Attenuators	87	$ 13.50	$ 1,174.50
50-Ohm Terminators	2	$ 2.50	$ 5.00
Amplifiers	51	$ 98.95	$ 5,046.45
Amplifier Boxes	55	$ 10.00	$ 550.00
Wire Stress Clamps	55	$ 1.00	$ 55.00
Electrical Barrier Strips	49	$ 1.00	$ 49.00
Antenna Masts	27	$ 15.00	$ 405.00
Tri-pods	8	$ 45.00	$ 360.00
Antenna Mounts	7	$ 75.00	$ 525.00
3-Element Yagi Antennas	13	$ 65.00	$ 845.00
6-Element Yagi Antennas	8	$ 95.00	$ 760.00
UHF-BNC adapters	21	$ 2.50	$ 52.50
RG-58 Coax Cable	5,850	$ 0.35	$ 2,047.50
Single Pair Wire	1,880	$ 0.24	$ 451.20
BNC Connectors	230	$ 0.92	$ 211.60
		Equipment Total:	$ 77,397.75

Note: This summary assumes the purchase of the Orion receivers. However, it is likely that the units may be rented at a reduced rate.