

RECLAMATION

Managing Water in the West

**Cle Elum Dam
Interim Fish Passage Operations
2007 Annual Report
Storage Dam Fish Passage Study
Yakima Project, Washington**

Technical Series No. PN-YDFP-013



U.S. Department of the Interior
Bureau of Reclamation
Pacific Northwest Region
Boise, Idaho

May 2008

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The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Tribes and our commitments to island communities.

Mission of the Bureau of Reclamation

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

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**Storage Dam Fish Passage Study
Yakima Project, Washington**

**Cle Elum Dam
Interim Fish Passage Operations
2007 Annual Report**

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Background

Objectives

The Bureau of Reclamation (Reclamation) is leading a cooperative investigation with the Yakama Nation (YN), state and Federal agencies, and others, to study the feasibility of providing fish passage at the five large storage dams of the Yakima Project. These dams Bumping, Kachess, Keechelus, Cle Elum, and Tieton were never equipped with fish passage facilities. Four of the five reservoirs were originally natural lakes (Rimrock Lake above Tieton Dam is the exception) and historically supported Native American fisheries for sockeye salmon (*Oncorhynchus nerka*) and other anadromous and resident fish.

Implementation of passage features at the dams has the potential to reintroduce sockeye salmon to the watershed; increase populations of upper Yakima basin steelhead (*O. mykiss*), coho salmon (*O. kisutch*), and Chinook salmon (*O. tshawytscha*); restore life history and genetic diversity of salmon; and reconnect isolated populations of bull trout (*Salvelinus confluentus*). Bull trout and Mid-Columbia River steelhead (of which Yakima Basin steelhead are a sub-component) are listed under the Endangered Species Act (ESA).

The scope of the feasibility study is currently limited to the study of passage features at Cle Elum and Bumping dams. Successful implementation of fish passage at Cle Elum and Bumping dams could eventually lead to future detailed study of fish passage at Kachess, Keechelus, and Tieton dams.

One component of the feasibility study is to provide interim (temporary, experimental) passage features at Cle Elum Dam to test the ability of juvenile salmonids to locate the fish passage features and successfully migrate out of the reservoir under their own volition. Uniquely marked fish will be monitored as they exit the reservoir, migrate downstream, and return as adults. The interim passage protocols use Passive Integrated Transponder (PIT) tags implanted in the test fish to monitor their movement through the system. PIT tag detectors located at Cle Elum, Rosa, Prosser, McNary, and Bonneville dams will record the passage of these juveniles as they migrate downstream, and when they return as adults.

Results of these interim passage experiments over a period of 5 to 8 years will be used as one indicator of the feasibility of reintroducing anadromous fish species above the dam and reservoir.

Installation and Testing of PIT Tag System–2005

In the early spring of 2005, Reclamation completed construction of the interim downstream juvenile fish passage facility at Cle Elum Dam. The passage features include a stop-logged overflow section and plunge pool installed in the second radial gate bay from the left side of the spillway, and a temporary plywood and lumber framed flume built on the existing spillway. Two PIT tag detectors were installed in the flume by Biomark, Inc., Boise, ID. The interim passage facility is designed to pass a maximum flow of about 400 ft³/s. The

overflow section can pass flows; whenever, the reservoir pool is at least two feet above the spillway crest (elevation 2223).

Interim Passage Activities in 2005-2006

Drought conditions resulted in low reservoir levels in 2005 precluding the planned release of 10,000 PIT tagged coho salmon smolts into the reservoir. Instead, the fish were released in April at several points downstream from Cle Elum Dam ($\frac{1}{3}$ below Cle Elum, $\frac{1}{3}$ in Roza pool, and $\frac{1}{3}$ below Roza). Nevertheless, Reclamation was able to operate the passage flume for several days. Yakama Nation and Biomark were able to test the functionality and efficiency of the PIT tag system by releasing several groups of PIT tagged coho salmon smolts directly into the flume on June 2 and 3, 2005.

