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Public Utility District No. 1 of Douglas County

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March 30, 2007

Honorable Philis J. Posey, Acting Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington DC 20426

Subject: Wells Hydroelectric Project No. 2149
2006 Annual Report - Wells Bull Trout Monitoring and Management Plan

Dear Secretary:

In accordance with Article 62 of the Federal Energy Regulatory Commission (Commission) license for the Wells Hydroelectric Project, the Public Utility District No. 1 of Douglas County (Douglas PUD) hereby submits the 2006 Annual report detailing the implementation of activities covered by the Wells Bull Trout Monitoring and Management Plan (Bull Trout Plan).

On June 21, 2004, the Commission issued orders amending the license for the Wells Project in order to implement the terms of the Anadromous Fish Agreement and Habitat Conservation Plan (Wells HCP). The United States Fish and Wildlife Service (USFWS) issued a biological opinion (BO) pursuant to Section 7 of the Endangered Species Act (ESA) to assess the effects of the HCP on ESA listed bull trout and other listed species under the jurisdiction of the FWS. The BO included reasonable and prudent measures (RPMs) and associated terms and conditions for implementing the RPMs for bull trout. The Commission order approving the Wells HCP added Article 61, 62 and 63 to the Wells Project license.

Article 61 of the license required Douglas PUD to file with the Commission a Bull Trout Plan for monitoring take associated with the operations of the Wells Project. Article 61 further required that Douglas PUD prepare the Bull Trout Plan in consultation with the USFWS, National Marine Fisheries Service (NMFS), Washington Department of Fish and Wildlife (WDFW) and interested Indian Tribes (Colville Confederated Tribes and the Yakama Nation).

Following Consultation with the USFWS, NMFS, WDFW, Colville Confederated Tribes and the Yakama Nation, Douglas PUD filed the Bull Trout Plan with the Commission on February 28, 2005. The Bull Trout Plan was approved by the Commission on April 19, 2005.

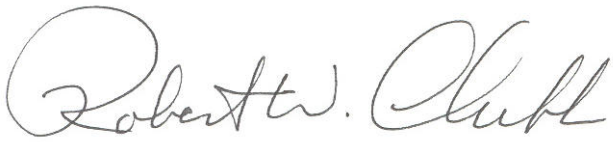
Article 62 of the license requires Douglas PUD to prepare and file with the Commission an annual report describing the activities required by the Bull Trout Plan.

Article 63 of the license reserves the Commissions authority to require Douglas PUD to carry out specified measures for the purpose of participating in the development and implementation of a bull trout recovery plan.

Enclosed, please find Douglas PUD's annual report for activities covered under the Bull Trout Plan during calendar year 2006.

If you have any questions related to the 2006 annual bull trout monitoring report, please contact Bao Le, Senior Aquatic Resource Biologist at (509) 881-2323 (ble@dcpud.org).

Sincerely,



Robert Clubb, Ph.D.
Chief of Environmental and Regulatory Services

Copy: Mark Miller, USFWS
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Gregg Kurz, USFWS
Brian Cates, USFWS

Mike Schiewe, Coordinator - HCP Coordinating Committee
HCP Coordinating Committee - Members List

Shane Bickford, Douglas PUD
Bao Le, Douglas PUD

Enclosures: (1) Wells Bull Trout Monitoring and Management Plan, 2006 Annual Report. March 2007.

WELLS BULL TROUT MONITORING AND MANAGEMENT PLAN 2006 ANNUAL REPORT

WELLS HYDROELECTRIC PROJECT

FERC NO. 2149

March 30, 2007

Prepared by:
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Prepared for:
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ABSTRACT

The goal of the Wells Bull Trout Monitoring and Management Plan (WBTMMP) is to monitor and evaluate bull trout (*Salvelinus confluentus*) presence in the Wells Project and to quantify potential project-related impacts on bull trout. The plan has four main objectives.

The first objective of the plan is to "identify potential project-related impacts on upstream and downstream passage of adult bull trout through the Wells Dam and reservoir and implement appropriate measures to monitor any incidental take of bull trout." In order to meet the first objective of the WBTMMP, the Public Utility District No.1 of Douglas County (Douglas PUD) implemented a bull trout telemetry program to monitor upstream and downstream passage, and implemented an experimental off-season bull trout counting program during the winter. In 2006, 10 adult bull trout were trapped in the Wells Dam fishway, radio-tagged, and released upstream of the dam. Also in 2006, the US Fish and Wildlife Service (USFWS) radio-tagged and released 13 bull trout in the Methow; and the Public Utility District No. 1 of Chelan County (Chelan PUD) released 29 radio-tagged bull trout at Rock Island and Rocky Reach dams. In total, 13 downstream passage events and 8 upstream passage events were recorded, and there were no conclusive instances of bull trout mortality resulting from these passage events. Based on video monitoring data, upstream passage events were observed from 16 May to 12 July, with a peak on 31 May. In general, upstream passage events were more likely to take place between 11 AM and 8 PM and typically coincided with periods of highest total discharge. Off-season video monitoring of the Wells Dam fishways for the 2005-2006 winter period (November 16, 2005 to April 30, 2006) found no adult bull trout utilizing the fishway.

The second objective is to assess project-related impacts on upstream and downstream passage of sub-adult bull trout. To this end, sub-adult bull trout were PIT tagged opportunistically when encountered during standard fish sampling operations at the Project or during tributary smolt trapping activities. In 2006, no sub-adult bull trout were observed at the Project, but 20 sub-adults were opportunistically PIT-tagged during tributary smolt trapping operations. Off-season video monitoring of the Wells Dam fishways for the 2005-2006 winter period (November 16, 2005 to April 30, 2006) found no sub-adult bull trout utilizing the fishway.

The third objective is to investigate the potential for sub-adult entrapment or stranding in off-channel or backwater areas of the Wells Reservoir. In 2006, this objective was addressed through a field survey of potential bull trout stranding sites conducted during a period of low reservoir elevation associated with the Methow River flood control program. High resolution bathymetric information in combination with Project information (reservoir elevations, backwater curves, inflow patterns) were used to identify potential stranding sites for the survey. No stranded bull trout (sub-adult or adult) were found during the 2006 field survey.

The fourth objective is to identify the Core Areas and Local Populations of those bull trout that utilize the Wells Project. In 2006, 10 genetic samples were collected from adult bull trout during radio-tagging operations at Wells Dam. Additionally, Douglas PUD also provides funding for genetic sampling (including PIT tagging) of adult and sub-adult bull trout captured from smolt trapping operations at locations outside of the Wells Project Boundary on the Twisp and Methow rivers (up to 10 genetic samples per location). Ten genetic samples were collected from these

off-Project operations in 2006. These samples will be analyzed and compared to genetic baseline data by the USFWS. Currently, such a genetic baseline has not yet been developed, and more work is required by the USFWS to generate useful information from the collected genetic data. However, for the 10 bull trout radio-tagged at Wells Dam in 2006, spawning stock information may be inferred, since all 10 were detected in spawning tributaries during spawning-season mobile surveys. Based on these mobile radio-telemetry surveys, the bull trout sampled at the Wells Dam fishways in 2006 appear to be 70% associated with the Methow River Core Area, and 30% associated with the Entiat River Core Area.

The WBTMMP is a multi-year plan for which tagging is scheduled each year from 2005 to 2007, and for which tracking will continue until 2008. This report represents the results of activities conducted in 2006.

1.0 INTRODUCTION

In August 1993, Douglas, Chelan, and Grant Public Utility Districts (collectively, "Mid-Columbia PUDs") initiated discussions to develop a long-term, comprehensive program for managing fish and wildlife that inhabit the mid-Columbia River basin (the portion of the Columbia River from the tailrace of Chief Joseph Dam to the confluence of the Yakima and Columbia rivers).

These discussions first explored the possibility of developing an ecosystem-based plan for managing fish and wildlife resources inhabiting the mid-Columbia River basin. Due to the immense breadth of this type of plan, the negotiating parties decided to focus on an agreement for aquatic species inhabiting the mid-Columbia River basin including fish, plants and animals. After extensive review, the negotiating parties further concluded, given the likelihood that certain species of salmon and steelhead would be listed in the near future under the Endangered Species Act (ESA) and given the lack of information regarding the other aquatic species, that the best basin-wide approach would be to develop an agreement for anadromous salmonids, specifically: spring, summer/fall Chinook salmon (*Oncorhynchus tshawytsha*); sockeye salmon (*O. nerka*); coho salmon (*O. kisutch*); and steelhead (*O. mykiss*) (collectively, "Plan Species") which are under the jurisdiction of the National Marine Fisheries Service (NMFS).

On July 30, 1998, the Public Utility District No. 1 of Douglas County (Douglas PUD), which operates the Wells Hydroelectric Project (Wells Project), submitted an unexecuted form of an Application for Approval of the Wells Anadromous Fish Agreement and Habitat Conservation Plan (the "HCP Agreement") to the Federal Energy and Regulatory Commission (FERC) and to NMFS. Furthermore, to expedite the ability of FERC to complete formal consultation, Douglas PUD prepared a biological evaluation of the effects of implementing the Habitat Conservation Plan (HCP) on listed species under the jurisdiction of the US Fish and Wildlife Service (USFWS).

In a letter to FERC, the USFWS requested consultation under Section 7 of the ESA regarding the effects of hydroelectric project operations on bull trout (*Salvelinus confluentus*) in the Columbia River (letter from M. Miller, USFWS, to M. Robinson, FERC, dated January 10, 2000). The request for consultation was based on observations of bull trout in the study area. In its reply to the USFWS, FERC noted that there was virtually no information on bull trout in the mainstem Columbia River.

On November 24, 2003, Douglas PUD filed an application for approval of the executed Wells HCP. The 2004 application for approval replaced the 1998 application with the executed form of the Wells HCP.

On December 10, 2003, the USFWS received a request from FERC for formal consultation to determine whether the proposed incorporation of the HCP Agreement into the FERC license for operation of the Wells Hydroelectric Project was likely to jeopardize the continued existence of the Columbia River distinct population segment (DPS) of ESA-listed bull trout, or destroy or adversely modify proposed bull trout critical habitat. In response to the FERC request, the USFWS submitted a Biological Opinion (BO) and issued an Incidental Take Permit (ITP) to

Douglas PUD. On June 21, 2004, FERC issued an order incorporating the HCP Agreement and the bull trout BO into the FERC license for the Wells Project. As requested by the new license article, Douglas PUD, in concert with the USFWS, developed and began to implement the Wells Bull Trout Monitoring and Management Plan (WBTMMP).

2.0 STUDY GOAL

The goal of the WBTMMP is to monitor and evaluate bull trout presence in the Wells Project and quantify and address, to the extent feasible, potential project-related impacts on bull trout from Project operations and facilities. The plan is designed specifically to (1) address ongoing project-related impacts through the life of the existing operating license; (2) provide consistency with recovery actions as outlined in the USFWS's draft bull trout recovery plan; and (3) monitor and minimize the extent of any incidental take of bull trout consistent with Section 7 of the Endangered Species Act.

The WBTMMP has four main objectives, specifically to (1) identify potential project-related impacts on upstream and downstream passage of adult bull trout through the Wells Dam and reservoir and implement appropriate measures to monitor any incidental take of bull trout; (2) assess similar impacts on sub-adult bull trout; (3) investigate the potential for sub-adult entrapment or stranding in off-channel or backwater areas of Wells Reservoir; and (4) identify which Core Areas and Local Populations of bull trout utilize the Wells Project.

This report is divided into four parts. The first part consists of background information outlining the Plan's origin (Section 1.0 and Section 2.0). The second part provides a brief description of bull trout biology, life history, and their status under the Endangered Species Act (Section 3.0). The third part provides a description of the Wells Project study site including background regarding previous bull trout studies at Wells Dam (Section 4.0). The fourth part describes the strategies used by Douglas PUD to address the four objectives of the plan, the methods used, the results observed to 31 Jan 2007, and a brief discussion of ongoing and future work (Section 5.0 and 6.0).

3.0 BULL TROUT BIOLOGY AND STATUS

Bull trout are native to northwestern North America, historically occupying a large geographic range extending from California north into the Yukon and Northwest Territories of Canada, and east to western Montana and Alberta (Cavender 1978). They are generally found in interior drainages, but also occur on the Pacific Coast in Puget Sound and in the large drainages of British Columbia.

Bull trout currently occur in lakes, rivers and tributaries in Washington, Montana, Idaho, Oregon (including the Klamath River basin), Nevada, two Canadian Provinces (British Columbia and Alberta), and several cross-boundary drainages in extreme southeast Alaska. East of the Continental Divide, bull trout are found in the headwaters of the Saskatchewan River in Alberta, and the McKenzie River system in Alberta and British Columbia (Cavender 1978; McPhail and Baxter 1996; Brewin and Brewin 1997). The remaining distribution of bull trout is highly fragmented.

Bull trout are members of the char group within the family Salmonidae. Bull trout closely resemble Dolly Varden (*Salvelinus malma*), a related species. However, genetic analyses indicate that bull trout are more closely related to an Asian char (*S. leucomaenis*) than to Dolly Varden (Pleyte et al. 1992). Bull trout are sympatric with Dolly Varden over part of their range, most notably in British Columbia and the Coastal-Puget Sound region of Washington State.

Bull trout are believed to have more specific habitat requirements than other salmonids (Rieman and McIntyre 1993). Growth, survival, and long-term persistence are dependent upon habitat characteristics such as cold water, complex instream habitat, a stable substrate with a low percentage of fine sediments, high channel stability, and stream/population connectivity. Stream temperature and substrate type, in particular, are critical factors for the sustained long-term persistence of bull trout. Spawning is often associated with the coldest, cleanest, and most complex stream reaches within basins. However, bull trout may exhibit a patchy distribution, even in pristine habitats (Rieman and McIntyre 1995), and should not be expected to occupy all available habitats at the same time (Rieman et al. 1997).

Bull trout exhibit four distinct life history types: resident, fluvial, adfluvial, and anadromous. The resident, fluvial and adfluvial forms exist throughout the range of the bull trout (Rieman and McIntyre 1993). These forms spend their entire life in freshwater. The anadromous life history form is currently known only to occur in the Coastal-Puget Sound region within the coterminous United States (Volk 2000; Mongillo 1993). Multiple life history types may be expressed in the same population, and this diversity of life history types is considered important to the stability and viability of bull trout populations (Rieman and McIntyre 1993).

The majority of growth and maturation for anadromous bull trout occurs in estuarine and marine waters, adfluvial bull trout in lakes or reservoirs, and fluvial bull trout in large river systems. Resident bull trout populations are generally found in small headwater streams where fish remain their entire lives.

For migratory life history types, juveniles tend to rear in tributary streams for 1 to 4 years before migrating downstream into a larger river, lake, or estuary and/or nearshore marine area to mature (Rieman and McIntyre 1993). In some lake systems, age 0+ fish (less than 1 year old) may migrate directly to lakes (Riehle et al. 1997). Juvenile and adult bull trout in streams frequently inhabit side channels, stream margins and pools with suitable cover (Sexauer and James 1993) and areas with cold hyporheic zones or groundwater upwellings (Baxter and Hauer 2000).

3.1 Bull Trout Status

On June 10, 1998, the USFWS listed bull trout within the Columbia River basin as threatened under the Endangered Species Act (FR 63(111)). Later (November 1, 1999), the USFWS listed bull trout within the coterminous United States as threatened under the ESA (FR 63(111)). The USFWS identified habitat degradation, fragmentation and alterations associated with dewatering, road construction and maintenance, mining, and grazing; blockage of migratory corridors by dams or other diversion structures; poor water quality; incidental angler harvest; entrainment into diversion channels; and introduced non-native species as major factors affecting the distribution

and abundance of bull trout. They noted that dams (and natural barriers) have isolated population segments resulting in a loss of genetic exchange among these segments (FR 63(111)). The USFWS believes many populations are now isolated and disjunct.

In October 2002, the USFWS completed the first draft of a bull trout recovery plan intended to provide information and guidance to lead to recovery of the species, including its habitat. Threatened bull trout population segments are widely distributed over a large area and because population segments were subject to listing at different times, the USFWS adopted a two-tiered approach to develop the draft recovery plan for bull trout (USFWS 2002).

The first tier addressed broad aspects of bull trout recovery that apply at the level of Distinct Population Segments. The USFWS, identified the Columbia River, Coastal-Puget Sound, St. Mary-Belly River, Jarbidge River, and the Klamath River as Distinct Population Segments. The second tier addressed bull trout recovery in smaller areas, such as specific river basins or collections of river basins within population segments, termed "recovery units." There are 22 recovery units in the Columbia River, 1 in the Klamath River, 1 in the Jarbidge River, 1 in the St. Mary-Belly River, and 2 in the Coastal-Puget Distinct Population Segment (USFWS 2002).

The State of Washington contains the Coastal-Puget Sound Distinct Population Segment and is a part of the larger Columbia River Distinct Population Segment. In total, there are 9 recovery units within the state; the Olympic Peninsula, Puget Sound, Lower Columbia River, Middle Columbia River, Upper Columbia River, Northeast Washington, and portions of the Snake River, Umatilla-Walla Walla River and Clark Fork River Recovery Unit.

The Wells Project is situated within the Upper Columbia River Recovery Unit and the USFWS has identified the Wenatchee, Entiat, and Methow rivers as its core areas. A core area represents the closest approximation of a biologically functioning unit for bull trout. Within a core area, many local populations may exist. A local population is assumed to be the smallest group of fish that is known to represent an interacting reproductive unit. Nineteen Local Populations were identified in the Wenatchee (7), Entiat (2) and Methow (10) Core Areas (Judy DelaVergne, Pers. Comm.).

4.0 STUDY AREA

The Wells Hydroelectric Project is located on the mainstem Columbia River at RM 515.6. The nearest town is Pateros, Washington, which is located approximately 8 miles upstream from Wells Dam. The dam spans 4,460 feet, with the hydro-combine structure (spillway, turbine and fishways combined into one structure) comprising 1,130 feet. Wells Dam is a 185 foot high concrete gravity dam completed in 1967. The reservoir formed by the Project extends upstream 29.5 miles past the cities of Pateros, Brewster and Bridgeport and up to the Army Corps of Engineer's Chief Joseph Dam, totaling 331,200 acre feet of water, and having a surface area of 9,740 acres at the normal maximum reservoir elevation of 781 feet above msl.

The Project includes a spillway, powerhouse, an earthen embankment section, a juvenile bypass system and two adult fishways. The spillway consists of 11 spillway gates with a combined capacity of 1,180 kcfs. The powerhouse has 10 Kaplan turbine units, equipped with minimum

gap turbine runners to increase protection for juvenile salmonids during turbine passage, with a combined hydraulic capacity of 205 kcfs and a peak generating capacity of 840,000 kW of electricity. The two adult fishways are mirror image left and right bank fishway facilities. Each of the two fishways contains a single main entrance, a collection gallery, a fish ladder, adult count station, trapping facilities and an exit in the forebay. The juvenile bypass system utilizes five of the existing spill bays and consists of five evenly spaced surface collector entrances that guide fish into and through the juvenile bypass system and into the tailrace of the dam.

4.1 Previous Bull Trout Study at Wells Dam

Columbia River bull trout have been observed and counted at Wells Dam since 1998. In 2000 the USFWS requested that the mid-Columbia PUDs evaluate the status of bull trout in their respective project areas. This request was due to the potential for operations at the mid-Columbia PUD dams to affect the movement and survival of bull trout. At that time, little was known about the life-history characteristics (e.g., movements, distribution, habitat use, etc.) of bull trout in the mid-Columbia River. Therefore, in order to assess the operational effects of hydroelectric projects on bull trout within the mid-Columbia, a three PUD (Grant, Chelan and Douglas PUDs) radio-telemetry study was implemented beginning in 2001 (BioAnalysts 2004). The goal of the study was to monitor the movements and migration patterns of adult bull trout in the mid-Columbia River. The number of bull trout collected and tagged at each dam (Rock Island, Rocky Reach, and Wells) was based on the proportion of fish that migrated past those dams in 2000. Radio tags were applied to bull trout during their upstream migrations in 2001 and 2002.

Bull trout at Wells Dam were trapped at the brood-stock collection facility located within the left bank fish ladder. Bull trout > 40 cm were anesthetized, weighed, measured and radio tags were inserted into the peritoneal cavity using surgical procedures similar to those described in Summerfelt and Smith (1990). After recovery from sedation, the fish were released. In order to increase the sample size of fish ascending the ladder system, half of the radio-tagged fish were released downstream of the dam. The remaining radio-tagged fish were released upstream from the dam, as close to the dam as possible, yet outside of the influence of the forebay hydraulics (including spill and bypass entrainment flows). A combination of aerial and underwater antennas were deployed in order to document the presence of bull trout at the Project, identify passage times and determine their direction of travel (upstream/downstream). Additional telemetry systems were deployed to monitor behavior in the fish ladders. All possible access points to the adult fish ladders and the exits were monitored individually in 2001, 2002 and 2003, allowing the route of passage to be determined as well as the exact time of entrance and exit from the ladder system. English et al. (1998, 2001) provided a detailed description of the telemetry systems at each of the dams and within the tributaries. To assess bull trout movements into and out of the Wells Reservoir, fixed-station telemetry monitoring sites were established at the mouth of the Methow and Okanogan rivers and periodic aerial surveys were conducted on the reservoir and throughout both watersheds (see English et al. 1998, 2001).

The key findings of these previous studies (BioAnalysts 2004) were:

- Total upstream fishway counts (May 1st to November 15th) at Wells Dam from 2000 to 2003 were 90, 107, 76, and 53 bull trout, respectively. Bull trout migrating

upstream through Wells Dam in 2001 were 5 year old (n=2, mean fork length=55.6cm) and 6 year old (n=6, mean fork length= 54.6cm) fish as determined by scales.