The flume functioned properly with no vibration and minimal turbulence. Even under this low flow operating condition, the PIT tag detectors performed well. A total of about 1,800 smolts were released into the flume in various sized groups. The combined detection rate for these 1,800 smolts was over 97 percent when single groups of up to 5 fish were released at once.

The YN also released 3,000 PIT tagged coho salmon parr in August 2005 at Tucquala Lake in the Cle Elum River about 12.9 miles upstream from the reservoir. The purpose of this release was to test rearing and overwintering survival, and outmigration in the spring of 2006.

The PIT tag detectors were taken back to the laboratory for testing and adjustment. Modifications such as sun shades and spillway flow deflectors were installed at the detector locations and other modifications to monitoring and control equipment and other physical features were made.

In 2006, Yakama Nation biologists released about 10,000 PIT tagged coho salmon smolts into the reservoir from a net pen located about $\frac{1}{2}$ mile upstream from the spillway. Several hundred of these fish were recorded by the PIT tag detector in the spring of 2006 as they passed through the interim flume. About 5 percent of the fish counted were from the coho parr released in 2005. We also released about 1,000 PIT tagged coho salmon smolts downstream from the dam as controls, and another 1,000 fish directly into the passage flume to check the efficiency of the PIT tag detectors.

Reservoir levels didn't reach spillway elevation until early June. The passage facilities were operated from June 6 through July 9, 2006, at which time pool elevations again dropped below spillway levels. This is late in the coho salmon season of migration which normally is late winter or early spring, but did allow for 32 days of downstream passage and a reasonable testing both of the passage facility and the PIT tag detectors.

Even though the period of operation was late in the season and of relatively short duration, 617 PIT tagged coho salmon smolts were recorded passing through the passage flume. Thirty of these fish were from the group of 3,000 coho salmon parr released in 2005. The remaining fish were from the 2006 release group.

Interim Passage Activities in 2007

Outmigration Passage

In 2007 Yakama Nation biologists again released about 10,000 PIT tagged coho salmon smolts into the Reservoir from a net pen located about ½ mile upstream from the spillway. The reservoir was maintained at spillway elevations from April 4 through July 11, 2007 allowing 98 days of downstream passage. This compared to the 32 days of passage from June 6 through July 9, 2006. Largely attributed to the longer passage duration and more favorable passage timing in 2007, YN biologists detected 4,587 PIT tagged coho salmon smolts passing through the passage flume (compared to only 617 in 2006). Of these, 986 (about 20 percent of total detections) were from the coho parr released in the summer of 2006 as yearlings the remaining fish were from the 2007 release group. These results are encouraging and seem to confirm that the basic concept proposed for downstream passage will work to effectively move fish downstream. We also released about 1,000 PIT tagged coho salmon smolts downstream from the dam as controls for release-to-adult survival evaluation. Another 900 fish were released directly into the passage flume to check the efficiency of the PIT tag detectors. The peak passage day was May 27, 2007 when 535 of the PIT tagged coho salmon were detected. The highest daily average forebay elevation during the 2007 period was 2239 feet on June 4, with 4050 cfs gauged below the dam.

Balloon Tag Testing to Evaluate the Biological Effects of Flume Passage

In 2007 we also used balloon tags to evaluate the survival and condition of coho salmon smolts after passage through the interim flume. Deflated balloon tags were attached to numbered disc tags on test fish released at the top of the fish passage flume. The tags self-inflated after a 1 minute delay, long enough for the test fish to travel to the bottom of the flume and into the river below the dam. As the balloons inflated, the smolts rose to the water surface downstream from the dam spillway. Reclamation added stop logs into the overflow section above the plunge pool to allow testing at three differing flow levels.