- Adult bull trout made migrations upstream through Wells Dam from May through November. Peak movement occurred in May and June with 94, 95, 92, and 89 percent of adult bull trout being detected during these months at Wells Dam for years 2000-2003, respectively.
- Tagged migratory adult bull trout successfully moved both upstream and downstream past the Project. Five radio-tagged bull trout passed downstream through Wells Dam, four through Rocky Reach, and eight through Rock Island from 2001 to 2003. None of the downstream passage events resulted in mortality to bull trout.
- Median Wells tailrace occupancy times in 2001-2003 were 1.53, 7.84, and 1.00 days, respectively. Median Wells fishway passage times in 2001-2003 were 8.87, 7.60, and 1.16 days, respectively. Median Wells ladder passage times in 2001-2003 were 5.70, 0.23, and 0.16 days, respectively.
- Adult bull trout migrating upstream of Wells Dam were destined for the Methow River. Between 2001-2003, no bull trout selected the Okanogan system (one trout moved into the Okanogan, but left shortly thereafter and moved into the Methow system).
- Median travel time from Wells Dam (ladder exit) to the Methow River in 2001-2003 was 0.40, 2.78, and 1.09 days, respectively.
- All 28 tributary entrance events occurred before June 27. Bull trout in the Methow system selected two primary areas, the mainstem Methow River and the Twisp River.
- 30% of bull trout that entered the Methow River have been detected leaving the system. Tributary exit dates were recorded for 78% of these emigrating bull trout and 86% of these left the Methow River system between Oct-Dec.
- It appears that no radio tagged bull trout were injured at the dams or in the reservoirs due to project effects during telemetry monitoring in 2001, 2002, and 2003.
- 92% and 53% of tagged bull trout detected in the vicinity of Wells Dam entered the Wells Hatchery Outfall in 2001 and 2002, respectively, possibly in search of prey near the hatchery outfall.

5.0 WELLS BULL TROUT MONITORING AND MANAGEMENT PLAN

The goal of the WBTMMP is to identify, develop, and implement measures to monitor and address potential project-related impacts on bull trout from Wells Project operations and facilities. This plan is intended to be an adaptive approach, where strategies for meeting the goals and objectives may be negotiated under a collaborative effort with the USFWS based on new information and ongoing monitoring results.

Through monitoring and implementation of WBTMMP measures, this plan's goals are designed specifically to: (1) address ongoing project-related impacts through the life of the existing operating license; (2) provide consistency with recovery actions as outlined in the USFWS's draft bull trout recovery plan; and (3) monitor and minimize the extent of any incidental take of bull trout consistent with Section 7 of the Endangered Species Act.

Douglas PUD has committed to use the management strategies outlined in this section to meet the protection, monitoring, and evaluation (PME) measures outlined in the 2004 BO for bull trout; and will simultaneously address potential project-related impacts on bull trout for the duration of the existing license as required by license articles 61, 62 & 63. The PME measures will also be consistent with the USFWS's overall bull trout recovery plan and with Section 7 of the Endangered Species Act.

The WBTMMP has four main objectives. Specifically, these are to: (1) identify potential project-related impacts on upstream and downstream passage of adult bull trout through the Wells Dam and reservoir and implement appropriate measures to monitor any incidental take of bull trout; (2) assess similar impacts on sub-adult bull trout; (3) investigate the potential for sub-adult entrapment or stranding in off-channel or backwater areas of the Wells Reservoir; and (4) identify which Core Areas and Local Populations of bull trout utilize the Project area. Each of these four objectives is treated separately below.

5.1 Objective 1

The first objective was to identify potential project-related impacts on upstream and downstream passage of adult bull trout through the Wells Dam and reservoir and implement appropriate measures to monitor any incidental take of bull trout. This objective was addressed using four strategies: (1) an adult bull trout telemetry program was implemented to monitor adult upstream and downstream passage in the Wells Project and to monitor any incidental take of bull trout; (2) passage results and operational data were analyzed to determine if correlations exist between passage times and passage events and project operations; (3) video monitoring was used to determine off-season adult bull trout passage through the adult fishways at Wells Dam; and (4) should upstream or downstream passage problems be identified, to assess the feasibility of options to modify upstream passage facilities or operations that reduce the impact to bull trout passage.

5.1.1 Strategy 1-1: Adult bull trout telemetry program

The adult bull trout telemetry program has several main goals. First, the program would allow monitoring of bull trout movements in the Wells Project, including the timing and frequency of upstream and downstream passage events (and associated survival rates). Second, the program allowed for monitoring of any incidental take. Finally, the program also supported several of the other objectives of the WBTMMP. For example, the program provided genetic samples of the radio-tagged bull trout (in support of strategy 4-1), and provided data on the timing and frequency of movements into and out of spawning tributaries (in support of strategy 4-2). In brief, the program involves the capture and radio-tagging of 10 adult bull trout each year for three years (May 2005 through July 2007), and tracking until 2008. Details of methodology and results are presented below.

5.1.1.1 Tagging

Bull trout at Wells Dam were trapped using the brood-stock collection facilities located within the East and West fishways. Trapping operations occurred during the peak of the bull trout passage period. The majority of the trapping occurred in the East fishway, though the West fishway trap was used periodically in both 2005 (LGL and Douglas PUD 2006) and 2006 (Table 1).

In 2006, trapping occurred in the East fishway for 6 days per week, and for 8 hours per day. In addition, the Washington Department of Fish and Wildlife (WDFW) operated the West ladder trap one 24 hour period of every three day period for Chinook brood-stock collection. Bull trout were tagged opportunistically from the West ladder (Table 1). The brood-stock collection facilities were located at pool 40 approximately half way up each fish ladder. The traps were operated by placing a barrier fence across the entire width of the pool. When a trap was in operation, all fish attempting to ascend the ladder were forced to ascend a steep-pass denil into an upwell enclosure, and then down a sorting chute. When a bull trout was observed in the sorting chute, it was redirected into a holding facility; whereas non-target species were shunted back to the ladder upstream of the trapping barrier. When a bull trout was observed in the West ladder sorting chute, a technician activated a pneumatic gate diverting the fish into the Wells Hatchery brood stock collection pond. In the East ladder, bull trout were pneumatically diverted into a 1236 L holding tank. The fish ladder supplied the East ladder holding tank with freshwater at a rate of 24 L/min to maintain adequate dissolved oxygen and temperature levels. For details of the 2005 tagging efforts, see the 2005 WBTMMP Annual Report (LGL and Douglas PUD 2006).

Bull trout collected in the East ladder were tagged immediately after capture. Those collected in the West ladder were tagged at the end of the 24 hour trapping session when the hatchery pond was processed for fish. Bull trout captured on the West ladder were subsequently transported over to the East ladder tagging facility. The collected bull trout were netted from the holding tank and transferred to an anesthetic vessel containing an 90 mg/L solution of tricaine methanesulfonate (MS-222) and a few drops of Stress Coat (Aquarium Pharmaceuticals, Inc. Chalfont, PA). After 1.5 to 2 minutes, the fish lost equilibrium and was considered to be adequately anesthetized. The fish was then removed from the solution, weighed, measured, and placed in a wet V-shaped trough (coated with Stress Coat to minimize scale loss and maintain the exterior mucous coat) for further processing. A tube was placed in the fish's mouth, supplying cool river water and MS-222 (45 mg/L), flushing the gills, and maintaining unconsciousness during the procedure. A small (1 cm^2) clip was taken from the upper lobe of the caudal fin, and placed in non-denatured alcohol to be sent to the USFWS for genetic analyses. Four to five scales were removed from the area above the lateral line (adjacent to the "line" between the end of the dorsal fin and the start of the anal fin), and placed in a scale book to be sent to the WDFW for aging analyses. For sub-adults, (bull trout smaller than 40 cm), a Passive Integrated Transponder (PIT) tag was injected into the dorsal musculature, and the fish was released back into the fish ladder (upstream of the trapping barrier). Larger fish were PIT and radio-tagged as described below.

Surgical procedures were similar to those described in Adams et al. (1998), Martinelli et al. (1998), and Summerfelt and Smith (1990). A 3-4 cm incision was made 2 cm away from and parallel to the mid-ventral line starting approximately 3 cm anterior to the pelvic girdle (and only deep enough to penetrate the peritoneum). A PIT tag was placed into the body cavity. A shielded-needle catheter was then inserted through the incision, posteriorly between the pelvic girdle and viscera, to a point 5-10 cm off-center from the mid-ventral line and posterior to the origin of the pelvic fins. The catheter was then pulled back onto the needle shaft, exposing the point of the needle. Pressure was then applied until both the needle and catheter pierced the skin of the fish. The needle was pulled back out of the incision, leaving the catheter in position to guide the transmitter antenna through the body wall of the fish.

Table 1. Timing of trap operations and catch of bull trout at Wells Dam, 2006.

EAST LADDER

Day	Date	Open	Close	Duration (h)	Catch
Sunday	14 May	10:00 AM	6:00 PM	8.0	
Monday	15 May	10:00 AM	6:00 PM	8.0	
Tuesday	16 May	10:00 AM	6:00 PM	8.0	
Wednesday	17 May	10:00 AM	6:00 PM	8.0	
Thursday	18 May	10:00 AM	6:00 PM	8.0	1
Friday	19 May	10:00 AM	6:00 PM	8.0	1
Saturday	20 May			0.0	
Sunday	21 May	9:00 AM	5:00 PM	8.0	1
Monday	22 May	9:00 AM	5:00 PM	8.0	
Tuesday	23 May	9:00 AM	5:00 PM	8.0	
Wednesday	24 May	9:00 AM	1:50 PM	4.8	4
	TOTAL CATCH				**7 Bull Trout**
	Total Op Time				**76.83 h**

WEST LADDER

Day	Date	Open	Close	Duration (h)	Catch
Sunday	14 May			0.0	
Monday	15 May	11:00 AM	12:00 AM	13.0	
Tuesday	16 May	12:00 AM	8:00 AM	8.0	2
Wednesday	17 May			0.0	
Thursday	18 May	8:15 AM	12:00 AM	15.8	
Friday	19 May	12:00 AM	8:15 AM	8.3	1
Saturday	20 May			0.0	
Sunday	21 May	8:00 AM	12:00 AM	16.0	
Monday	22 May	12:00 AM	8:00 AM	8.0	
Tuesday	23 May			0.0	
Wednesday	24 May			0.0	
	TOTAL CATCH				**3 Bull Trout**
	Total Op Time				**69.00 h**

The radio transmitter was implanted by first threading the antenna through the incision end of the catheter. Both the antenna and catheter were then gently pulled posteriorly while the transmitter was inserted into the body cavity through the incision. The position of the transmitter inside the fish was adjusted by gently pulling on the antenna until the transmitter was resting horizontally in the body cavity directly under the incision. An intraperitoneal antibiotic was pipetted (50 μL) into the incision to prevent infection. The incision was closed with four to five interrupted, absorbable sutures (3-0 braided Coated Vicryl and taper RB-1 needle, Ethicon Corp.) evenly spaced across the incision. The antenna was then attached to the side of the fish with a single suture approximately 1 cm posterior to the antenna exit site. The incision site was cleaned, and a small amount of a cyanoadhesive compound (Vetbond) was applied to the incision and antenna exit site to secure the sutures in place. The fish was then transferred to a recovery tank (a cooler, supplied with flow-through river-water, and supplied with oxygen through an air stone) located on the back of a pickup truck. Note that approximately one minute before the procedure was complete, the MS-222 was removed from the water flushing over the gills to begin the recovery process. Surgical equipment was disinfected with a diluted germicidal solution before and after each fish.

After the surgical procedure was complete, the flow-though water was detached from the recovery tank, and the fish was quickly transported to the release site. At the release site, the air stone was removed and the recovery tank was placed into the river. The tank was gently rolled onto its side and the lid was opened allowing the fish to swim free of the vessel. The swimming behavior of the fish was observed and any abnormalities were noted. All fish were released at the Starr Boat Ramp, which was as close to the dam as possible, while still outside of the influence of the forebay hydraulics (including spill and bypass entrainment flows). All tagged fish, released upstream of Wells Dam, were counted as a successful adult fishway passage event for the year it was tagged.

The goal was to tag and release 10 adult bull trout each year from 2005-2007. This number represents approximately 13% of the average annual ladder counts from May to July, 2000 to 2003. To increase sample size, it was decided to monitor the radio-tagged bull trout that were released by the USFWS in the Methow in 2006 (n=13), and those that were released by the Public Utility District No. 1 of Chelan County (Chelan PUD) at Rock Island and Rocky Reach dams in 2005 (n=38) and 2006 (n=29).

A variety of tag types were used to track bull trout in the mid-Columbia during the study period. Chelan PUD tagged bull trout using coded transmitters manufactured by Lotek. In 2005, Douglas PUD tagged bull trout using similar tags, but from a different manufacturer (Grant Systems Engineering). In 2006, Douglas PUD and the USFWS both used motion-sensor coded transmitters manufactured by Lotek. These transmitters changed their broadcast code if the tag remained motionless for 24 hours. For this study, the "motionless" signal was assumed to indicate the death of the fish or the expulsion of the tag. Tags were programmed to have mid-range motion sensitivity, which was shown during Lotek field tests (Lotek, unpublished data) to be most suitable to detect the death of fish.

Battery life for all tags was approximately two-years, but because of variable tag retention times in individual fish, and inherent inconsistencies in transmitter battery life, take levels were calculated using data from only the first year (365 days) of tag life for each tagged fish. Tag detections occurring outside of this period were not used for take monitoring, but were compiled (through July 2008) to assist the USFWS with characterizing movements of bull trout in the mainstem (Douglas PUD, 2004).

5.1.1.2 Telemetric monitoring

A combination of aerial and underwater antennas were used to document the presence of bull trout at the Project, identify passage times and determine their direction of travel (upstream/downstream). Three aerial antennas monitored the mainstem Columbia River 3 miles downstream of the dam to detect any movements of bull trout out of the study area. Two aerial stations, located immediately downstream of the dam on each side of the river, monitored movements within the Wells tailrace. Five combined aerial antennas monitored movements in the Wells forebay. Underwater dipole arrays were deployed into each of five spillbays (2, 4, 6, 8, and 10) where spring/summer bypass spill is typically released. In each spillbay, a dipole antenna was mounted on each of the left and right bulkhead tracks at approximately 10 ft off the bottom of the spill intake floor. In addition, on gates 2 and 10, paired dipole antennas were deployed approximately 10 ft below the water surface to monitor spill water passing via the sluice gates. Finally, nine underwater antennas were deployed within each fishway to monitor bull trout approach, ascent, and exit timing. To assess bull trout movements into and out of the Wells Reservoir, fixed-telemetry monitoring sites were established at the mouth of the Methow and Okanogan rivers. For each tributary, a pair of antennas were deployed, one facing upstream and one facing downstream, in order to determine the direction of fish movements within the tributary. English et al. (1998, 2001) provided a description of the typical telemetry systems setup for Wells Dam and at the mouths of tributaries.

Radio-tagged bull trout were tracked while in the Wells Project (dam and reservoir) until a tributary entrance was observed, and after reservoir re-entry. Fixed-station receiver sites were operated to detect any upstream and downstream movement at tributary entrances. Periodic mobile tracking methods were also used to confirm the presence of bull trout within tributaries and to track fish within the reservoirs (Table 2 - Table 4). Mobile methods included aircraft, boat, vehicle and/or foot surveys.

Tracking data were compiled continuously throughout the year to determine fish locations, tag status, and the need to deploy tag recovery operations in the Wells Project. Douglas PUD sponsored tracks in the Wells Dam reservoir and surrounding areas (Table 2). The USFWS conducted several mobile surveys of the Methow River Core Area (Table 3), and provided Douglas PUD with the location and date of any records of bull trout detections. Similarly, Chelan PUD monitored Douglas PUD bull trout frequencies during several of their mobile tracks in the Entiat and the Wenatchee systems (Table 4).

Table 2. Dates and locations of Douglas PUD sponsored mobile tracks of the Wells Dam reservoir and surrounding areas, 2006.

Date	Survey Type	Location	Tags Detected
9 May 2006	Truck	Wells forebay, Methow to old hatchery	none
23 May 2006	Boat	Wells tailrace to gateway	none
23 May 2006	Truck	Wells forebay, Methow to old hatchery	11,12,13,15,16
19 Sep 2006	Boat	Wells Tailrace	one non-DCPUD tag
21 Dec 2006	Boat	Wells tailrace to Beebe Bridge	11,20, one non-DCPUD tag

Table 3. Mobile tracks performed by the U.S. Fish and Wildlife Service (USFWS) for which Douglas PUD bull trout tags were detected in 2006. Survey types are not known by date, but the USFWS performed a total of 60 truck and foot surveys.

Date	Locations	DPUD Tags Detected
20 Apr 2006	Columbia	3
11 May 2006	Columbia	2
1 Jun 2006	Columbia	14
5 Jun 2006	Columbia, Methow	2,11,12,15,16,17,18,20
6 Jul 2006	Methow	20
7 Jul 2006	Entiat	13,17,19
12 Jul 2006	Goat Creek	16
13 Jul 2006	Twisp	2,11,12,14,15,18
21 Jul 2006	Entiat	13,17,19
11 Oct 2006	Methow, Twisp	2,11,12,14,15,16,18,20
19 Oct 2006	Methow	11,12

Table 4. Dates and locations of Chelan PUD mobile tracks that monitored the Douglas PUD bull trout tag frequencies in 2006.

Date	Survey Type	Locations	DPUD Tags Detected
19 Sep 2006	Aerial	Columbia, Wenatchee, Entiat (a), Methow (b)	a: 13, 19; b: 12, 20
30 Nov 2006	Boat	RR reservoir (RR Dam to Beebe Bridge); 1/2 of RI reservoir.	none
1 Dec 2006	Boat	Rest of RI reservoir; WAN reservoir (Crescent Bar to RI Dam)	none
20 Dec 2006	Aerial	Columbia, Wenatchee, Entiat, Mad	none
10 Jan 2007	Boat	Columbia mainstem (RI to Wells)	none
11 Jan 2007	Boat	Columbia mainstem (RI to Cresent Bar)	none
24 Jan 2007	Aerial	Columbia, Wenatchee, Entiat, Mad	none

Aerial surveys typically included the Columbia River (from Rock Island Dam to Wells Dam), the Wenatchee River (from the confluence to the lake), the Entiat River (from the confluence to Entiat Falls), and the Mad River (from Maverick Saddle to the confluence), but were dependent upon weather conditions. Boat surveys typically surveyed both Rocky Reach and Rock Island reservoirs in their entirety, but were dependent upon weather conditions and time constraints.

5.1.1.3 Data processing

Fish detection data were downloaded from the Lotek receivers a minimum of two times per month, and more often if receiver memory began to exceed capacity prior to the scheduled downloads. In addition, telemetry systems (i.e., antennas, amplifiers, power inserters and receivers) were tested periodically during the study period to ensure they were operational and functioning correctly.

Data logged by the Lotek receivers were downloaded to a laptop computer as hex-encoded files, which were converted to standard ASCII format using software developed by LGL Limited. This software assessed several diagnostics, including the number of invalid records. If the number of invalid records was large, the receiver was downloaded a second time. The program also displayed the distribution of antenna noise by power level, so that problems with specific antennas could be isolated, and the appropriate troubleshooting measures could be taken. Data files were then uploaded to the LGL FTP site and subsequently downloaded by staff at the LGL Limited office.

Data processing throughout the study period were performed using Telemetry Manager Version 3.0, and other computer programs developed in Visual FoxPro by LGL Limited. The Telemetry Manager imported raw ASCII data files downloaded from the Lotek SRX receivers, and constructed an initial database containing records for each logged data transmission from the tagged fish. The Telemetry Manager then edited the database to remove records that did not meet the criteria identified for valid data records. Examples of invalid data included background noise at the Project, records with a signal strength that is below a set threshold, single records for a given frequency-code-location combination, and records that were recorded before the official release time and date. The Telemetry Manager then constructed an operational database that summarized the time of arrival and departure from each zone of interest. Queries of the operational database specified subsets of tagged fish for use in specific comparisons and analyses.

5.1.1.4 Data analyses

At the end of the present study, upstream and downstream passage results will be included to calculate a long-term average incidental take level for the Project. The long-term average take will be calculated by averaging the annual observed take levels for two bull trout studies (i.e., the present study will be combined with data collected from 2001 to 2003 (BioAnalysts 2004)). Total Project effect will be calculated for each passage route where feasible, by dividing the number of tagged fish "taken" via that route, by the total number of radio tagged fish. Data from each of the Douglas PUD bull trout studies will be evaluated in this manner, and at the conclusion of the present study (2008), the results from all of the previous years of monitoring will be averaged to determine the Project's take level.

The incidental take for each passage route (if any and if feasible) is to be estimated by the number of observed mortalities to tagged fish that are attributable to that passage route divided by the total number of tagged fish known to have passed through that route. If the passage route was unknown, the route determination would default to downstream passage through the dam. If any take occurred, a statistical analysis would be used to detect if the level of incidental take for

each passage route (and for the total project) exceeds the anticipated incidental take level as documented in the applicable USFWS biological opinion. The statistical analysis would be a one-tailed test of the hypothesis that the anticipated incidental take level is not exceeded.

If Project effects were shown to be negligible as measured by incidental take monitoring, then the monitoring program will be repeated on a ten year interval, as described in the WBTMMP.

5.1.1.5 Douglas PUD 2006 Tagging Results

Trapping efforts to target bull trout began on 14 May 2006, and continued for six days a week (8 hours per day) until the tenth bull trout was tagged on 24 May (Table 1). In total, 145.8 trap-hours of effort were expended, including 76.8 and 69 hours at the East and West ladders, respectively.

The radio-tagged bull trout ranged from 43 to 70 cm in fork length, and from 1.0 to 5.2 kg in weight. For the first and eighth fish, 1.0 h elapsed between the start of surgery and release, but for all other fish, the procedure took less than 35 minutes (avg. 29 minutes).