In the balloon study, 100 coho smolts were PIT tagged with discs numbered 0-99. Of these, 90 used in the test consisted of: 25 fish released at 235 cfs, 29 fish released at 105 cfs, and 36 fish (including 6 control fish) released at 310 cfs. Yakama Nation technicians then captured the fish downstream and transported them to aquarium tanks back at the dam. Biologists then inspected the salmon for signs of abrasion or other injuries that could be attributed to their journey through the passage facility.

Results

Balloon Tag Test Results:

Overall % Recaptured = 41.7

Overall % Survival of fish scored "good" or "10 % descaled" = 70.4

Overall % Survival of fish scored "15-20 % descaled" or "injured" = 25.0

% Survival of control fish = 100.0

<u>Flow (CFS)</u>	<u>Flume</u>	<u>% Survival</u>
105		75.0
235		26.7
310		75.0

Monitored Flume Survival Results:

Thursday, April 26, 2007 – 15 mortalities counted, 2 out of the 15 were unknown, no disc tags found and none released this day.

Friday, April 27, 2007 – 3 mortalities counted and 28 others appeared normal and were fed then released.

The validity of the results from the 235 cfs flow level test is questionable as this was the first test we conducted and some problems occurred. Balloons were not immediately cut off of coho, and then tangled with other balloons in the bucket prior to release, which likely contributed to higher mortality. The 25 percent mortality observed for the other 2 flow levels was likely due to stress from handling and to the high iron content in the well water used in the aquarium tanks. Coho survival may have been higher had we been better able to control these factors. Not all fish were caught by technicians downstream due to strong currents and safety concerns. This may also have resulted in higher mortality estimates since these fish were counted as mortalities.

We conclude that fish can safely pass over the entrance weir, pass through the plunge pool, and survive changing flume velocities with little or no physical injury.

Adult Returns of Prior Releases

Adult returns from fish released above Lake Cle Elum in 2006 fish were: 21 PIT tag detections at Bonneville and 9 PIT tag detections at Prosser. This represents an adult return rate of 3.4 percent (to Bonneville) and 1.5 percent (to Prosser) for the 617 PIT tagged juvenile coho salmon that were detected passing through the passage flume in 2006. The short passage window and late passage timing for 2006 juvenile releases at Cle Elum Dam as well as harvest in marine and Columbia River fisheries likely impacted the adult return rates for these fish.

2007 Fish Passage Season Operations Log

Note: All times in the operations log is PST or PDT. However, the times noted in the PIT tag files are GMT or Zulu times (PST = GMT-8, PDT = GMT-7).

Abbreviations: SG = Slope Gage reading, AF = Acre-Feet

Lake Elevations and acre-feet numbers are from Hydromet files.

DATE TIME	
3/27/2007	Prepared PIT tag trailer in Prosser for tagging 12,000 coho salmon smolts.
3/28/2007	PIT tagged 4,000 coho smolts.
3/29/2007	PIT tagged 4,000 coho smolts.
3/30/2007	PIT tagged 2,000 coho smolts for total of 10,000 that were placed in separate runway, PIT tagged another 1,000 to be released below dam, PIT tagged another 1,000 for flume and balloon tag tests.
4/3/2007	Lake Elevation 2226.06 for 372110 AF.
4/4/2007	Lake Elevation 2226.31 for 373225 AF. Disc and String tagged 100 coho smolts for balloon flume tag test.
4/5/2007	Lake Elevation 2226.53 for 374215 AF.
4/6/2007	Lake Elevation 2226.76 for 375250 AF. Transported 10,000 pit tagged coho from Prosser to net pen in Lake Cle Elum. Coho seem to acclimate to Lake temps with out any problems.
4/7/2007	Lake Elevation 2227.11 for 376825 AF. Fed and monitored coho in Cle Elum Lake.
4/8/2007	Lake Elevation 2227.63 for 379164 AF. Fed and monitored coho in Cle Elum Lake.
4/9/2007	Fed and monitored coho in Cle Elum Lake.
4/10/2007 23:45	Lake Elevation 2229.18 for 386208 AF. Fed and monitored coho in Cle Elum Lake.
4/11/2007 23:45	Lake Elevation 2229.71 for 388635 AF. Fed and monitored coho in Cle Elum Lake.
4/12/2007 14:00	Lake Elevation 2229.96 for 389776 AF. Fed and monitored coho in Cle Elum Lake.
4/13/2007	Fed and monitored coho in Cle Elum Lake.
4/14/2007	Fed and monitored coho in Cle Elum Lake.
4/15/2007	Fed and monitored coho in Cle Elum Lake.
4/16/2007	Fed and monitored coho in Cle Elum Lake.
4/17/2007	Fed and monitored coho in Cle Elum Lake.
4/18/2007	Did not make it out onto the Lake, too windy for little boat
4/19/2007	Fed and monitored coho in Cle Elum Lake.
4/20/2007	Fed and monitored coho in Cle Elum Lake.
4/21/2007	Fed and monitored coho in Cle Elum Lake.
4/22/2007	Fed and monitored coho in Cle Elum Lake.
4/23/2007 23:45	Lake Elevation 2232.85 for 403126 AF.
4/24/2007 23:45	Lake Elevation 2232.86 for 403173 AF, released 1,000 fish directly into passage flume to check efficiency of PIT tag detectors.
4/25/2007 23:45	Lake Elevation 2232.88 for 403226 AF, Balloon Tag Test, conducted at 3 different flows, first 25 fish at 235 cfs, second 29 fish at 105 cfs, and third 36 fish, 6 being control fish, at 310 cfs, fish then retrieved below the dam by Yakama Nation Fisheries Technician crew and transported back to dam and placed in aquarium tanks for study and observation.
4/26/2007 23:45	Lake Elevation 2232.89 for 403313 AF, Balloon Tag Test fish monitored and evaluated.
4/27/2007 23:45	Lake Elevation 2232.95 for 403590, Balloon Tag Test fish monitored, evaluated and released below dam.