The detection histories of the 10 radio-tagged bull trout (Table 5) were as follows:

- Fish 1-56 was released on 16 May at 2:10 PM. This fish was detected between Lion Rock and the mouth of the Methow at 4:12 PM during a mobile survey on 23 May. On May 27, Fish 1-56 was detected moving upstream past the receiver in the mouth of the Methow River. It was detected on the downstream-facing antennas from 2:39 to 2:44 PM, and on the upstream-facing antenna from 2:53 PM until 3:12 PM. The fish was seen during a USFWS mobile track on 5 June at Methow River Mile 3, and again 13 July in the Twisp downstream of Reynolds Creek. Fish 1-56 moved from the Twisp into the Methow, where it was detected on 11 Oct about 5 miles downstream of Twisp. The fish was detected in the lower Methow (river mile 32) during a USFWS mobile survey on 19 Oct, 9 Nov, and 16 Nov. On 17 Nov, the fish passed the Methow fixed station moving downstream. On 18 Nov, it was detected in the Wells forebay from 12:18 to 3:36 PM. Its next detections were on 19 Nov (7 AM – 8 PM) at the Wells gateway station. Therefore, the downstream passage event occurred on 18 or 19 Nov. Since there was no spill at the time of passage, the fish must have passed via a turbine. Fish 11 was next detected on 21 Dec 2006 near Beebe Bridge, and again on 24 Jan 2007. These data show that Fish 1-56 survived passage downstream through Wells Dam.
- Fish 1-52 was released on 16 May at 2:12 PM. This fish was detected between Lion Rock and the mouth of the Methow at 4:12 PM during a mobile survey on 23 May. Fish 1-52 was detected moving upstream past the receiver in the mouth of the Methow River. It was detected at the mouth of the Methow from 31 May to 4 June. The fish was detected during a USFWS mobile track on 5 June near US 97 Bridge. Subsequently, the fish moved back to the mouth from 6 June at midnight until 7 June at 1 AM. On 13 July, it was detected between War Creek and Mystery Campground during a USFWS mobile survey of the Twisp River. Fish 1-52 moved from the Twisp to the Methow River, and was detected on 19 Sept just north of the town of Carlton, and on 11 Oct near the town of Methow. On 1 Nov, this fish was detected moving downstream past the Methow fixed station.

- Fish 1-68 was released on 18 May at 2:55 PM. Fish 1-68 was detected at 5 PM on 21 May in the Wells forebay; and a few minutes later, it was in the Wells tailrace. Therefore, the downstream passage event occurred on 21 May. The precise passage route is unknown, but the fish was not detected on the underwater spillway array. This fish was detected downstream of the United States Geological Survey (USGS) Gauging Station (just downstream of the Wells tailrace) during a 23 May mobile survey. On 24 May, this fish was detected in the Wells tailrace between 4:20 and 7:24. It was then detected in the gateway area downstream of Wells from May 24 (8 PM) until May 25 (noon). By 5 PM on 25 May, the fish was back in the tailrace, where it moved into the right fish ladder up to the first weir. By 26 May at 5 PM, it was back in the tailrace, and by 11 PM on 27 May, it was back in the gateway area. At noon on 28 May, it was again in the tailrace area, where it explored both fishways as far as the first wall. By May 31 at 3 PM, it was back in the tailrace again. The fish was detected from 11:30 PM until midnight in the gateway area. On 25 June, this fish was detected at the USFWS fixed-station at the junction of the Entiat and Mad Rivers. On 7 July, this fish was detected at mile 29 of the Entiat River during a mobile survey conducted by the USFWS. It was detected again in the Entiat on 21 July, 19 September, 19 October, and near the mouth on 2 Nov. Fish 1-68 was next detected outside of the Entiat. It was detected on three separate mobile surveys (30 Nov 2006, 10 Jan 2007, and 24 Jan 2007) in the Columbia near the Desert Canyon Golf Course. These data show that Fish 13 survived passage downstream through Wells Dam.
- Fish 1-64 was released on 19 May at 11:22 AM. Fish 1-64 was first detected in the Wells tailrace on 24 May at 5 PM. Therefore, it was not detected on the Wells forebay aerial array or the underwater spillway array, and the passage event must have occurred between 19 and 24 May. The precise passage route for this fish is unknown. It explored the right fishway up to the first wall, and was also detected at the entrance of the left fishway. It departed the tailrace on 2 June at noon. From 8:30 AM on 3 June until noon, this fish was detected in the gateway area. By 4 PM it was back in the tailrace, and entered the left fishway as far as the beginning of the fish ladder. However, the fish returned to the tailrace. The fish continued in the Wells tailrace, and successfully ascended the left ladder on 13 June (detected at the entrance at 6:55 AM and at the exit at 7 PM). The fish remained near the exit until 14 June at 10 AM. By 5 PM, the fish was detected at the upstream-facing receiver at the mouth of the Methow. On 13 July, a USFWS mobile survey relocated the fish in Twisp River upstream of Poorman Creek. Fish 1-64 moved from the Twisp into Reynolds Creek (a tributary to the Twisp), where its tag was recovered on 11 Oct. The tag was located in a pool downstream of the road culvert, near the edge in shallow water, broadcasting its “motionless” signal. It was laying on the bottom underneath some fallen tree limbs and brush. There were no carcasses in the area. These data show that Fish 1-64 survived both downstream and upstream passage through Wells Dam.

- Fish 1-58 was released on 19 May at 3:12 PM. This fish was detected at the Highway 97 bridge on the Methow at 4:11 PM during a mobile survey on 23 May. It passed the receiver station at the mouth of the Methow. It was first detected on the downstream-facing antennas at noon on 24 May. It was last seen on the upstream-facing antennas at 6:30 PM on 25 May. The fish was seen during a USFWS mobile track on 5 June near the pump station at the mouth of the Methow (just upstream from the fixed-station receiver). On 13 July, it was detected again in Twisp River downstream of War Creek. On 11 Oct, it was again detected in the Twisp. Fish 1-58 moved out of the Twisp, and was detected during a mobile track in the Methow (mile 39) on 16 Nov. Fish 1-58 next was detected in the Methow on 20 Dec 2006 near the junction of highways 20 and 153.
- Fish 1-60 was released on 21 May at 4:17 PM. This fish passed the receiver station at the mouth of the Methow. On 23 May, it was first detected on the downstream-facing antennas at 1:30 PM; its last detections on that receiver were on the upstream-facing antennas at 1:57 PM. This fish was detected downstream of Libby Creek on the Methow River at 4:03 PM during a mobile survey on 23 May. The fish was seen during a USFWS mobile track on 5 June upstream of Black Canyon Creek, and on 12 July in Goat Creek near Long Creek. It was detected again in Goat Creek on 11 Oct. On 18 October and 9 November, the tag was detected in Goat Creek broadcasting its "motionless" signal.
- Fish 1-66 was released on 24 May at 11:10 AM. Fish 1-66 was detected for about 3 minutes around 5 AM on 28 May in the Wells Forebay. Starting at 4 PM on 29 May, this fish was detected in the gateway area. Therefore, the downstream passage event occurred between 28 and 29 May. The precise passage route is unknown, but the fish was not detected on the underwater spillway array. It was also not detected on the tailrace array. The fish was detected at 8 PM on 30 May in the gateway area, and was seen during a USFWS mobile track on 5 June at the mouth of the Entiat. The fish was detected in the gateway area on 15 June from 8:30 to 9:30 AM. By 5:50 PM, it was in the Wells tailrace, where it remained until 18 June at 6 PM. The fish moved out of the tailrace, and was detected at the gateway site on 19 June from 3:28 PM to 3:36 PM. On 4 July, this fish was detected at the USFWS fixed-station at the junction of the Entiat and Mad Rivers. It was detected within the Entiat on 7 July, 21 July, and 8 October. It was detected near the mouth of the Entiat on 14 Nov. It was next detected in the Columbia, near the mouth of the Entiat on 20 Dec 2006. These data show that Fish 1-66 survived passage downstream through Wells Dam.
- Fish 1-50 was released on 24 May at 1:09 PM. This fish passed the receiver station at the mouth of the Methow. It was first detected at 9:30 AM on 26 May, on the downstream-facing antennas. Its last detections were on the upstream-facing antennas at 6:45 PM on 30 May. It was seen during a USFWS mobile track on 5 June near the pump station. This fish was detected during a 13 July USFWS mobile survey in the Twisp River upstream of South Creek. Fish 1-50 was again detected in the Twisp on 11 and 13 Oct. On 15 November, the tag was detected in the Twisp, near the Poplar Flat campground, broadcasting its "motionless" signal.

- Fish 1-54 was released on 24 May at 1:11 PM. Fish 1-54 was detected at 6:45 PM on 24 May in the Wells forebay. About an hour later, it was detected in the Wells tailrace, where it was observed until 8 PM on 24 May. Therefore, the downstream passage event occurred on 24 May. The precise passage route is unknown, but the fish was not detected on the underwater spillway array. It was then detected in the gateway area downstream of Wells Dam from May 30 (9:45 AM) until May 31 (3 AM). By 8 AM on 31 May, the fish was back in the tailrace, where it remained until 8 June at noon. It was detected in the gateway area from 11 PM on 8 June until 11 PM on 9 June. By 4 AM on 10 June, the fish was back in the tailrace. The fish moved between the tailrace and the gateway area, where it was detected until 30 June at 6 AM. On 7 July, this fish was detected at mile 10 of the Entiat River during a mobile survey conducted by the USFWS. It was detected in the Entiat River on 8 July, 21 July, 19 September, and again on 25 September. It was detected near the mouth of the Entiat on 2 Nov. These data show that Fish 1-54 survived passage downstream through Wells Dam.
- Fish 1-62 was released on 24 May at 2:12 PM. This fish passed the receiver station at the mouth of the Methow. It was first detected at 2:45 AM on 25 May, on the downstream-facing antennas and on the upstream-facing antennas at 6:15 AM on 25 May. It was seen during a USFWS mobile track on 5 June downstream of the town of Methow, and on 6 July in the Methow River at Lost Confluence. Fish 1-62 moved within the Upper Methow from the Lost River confluence to the West Fork where it was detected on 19 Sept and 11 Oct. Fish 1-62 was detected during a 12 Nov mobile survey in the Methow (at mile 6.7). Next, the fish was detected in the Wells forebay from 15 to 16 Nov. Fish 1-62 was then detected at the gateway array (30 Nov 2006). Therefore, the downstream passage event occurred between 16 and 30 Nov. Since there was no spill at the time of passage, the fish must have passed via the turbines. Subsequently, it was detected in four separate mobile tracks in the Columbia, in the Beebe Bridge / Chelan Falls area (1 Dec, 20 Dec, 21 Dec 2006; and 24 Jan 2007). These data show that Fish 1-62 survived passage downstream through Wells Dam.

Of the fish radio-tagged by Douglas PUD in 2006, there were six downstream and one upstream passage events (Table 5). All bull trout that passed through Wells Dam, either upstream or downstream, survived. All fish that passed downstream through Wells Dam during the spring (May/June) of 2006 were subsequently detected in a spawning tributary – three were detected in the Entiat, whereas one re-ascended through Wells Dam and entered the Methow. In the fall (November), two bull trout left the Methow and passed downstream through Wells Dam. Both were detected moving out of the study area at the gateway array (upper Rocky Reach Pool). Both were subsequently detected near Beebe Bridge in the mainstem Columbia River.