4/28/2007 23:45	Lake Elevation 2233.14 for 404473 AF.
4/29/2007 23:45	Lake Elevation 2233.51 for 406197 AF.
4/30/2007 23:45	Lake Elevation 2233.86 for 407883 AF.
5/1/2007 23:45	Lake Elevation 2234.2 for 409420 AF.
5/2/2007 23:45	Lake Elevation 2234.61 for 411337 AF.
5/3/2007 23:45	Lake Elevation 2235.01 for 413207 AF.
5/4/2007 23:45	Lake Elevation 2235.3 for 414570 AF.
5/5/2007 23:45	Lake Elevation 2235.47 for 415369 AF.
5/6/2007 23:45	Lake Elevation 2235.59 for 415933 AF.
5/7/2007 23:45	Lake Elevation 2235.83 for 417064 AF.
5/8/2007 23:45	Lake Elevation 2236.46 for 420042 AF.
5/9/2007 23:45	Lake Elevation 2237.25 for 423790 AF.
5/10/2007 23:45	Lake Elevation 2237.74 for 426122 AF.
5/11/2007 23:45	Lake Elevation 2238.1 for 427840 AF.
5/12/2007 23:45	Lake Elevation 2238.49 for 429703 AF.
5/13/2007 23:45	Lake Elevation 2238.84 for 431382 AF.
5/14/2007 23:45	Lake Elevation 2239.01 for 432198 AF.
5/15/2007 23:45	Lake Elevation 2239.11 for 432677 AF.
5/16/2007 23:45	Lake Elevation 2239.3 for 433580 AF.
5/17/2007 23:45	Lake Elevation 2239.37 for 433917 AF.
5/18/2007 23:45	Lake Elevation 2239.28 for 433484 AF.
5/19/2007 23:45	Lake Elevation 2239.3 for 433580 AF.
5/20/2007 23:45	Lake Elevation 2239.35 for 433821 AF.
5/21/2007 23:45	Lake Elevation 2239.27 for 433436 AF.
5/22/2007 23:45	Lake Elevation 2239.2 for 433100 AF.
5/23/2007 23:45	Lake Elevation 2239.16 for 432912 AF.
5/24/2007 23:45	Lake Elevation 2239.2 for 433100 AF.
5/25/2007 23:45	Lake Elevation 2239.36 for 433869 AF.
5/26/2007 23:45	Lake Elevation 2239.52 for 434636 AF.
5/27/2007 23:45	Lake Elevation 2239.66 for 435314 AF.
5/28/2007 23:45	Lake Elevation 2239.54 for 434732 AF.
5/29/2007 23:45	Lake Elevation 2239.42 for 434156 AF.
5/30/2007 23:45	Lake Elevation 2239.43 for 434204 AF.
5/31/2007 23:45	Lake Elevation 2239.59 for 434972 AF.
6/1/2007 23:45	Lake Elevation 2239.66 for 435314 AF.
6/2/2007 23:45	Lake Elevation 2239.74 for 435702 AF.
6/3/2007 23:45	Lake Elevation 2239.8 for 435990 AF.
6/4/2007 23:45	Lake Elevation 2239.76 for 435798 AF.
6/5/2007 23:45	Lake Elevation 2239.76 for 435798 AF.
6/6/2007 23:45	Lake Elevation 2239.82 for 436086 AF.
6/7/2007 23:45	Lake Elevation 2239.88 for 436374 AF.
6/8/2007 23:45	Lake Elevation 2239.89 for 436422 AF.
6/9/2007 23:45	Lake Elevation 2239.8 for 435990 AF.
6/10/2007 23:45	Lake Elevation 2239.79 for 435942 AF.
6/11/2007 23:45	Lake Elevation 2239.89 for 436422 AF.
6/12/2007 23:45	Lake Elevation 2239.93 for 436614 AF.
6/13/2007 23:45	Lake Elevation 2239.91 for 436518 AF.
6/14/2007 23:45	Lake Elevation 2239.9 for 436470 AF.
6/15/2007 23:45	Lake Elevation 2239.93 for 436614 AF.
6/16/2007 23:45	Lake Elevation 2239.96 for 436758 AF.
6/17/2007 23:45	Lake Elevation 2239.92 for 436566 AF.
6/18/2007 23:45	Lake Elevation 2239.89 for 436422 AF.
6/19/2007 23:45	Lake Elevation 2239.87 for 436327 AF.
6/20/2007 23:45	Lake Elevation 2239.74 for 435702 AF.
6/21/2007 23:45	Lake Elevation 2239.65 for 435264 AF.
6/22/2007 23:45	Lake Elevation 2239.56 for 434828 AF.

6/23/2007 23:45	Lake Elevation 2239.42 for 434156 AF.
6/24/2007 23:45	Lake Elevation 2239.09 for 432582 AF.
6/25/2007 23:45	Lake Elevation 2238.64 for 430421 AF.
6/26/2007 23:45	Lake Elevation 2238.1 for 427840 AF.
6/27/2007 23:45	Lake Elevation 2237.48 for 424884 AF.
6/28/2007 23:45	Lake Elevation 2236.84 for 421842 AF.
6/29/2007 23:45	Lake Elevation 2236.18 for 418716 AF.
6/30/2007 23:45	Lake Elevation 2235.43 for 415181 AF.
7/1/2007 23:45	Lake Elevation 2234.77 for 412082 AF.
7/2/2007 23:45	Lake Elevation 2234.03 for 408621 AF.
7/3/2007 23:45	Lake Elevation 2233.24 for 404938 AF.
7/4/2007 23:45	Lake Elevation 2232.45 for 401270 AF.
7/5/2007 23:45	Lake Elevation 2231.59 for 397284 AF.
7/6/2007 23:45	Lake Elevation 2230.76 for 393456 AF.
7/7/2007 23:45	Lake Elevation 2229.81 for 389086 AF.
7/8/2007 23:45	Lake Elevation 2228.83 for 384615 AF.
7/9/2007 23:45	Lake Elevation 2227.77 for 379802 AF.
	Lake Elevation 2227.25 for 377455 AF.

PIT-Tagged Coho Salmon - Daily Detections

Figure 1 shows total daily detections of PIT-tagged coho salmon released above Cle Elum Dam in 2006 or 2007 and detected in the spillway flume in 2007. The figure shows the period when the water level in the forebay was higher than the spillway crest, allowing water and fish to pass through the spillway flume. The number of detections per day was related to the amount of flow going through the flume. The highest daily average forebay elevation during the 2007 period was 2240 feet on June 16, 2007, with 1255 cfs gaged below the dam. The highest total daily detection of PIT-tagged coho salmon was 535 on June 6, 2007.

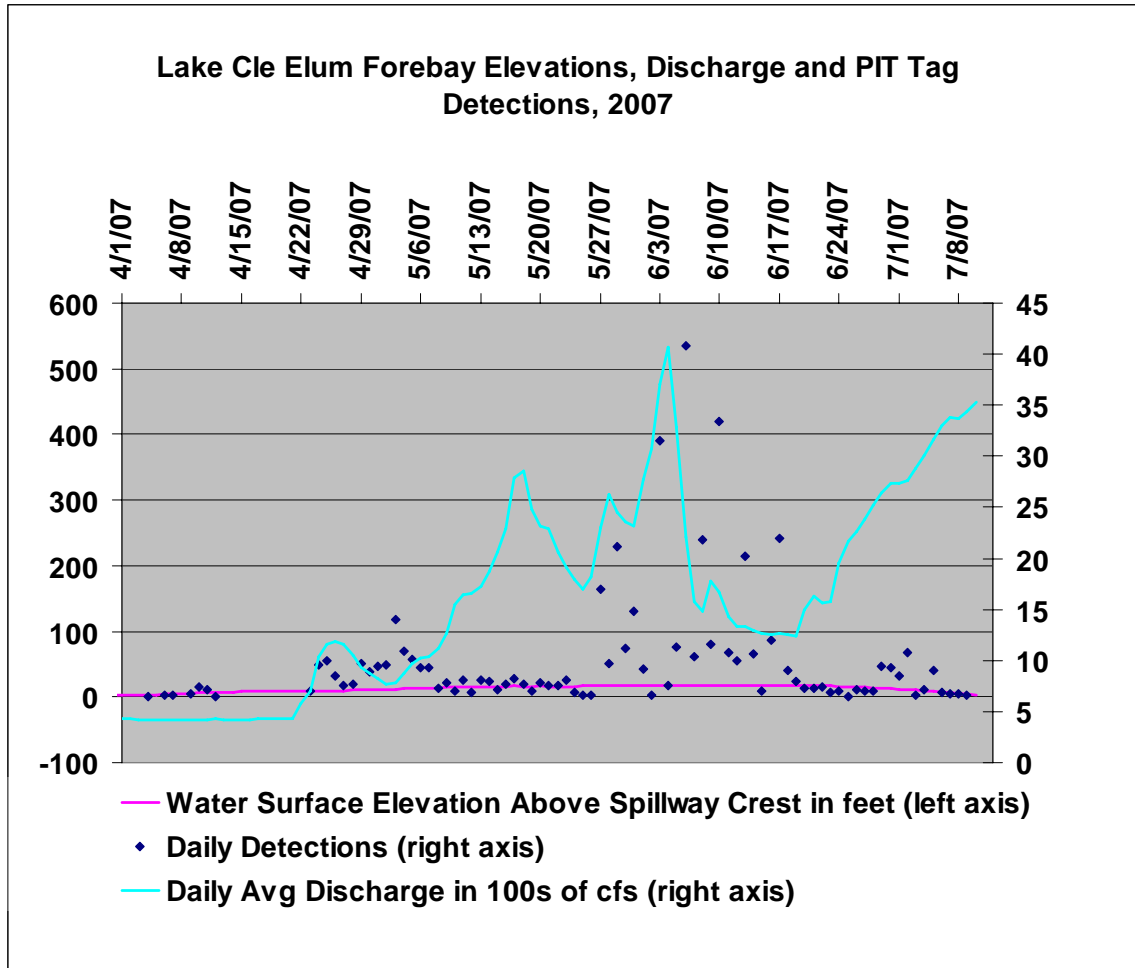


Figure 1. Lake Cle Elum Forebay Elevation, Discharge, and PIT-Tag Detection, 2007.

Photos taken April 5, 2007



Photo 1. Transporting coho above Cle Elum Dam to the reservoir.



Photo 2. Transferring coho to boat for transport to net pen on Cle Elum Reservoir.



Photo 3. Coho gently placed into net pen by Yakama Nation fish technician.



Photo 4. Coho acclimating to colder Cle Elum Reservoir temperatures.

Photos taken April 25, 2007



Photo 5. Balloon connected to numbered disc tag.



Photo 6. Injecting vinegar into balloon creating a gas reaction.



Photo 7. Fish technicians retrieve inflated balloons below dam.



Photo 8. Aquarium tank holding retrieved coho for observation.

Objectives of FY 2008 Interim Passage Activities

Interim Passage at Cle Elum Dam

The proposed FY 2008 activities are a continuation of the work done in the previous three fiscal years.

In 2008, Yakama Nation biologists will tag 12,000 coho salmon smolts with PIT tags to evaluate downstream passage and survival. Of the 12,000 – 6,000 smolts will be acclimated in a net pen in the reservoir about ½ mile upstream from the juvenile passage facility in March. The other 6,000 smolts will be released directly into the reservoir in April to assure that sufficient numbers of "physiologically-ready" migrant smolts are present to adequately test the facility.