Travel times from release to entry into the Methow ranged from 9.8 hours to 25.5 days. The slowest bull trout was the one that descended and re-ascended through Wells Dam. For the remaining bull trout, maximum travel time to the Methow was 14.4 days (median 2.4 days).

Travel times to the Entiat could not be measured precisely because there was no fixed-station receiver operating at the mouth of the Entiat River. The first detection of all three Douglas PUD bull trout that entered the Entiat was made during a 7 July mobile survey, but the exact date of

entry is unknown. For these three fish, downstream passage through Wells Dam occurred between 0 and 4 days after release. The time between downstream passage and the last detection at the gateway array ranged from 10 to 37 days.

5.1.1.6 Douglas PUD 2005 Tagging Results

Douglas PUD released 6 radio-tagged bull trout between 26 May and 26 June 2005 (LGL and Douglas PUD 2006). Four of these bull trout were detected in the study area between 1 Feb 2006 and 31 Jan 2007. The complete detection histories for the bull trout tagged in 2005 (Table 6) are as follows:

- Fish 1-2 was released on 26 May 2005, entered the Methow River 7 hours later, was detected on 1 Sep in the West Fork of the upper Methow River, and was still in that location when it was last detected on 27 Sep 2005. The tag from this fish was recovered by USFWS staff in the West Fork Methow River on Oct 13 2005. The associated fish was not found; it is not clear what happened to it.
- Fish 1-4 was released on 2 June 2005, entered the Methow River 21 hours later, and was detected on 31 Aug 2005 in the Twisp River above the confluence of Buttermilk Creek. It has since been detected in the Wells forebay (3 Feb – 6 March 2006), and then twice at Beebe Bridge (11 May and 5 June 2006). Therefore, the downstream passage event occurred between 6 March and 11 May 2006. The precise passage route is unknown, but the fish was not detected on the underwater spillway array. By 12 June 2006 the fish returned to the tailrace, and ascended the dam through the left fish-ladder (17 June 2006). It was then detected in the Twisp River during three mobile tracks (13 July-11 Oct 2006). These data show that Fish 1-4 survived both downstream and upstream passage events through Wells Dam. The upstream passage event occurred more than 1 year after release, and as a result will not be included in incidental take calculations.
- Fish 1-6 was released on 3 June 2005, and entered the Methow River 4 days later. It was detected on 31 Aug 2005 in the Twisp River above the confluence of Buttermilk Creek. It then moved down river and was detected on 10 Nov 2005 on the receiver at the mouth of the Methow River. This fish was subsequently detected near the town of Pateros in the Columbia River on 20 Apr 2006.
- Fish 1-8 was released on 7 June 2005, and entered the Methow River approximately 12 hours later. On 12 June 2005, the fish was detected in the Wells tailrace. It was not detected in the forebay, hence the downstream passage event was assumed to have occurred on 12 June 2005. It was not detected on the underwater spillway array so it likely passed via the turbines. The fish left the study area when it passed the gateway array on 28 Nov 2005, where it was not detected again until 10 Jan 2006. Since then, this fish was detected in the tailrace and at the gateway from 16 Feb to 12 May 2006. This movement within the tailrace indicated that Fish 1-8 survived a downstream passage event through Wells Dam in 2005.
- Fish 1-10 was released on 7 June 2005, and entered the Methow River approximately 12 days later. It was detected on 27 September 2005 in the Lost River gorge, and was last detected on 13 October 2005 in Lost River near Lost River Road bridge.

- Fish 1-12 was released on 28 June 2005, and 3 hours later was detected in the Wells forebay, where it remained for under an hour. The fish entered the Methow River without being detected, but was detected 2 months later (on 31 Aug 2005) in the Twisp River above the confluence of Buttermilk Creek. Since then, the fish has been detected at the mouth of the Methow (10 April 2006), in the Wells forebay (28 April – 13 May 2006), and in the tailrace of Wells Dam (17 May – 6 June 2006). Therefore, the downstream passage event occurred between 13 and 17 May 2006. The precise passage route is unknown, but the fish was not detected on the underwater spillway array. This fish was observed moving about in the tailrace, thus it was considered to have survived dam passage. It has not been detected on any array since 6 June 2006. These data show that Fish 1-12 survived a downstream passage events through Wells Dam in 2006. This passage event occurred less than 1 year after release, and as a result will be included in incidental take calculations.

All of the bull trout radio-tagged by Douglas PUD in 2005 entered the Methow River system. Travel time between release and Methow River entry ranged from 7 hours to 12 days. Subsequently, there were four passage events at Wells Dam (3 downstream and 1 upstream; Table 6). All bull trout that passed through Wells Dam, either upstream or downstream, survived. One fish passed downstream and then re-ascended past wells and moved into the Twisp – the upstream passage event occurred more than 1 year after the fish was released, thus it will not be included in the incidental take calculations (Table 7). The other 2 downstream passage events were followed by detections indicating movement within the tailrace. Both were last detected alive in the Wells tailrace.

Table 5. Release date, tributary entry and exit dates, last locations and the upstream and downstream Wells passage events for the 10 bull trout that were radio-tagged and released at Wells Dam in 2006. The columns are laid out in an order that corresponds to the sequence of detections for the fish: release, spring passage events, tributary entry, tributary exit, fall passage events, and final detection locations.

		Spring Passage Event Date		First Detection in	Spawning	Tributary	Fall Downstream	
Fish	Release Date	Downstream	Upstream	Spawning Tributary	Tributary	Exit	Passage Event Date	Last Location
1-56	16 May 2006	-	-	27 May	Methow	17 Nov	18-19 Nov	Columbia R. near Beebe Bridge
1-52	16 May 2006	-	-	31 May	Methow	1 Nov ?		Methow R. near mouth
1-68	18 May 2006	21 May	-	25 June [a]	Entiat	30 Nov		Columbia R. near Desert Canyon
1-64	19 May 2006	19-24 May	13 June	14 June	Methow	-		Recovered 10/11/06; Twisp River
1-58	19 May 2006	-	-	23 May	Methow	-		Methow River
1-60	21 May 2006	-	-	23 May	Methow	-		Goat Creek
1-66	24 May 2006	28-29 May	-	4 July [a]	Entiat	20 Dec		Columbia R. near Entiat mouth
1-50	24 May 2006	-	-	26 May	Methow	-		Twisp River
1-54	24 May 2006	24 May	-	7 July [a]	Entiat	-		Entiat R. near Columbia Junction
1-62	24 May 2006	-	-	25 May	Methow	15 Nov	16-30 Nov	Columbia R. near Beebe Bridge

[a] Exact tributary entry date unknown as no fixed station was deployed at the mouth.

Table 6. Date of release, upstream and downstream passage events, and site of last detection for bull trout detected in the Wells study area.

	Tag Info		Passage Event Date		
Tag Group	Channel-Code	Release Date	Downstream	Upstream	Last Location
DPUD 2005	1-2	26 May 2005			Recovered 10/13/05 West Fork Methow
DPUD 2005	1-4	2 Jun 2005	Mar/May 2006	17 Jun 2006*	Twisp River
DPUD 2005	1-6	3 Jun 2005			Pateros
DPUD 2005	1-8	7 Jun 2005	12 Jun 2005		Wells tailrace 05/12/06
DPUD 2005	1-10	7 Jun 2005			Lost River
DPUD 2005	1-12	28 Jun 2005	13-17 May 2006		Wells tailrace 06/06/06
USFWS 2006	1-74	12 Apr 2006	19 Jul 2006		Recovered 9/19/06 Wells tailrace
USFWS 2006	1-76	18 Jul 2006			Dead. Pateros
Chelan 2005	14-3	30 May 2005		14 Jun 2005	Methow
Chelan 2005	14-30	31 May 2005			Wells Gateway
Chelan 2005	14-31	31 May 2005	May/June 2006	25 Jun 2005	Columbia near Wenatchee
Chelan 2005	14-34	6 Jun 2005			Beebe Bridge
Chelan 2005	14-36	7 Jun 2005			Recovered 10/28/05 Entiat
Chelan 2005	14-41	16 Jun 2005			Columbia near Wenatchee
Chelan 2005	14-42	16 Jun 2005			Wenatchee
Chelan 2005	14-44	27 Jun 2005	16 Nov 2006*	23 May 2006	Entiat
Chelan 2005	14-46	30 Jun 2005			Wells Gateway
Chelan 2006	14-171	25 May 2006	10-17 Dec 2006	3 Jun 2006	Wells Gateway
Chelan 2006	14-174	26 May 2006	14 Nov 2006	4 Jun 2006	Columbia below Entiat
Chelan 2006	14-177	30 May 2006		7-23 June 2006	Methow?
Chelan 2006	14-180	31 May 2006		4 Jun 2006	Wells Forebay
Chelan 2006	14-181	1 Jun 2006			Columbia near Wenatchee
Chelan 2006	14-182	2 Jun 2006			Columbia near Wenatchee
Chelan 2006	14-184	5 Jun 2006		19 Jun 2006	Methow near mouth
Chelan 2006	14-186	14 Jun 2006			Beebe Bridge
Chelan 2006	14-188	22 Jun 2006	Oct/Dec 2006	30 Jun 2006	Crescent Bar
Chelan 2006	14-190	29 Jun 2006			Columbia near Orondo

* passage event occurred more than 1 year after release, and will not be included in incidental take calculations

5.1.1.7 USFWS 2006 Tagging Results

Of the 13 radio-tagged bull trout released by the USFWS, two were detected in the study area between 1 Feb 2006 and 31 Jan 2007 (Table 6). The complete detection histories for these radio-tagged bull trout are as follows:

- Fish 1-74 was released in the Methow River. It was detected at the mouth of the Methow (on 17 July 2006 from 2 to 5 AM), in the Wells forebay (19 July 2006 at 3 PM), and subsequently in the Wells tailrace (19 July 2006 at 7 PM). Therefore, the downstream passage event occurred on 19 July 2006. The precise passage route is unknown, but the fish was not detected on the underwater spillway array. It was detected repeatedly in the right tailrace until 25 July 2006, when it moved into the left tailrace. This movement within the tailrace indicated that the fish survived downstream passage through Wells Dam. From 11 Aug until noon on 17 Sept 2006, the tag was broadcasting its "motionless" signal, suggesting that the tag had been expelled or the fish had died. On 19 Sept 2006, the tag was recovered from the shore in the tailrace. The tag was found in a very active fishing location indicating a potential harvest. No carcass was found.

- Fish 1-76 was released in the Methow River. It was detected in the Methow on 19, 26 and 29 Sept 2006, and at the mouth of the Methow (fixed station) from 28 Sept until 1 Oct 2006. Most recently, the tag was detected on 15 Nov and again on 20 Dec 2006 (broadcasting its motionless signal on both occasions) in the Columbia mainstem near the town of Pateros.

One bull trout tagged by the USFWS in 2006 (Fish 1-74) passed downstream through Wells Dam (Table 6). The tag was later recovered from the shore of the tailrace. As required by the WBTMMP, Douglas PUD notified the USFWS within 48 hours of tag recovery (Douglas PUD, 2004). Since the detection history for this fish showed movement within the tailrace for 2 weeks, it was assumed to have survived passage and was not considered an incidental take event due to Wells Project operations.

5.1.1.8 Chelan PUD 2005 Tagging Results

In 2005, Chelan PUD released 38 radio-tagged bull trout, of which nine were detected in the Douglas PUD study area (Table 6). The complete detection histories for these radio-tagged bull trout are as follows:

- Fish 14-3 was not detected passing the gateway area. On 12 June 2005, the fish was first seen in the right tailrace area. It milled around the tailrace until 14 June 2005, when it entered the left fishway, passed the trap and the area of the video recorder, backed down to below the trap, and re- ascended. The fish exited into the forebay on 16 June 2005. On 29 June 2005, the fish was detected entering the Methow system. On 19 Oct, 2006, the fish was detected during a mobile survey of the lower Methow. From 26-28 Oct 2006, the fish was detected in the Wells forebay. By 16 Nov 2006, the fish had returned to the Methow, as it was detected at mile 3.2. These data show that Fish 14-3 survived upstream passage through Wells Dam.
- Fish 14-30 was detected at gateway site and in the Wells tailrace in 2005. The fish was last detected at 3 AM on 21 August 2005 at the gateway zone.
- Fish 14-31 was first detected at the right fishway entrance on 3 June, 2005. The fish made repeated movements between the gateway and the tailrace area, where it milled about and ventured into fishways, but always moved back out. On 22 June, the fish left the gateway area, and moved into the Wells tailrace. It milled around in the tailrace until 25 June 2005, when it entered the right fishway. It passed the trap and the video station, and was detected at the fishway exit at 11 PM. It remained in the area of the exit until 26 June 2005. By 27 June 2005, the fish was detected entering the Methow system. In 2006, this fish was again detected at the mouth of the Methow, from 24 to 29 May, but was last seen on the upstream-facing antenna. On 29 June 2006, it was detected downstream of the dam. Therefore, the downstream passage event occurred between 29 May and 29 June 2006. The precise passage route is unknown, but the fish was not detected on the underwater spillway array. On 2 Nov 2006, it was detected during a mobile track of the Wenatchee. On 30 Nov 2006, it was detected in the Columbia near the Wenatchee Golf Course. On 11 Jan, 2007, it was detected in the Columbia upstream of Rock Island Dam. These data show that Fish 14-31 survived both upstream and downstream passage through Wells Dam.

- Fish 14-34 was first detected at the gateway site on 11 June 2005. It left the gateway area on 16 July 2005, and milled around in the Wells tailrace until 22 July 2005 when it moved into the left fishway. It passed the 1st wall, and was detected at the "fishway beginning" zone, but later moved back into the tailrace. The fish was detected on 22 July 2005 in the Wells tailrace. It was detected in the upper Entiat on 8 July 2005. Since then, it has been detected at Beebe Bridge on 5 separate mobile surveys in 2005: 3 Aug, 1 Sep, 8 Sep, 7 Oct and 19 Oct.
- Fish 14-36 was detected at the gateway site and in the Wells tailrace in 2005. From 11 to 20 June 2005, the fish was detected moving among the gateway and tailrace zones. At Wells Dam, the fish was last detected on 20 June 2005 at the right-side tailrace aerial zone. Between 8 July and 28 October 2005, it was detected during 5 separate mobile tracks in the Entiat River. The tag has since been recovered in the Entiat.
- Fish 14-41 was detected at the gateway site and in the Wells tailrace in 2005. From 20 June to 16 Sept 2005, the fish was detected moving among the gateway and tailrace zones. At Wells Dam, the fish was last detected on 16 September 2005 at the gateway zone. This fish was later detected on 21 July 2006 in the Wenatchee, and on 30 Nov 2006 in the Columbia near the mouth of the Wenatchee.
- Fish 14-42 was detected at the gateway site and in the Wells tailrace in 2005. From 26 June to 21 Aug 2005, the fish was detected moving among the gateway and tailrace zones. At Wells Dam, the fish was last detected on 21 August 2005 at the right-side tailrace aerial zone. This fish was later detected on 2 Nov 2006 in the Wenatchee.
- Fish 14-44 was detected at the gateway site and in the Wells tailrace in 2005. From 29 June to 25 Oct 2005, the fish was detected moving among the gateway and tailrace zones. In 2006, the fish was detected passing the gateway area on 5 May. By 21 May 2006 the fish was first seen in the tailrace area. It entered the right fishway on 23 May 2006, passed the trap and the video area, and exited into the forebay. On 24 May 2006, the fish was detected entering the Methow system. On 9 Nov 2006, the fish was detected on the downstream antenna at the Methow mouth. From 12 -15 Nov, the fish was detected on the Wells forebay aerial antennas, and on the underwater antennas near spill-gate 10. On 15 Nov 2006, the fish was detected during a mobile track downstream of the Starr Boat Ramp. On 16 Nov 2006, the fish was again detected in the forebay, and then in the tailrace. At Wells Dam, the fish was last seen at the gateway array, where it was detected from 16-18 Nov 2006. Therefore, the downstream passage event occurred on 16 Nov 2006. Since there was no spill at the time of passage, the fish must have passed via the turbines. On 20 Dec 2006 and 24 Jan 2007, the fish was detected in the Entiat near the mouth. These data show that the fish survived both upstream and downstream passage through Wells Dam.
- Fish 14-46 was detected at the gateway site and in the Wells tailrace in 2005. From 1-30 July 2005, the fish was detected moving among the gateway and tailrace zones. On one occasion (14 July 2005), the fish moved into the right fishway as far as the 1st wall, but later moved back out into the tailrace. The fish was last detected on 30 July 2005 at the gateway zone.

Three of the bull trout that were tagged by Chelan PUD in 2005 passed Wells Dam, recording three upstream passage events, and two downstream events (Table 6). All bull trout that passed through Wells Dam, either upstream or downstream, survived. All three of the fish that passed

upstream through Wells moved into the Methow during the spawning season. Two of these fish later returned downstream past Wells Dam. One fish was subsequently detected near the mouth of the Wenatchee. The other fish was detected in the Entiat (the downstream passage event for this fish occurred more than 1 year after it was released, thus it will not be included in the incidental take calculations; Table 7).

5.1.1.9 Chelan PUD 2006 Tagging Results

In 2006, Chelan PUD released 29 radio-tagged bull trout: four were released at Rock Island, and 25 at Rocky Reach. Of the 29 tagged bull trout, 11 were detected in the Douglas PUD study area (Table 6). The complete detection histories for these radio-tagged bull trout are as follows:

- Fish 14-171 moved between the gateway area and the Wells tailrace from 27 May to 3 June 2006. On 3 June, it moved through the left tailrace, and began its ascent of the left fishway (10:19 AM). It passed the trap at 1:45 PM, and exited into the forebay at 4 PM. The fish was detected on 16 Nov 2006 in the Methow. These data show a successful upstream passage through Wells Dam. Subsequently, this fish was detected on the upstream-facing antenna at the mouth of the Methow on 10 Dec 2006, and then at the Wells gateway array on 17 Dec, 2006. These data show a downstream passage event (between 13 and 17 Dec 2006) through Wells Dam. Since there was no spill at the time of passage, the fish must have passed via a turbine. Although the fish was not detected in the tailrace, it was assumed to have survived downstream passage, given that it was detected at the gateway array.
- Fish 14-174 moved between the gateway area and the Wells tailrace from 29 May to 4 June 2006. On 4 June 2006, it moved through the right tailrace, and started its ascent of the right fishway at 8:27 AM. It passed the trap at 10 AM on 5 June. The fish was not detected at the fishway exit. At 11:55 PM on 7 June 2006, Fish 14-174 was detected entering the Methow system. Subsequently, this fish was detected in the Methow during a 19 Oct 2006 mobile track. Detections from 9-13 Nov 2006 show the fish moving downstream past the fixed station at the Methow mouth. The fish was detected in the Wells forebay from 6-8 AM on 14 Nov 2006, and then in the tailrace at 1 PM. Therefore, the downstream passage event occurred on 14 Nov 2006. Since there was no spill at the time of passage, the fish must have passed via the turbines. From 21-22 Nov 2006, the fish was detected at the gateway array. On 20 Dec 2006, the fish was detected in the Columbia downstream of the mouth of the Entiat. These data show that the fish survived both upstream and downstream passage through Wells Dam.
- Fish 14-177 was detected at the gateway site at noon on 1 June 2006. From 2-7 June 2006, the fish was detected in the tailrace. This fish was subsequently in the Methow on 9 and 23 June 2006. These data show that Fish 14-177 survived an upstream passage event through Wells Dam, and that passage occurred sometime between 7 and 23 June 2006 without the fish being detected. The USFWS believes this tag to be malfunctioning (Mark Nelson, pers. comm.).
- Fish 14-180 passed the gateway area on 2 June 2006. By 3 June 2006, it had been detected in the Wells tailrace. On 4 June 2006, it began its ascent of the left fishway. It passed the trap at noon, and was detected at the fishway exit at 3:45 PM. On 7 June 2006, it was detected entering the Methow system. On 15 Nov 2006, this fish was detected in the Columbia near Pateros. On 28 Nov 2006, the fish was detected in the

Wells forebay. This fish is potentially still in the Wells reservoir. These data show that the fish survived upstream passage through Wells Dam.

- Fish 14-181 was detected at the gateway site on 4 June 2006. It was subsequently detected (2 Nov 2006) in the Entiat. The fish was detected on 20 Dec 2006 in the Columbia at the mouth of the Wenatchee.
- Fish 14-182 moved past the gateway site on 8 June 2006. It moved into and out of the tailrace until 10 Aug 2006, and made several excursions into the left and right fishways up to the 1st wall. The fish was detected near the Wenatchee on 14 Aug 2006.
- Fish 14-184 passed the gateway area on 10 June 2006. It milled in the tailrace, ascending both fishways to the 1st wall. On 19 June 2006, the fish entered the left fishway, passed the trap at noon, and was detected at the fishway exit at 2:19 PM. It was detected in the Wells forebay until 3 PM. By 8:46 PM, the fish was detected entering the Methow system. It was subsequently detected (16 Nov 2006) in the Methow near Gold Creek. From 9-11 Dec 2006, this fish was detected on the downstream facing antenna at the mouth of the Methow. This fish may have moved into the Wells reservoir. These data show that the fish survived upstream passage through Wells Dam.
- Fish 14-186 passed the gateway site on 18 June 2006. It milled within the Wells tailrace, entered the left fishway to the 1st wall twice (20 and 21 June 2006), and moved back to the gateway site, where it was detected until 23 June 2006. It was subsequently detected near Beebe Bridge on 16 Nov, 30 Nov, 20 Dec, and 21 Dec 2006.
- Fish 14-188 was not detected at the gateway area, but was first seen in the Wells tailrace on 26 June 2006. The fish milled within the tailrace, and at one point (28 June 2006) entered the left fishway up to the 1st weir. On 30 June 2006, the fish entered the right fishway, passed the trap at 6 AM on 1 July 2006, and was detected at the fishway exit at 8:38 AM. The fish was detected entering the Methow system on 2 July 2006. The fish was detected at the USFWS fixed-station at Methow river mile 6.7 on 24 Oct 2006. Then, it was detected on the downstream-facing receiver at the Methow mouth on 31 Oct 2006. This fish was subsequently detected passing through Rocky Reach, and Rock Island dams, and was detected on 20 Dec 2006 in the Columbia near Crescent Bar. Therefore, the downstream passage event occurred sometime between October and December 2006. Since there was no spill at the time of passage, the fish must have passed via the turbines. These data show that the fish survived both upstream and downstream passage through Wells Dam.
- Fish 14-190 passed the gateway area on 1 July 2006. On 11 July 2006, the fish entered the right fishway, it passed the trap at 7 PM, and entered the video area at 8 PM. The fish moved back down to the trap area, where it remained until 5 AM on 12 July 2006. It then moved back out to the tailrace, and then to the gateway area (15 July 2006). From 23 July 2006 to 24 Sept 2006, Fish 14-190 was detected moving about the tailrace area. On 14 Nov 2006, the fish was detected in the Columbia downstream of the junction with the Entiat. On 24 Jan 2007, the fish was detected in the Columbia near Orondo.