Feasibility Study of Fish Passage at Cle Elum and Bumping Lake Dams

The Yakama Nation will continue to participate in the feasibility study of fish passage at Cle Elum and Bumping Lake dams and will work with the Washington Department of Fish and Wildlife to begin development of the Master Plan for reintroduction of anadromous fish above the reservoirs.

Proposed Plan and Key Activities for FY 2008

- 1.) Manage the biological aspects of interim passage as the lead fisheries agency.
- 2.) Develop Monitoring and Evaluation plans for interim passage activities.
- 3.) Provide technical review of the interim passage facility including overall performance and fish health concerns.
- 4.) Obtain hatchery coho salmon smolts, mark with PIT tags, and acclimate 6,000 in net pen, and release 6,000 directly into head end of Cle Elum Reservoir.
- 5.) Release marked coho salmon smolts into Cle Elum Reservoir and downstream from the dam.
- 6.) Conduct releases of coho salmon smolts directly into the interim passage flume to determine PIT tag antenna efficiency.
- 7.) Collect data. This will include bio-data from the release group, downloading PIT tag information from the Cle Elum site, and uploading to the Columbia River Basin PIT Tag Information System (PTAGIS).
- 8.) Retrieve and interpret all available data from PTAGIS.
- 9.) Assist Reclamation with producing an overall annual report on interim passage activities.
- 10.) Participate in Storage Dam Fish Passage Core Team meetings.
- 11.) Review and comment on reports produced by Reclamation staff and other team members.

12.) Work with Washington Department of Fish and Wildlife to begin development of the Master Plan for reintroduction of anadromous fish above Cle Elum and Bumping Lake dams.

13.) Attend Yakima Basin Aquatic Management and Science Conference and report on Storage Dam Fish Passage Study activities.