Six of the bull trout that were tagged by Chelan PUD in 2006 passed Wells Dam, recording six upstream passage events, and three downstream events (Table 6). All bull trout that passed upstream through Wells Dam survived, and moved into the Methow during spawning season. Two of these remained in the Methow, and one was last detected in the Wells forebay. The other three fish returned downstream through Wells Dam. All three of these fish survived during

downstream passage through Wells Dam. Two of these fish were detected downstream of the Entiat, and one was last detected at the Wells gateway array. This last fish was not detected in the Wells forebay or tailrace. Given that there were no detections at Wells Dam, the status on this fish is inconclusive (Table 7).

Table 7. Upstream and downstream passage of radio-tagged bull trout at Wells Dam in 2006. Passage events were included if they occurred within one year of the release date.

	Downstream Passage			Upstream Passage		
Tag Group	Events	Survived	Died [a]	Events	Survived	Died [b]
USFWS 2006	1	1	0	0	0	0
Chelan 2005	1	1	0	1	1	0
Chelan 2006	3	3	0	6	6	0
Douglas PUD 2005	2	2	0	0	0	0
Douglas PUD 2006	6	6	0	1	1	0
Total	13	13	0	8	8	0
Survival Rate		100%			100%	

a) prolonged detection of the tag in one place within the tailrace (i.e., no evidence of movement within tailrace).
b) last detected in forebay

5.1.1.10 Incidental Take Calculation

The 2005 and 2006 radio-tagging of adult bull trout was implemented to identify potential project-related impacts on upstream and downstream passage of adult bull trout through the Wells Dam and reservoir and to monitor any incidental take of bull trout. In 2006, 23 passage events were recorded for 17 radio-tagged bull trout. Two of these occurred more than 1 year after the fish had been released. Of the remaining 21 passage events (Table 7), there were 13 downstream and 8 upstream passage events. There were no conclusive instances of bull trout mortality resulting from these passage events. All passage events resulted in the survival of the bull trout as indicated either by movement out of the tailrace, or by movement among the tailrace detection zones. As such, the rate of incidental take in 2006 is estimated to be 0%.

5.1.2 Strategy 1-2: Correlations between passage events and Project operations

In order to assess potential impacts of Project operations on the passage of adult bull trout, correlations were generated between passage events and a suite of metrics of Project operations. These included flow through spillways and turbines, and reservoir elevations.

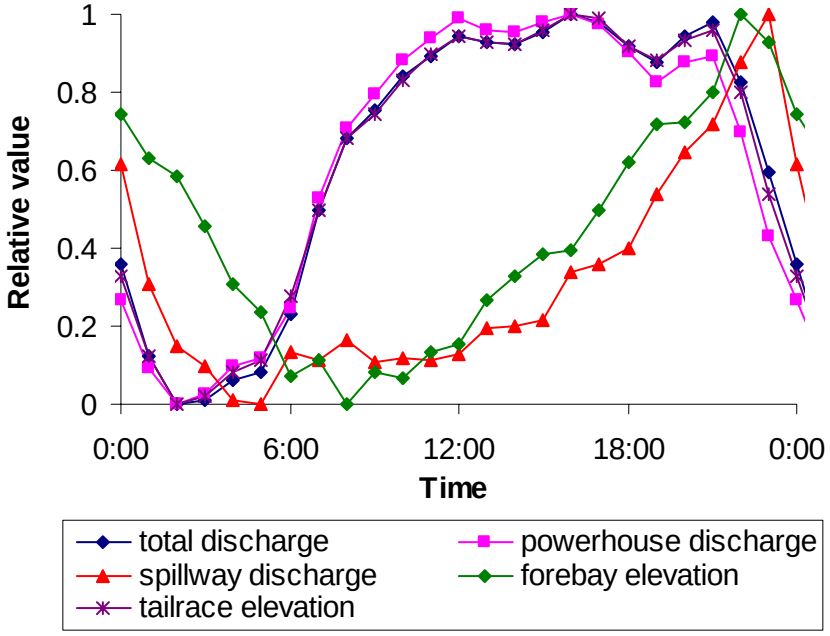
The upstream passage event data, as collected for radio-tagged bull trout, were compared against the video counts in 2006. Of the eight radio-tagged bull trout for which upstream passage data exist (i.e., excluding Fish 14-177; see above), six had a corresponding video-count observation in the correct ladder, on the correct date, and at approximately the correct time. The two missed radio-tagged fish were added to the video-count data, bringing the total number of observed bull

trout upstream passage events in 2006 to 100. These 100 upstream passage-timing data points were used in subsequent analyses of effects of Project operations on passage.

Of the 15 downstream passage events recorded for radio-tagged bull trout in 2006, six had detections in both the forebay and tailrace, and hence were of precisely known timing. Two others were known with ±1 day. Because of uncertainty in their passage timing, the other seven bull trout were excluded from analyses of Project operation effects on downstream passage.

The five available metrics of Project operations were total, powerhouse and spillway discharge; and forebay and tailrace elevations. Hourly data (from 1 May to 31 July 2006) were averaged across days to calculate hourly means (Figure 1). Lag times of -8 to +8 hours were considered for each variable to find the strongest correlations (note that a strong *negative* correlation was expected between forebay elevation and discharge). Total discharge, powerhouse discharge and tailrace elevation tracked each other, whereas spillway discharge was offset by -3 hours, and forebay elevation by +6 hours (Figure 1).

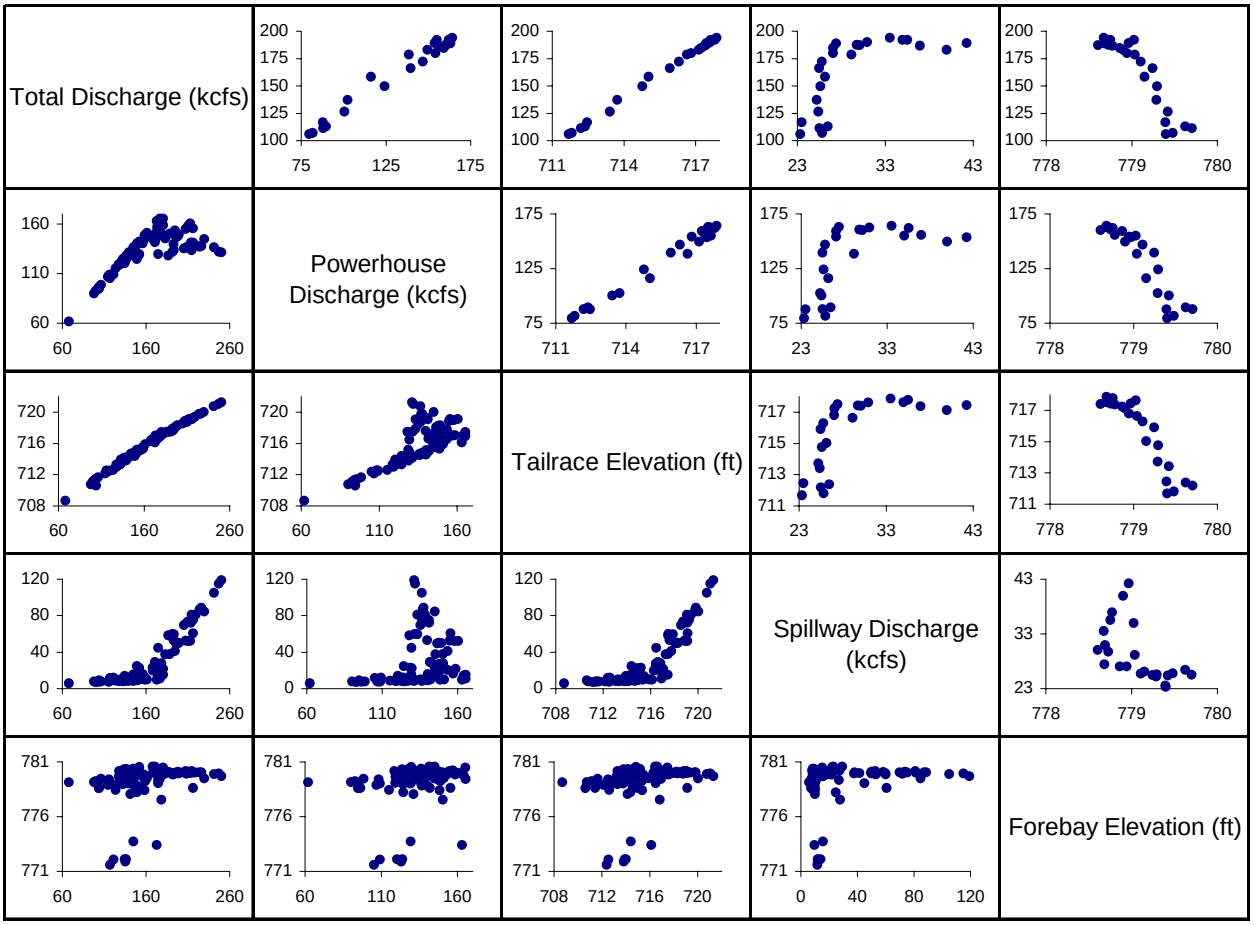
Figure 1. **Diurnal trends in Wells Project operations data, averaged from 1 May to 31 July, 2006. For comparison, the five Project operation metrics have been standardized (each observation is shown as a proportion of the range between the minimum and maximum observed values for that metric).**



Using the lagged raw operations data, hourly means were calculated for each metric. There were very strong correlations among total discharge, powerhouse discharge and tailrace elevation ($r = 0.99$; $P < 0.0001$; Figure 2). These three metrics were strongly and negatively correlated with the lagged forebay elevation ($r = -0.92$; $P < 0.0001$; Figure 2). Lagged spillway discharge was

correlated with all four other metrics, though the relationships were weaker (lagged forebay elevation r = -0.57; other three r = 0.61 to 0.66; *P* = 0.0004 to 0.0035; Figure 2). Due to the significant colinearity of these five metrics, only one was considered (total discharge) during subsequent analyses of diurnal trends.

Figure 2. **Correlation matrix for Wells Project operations data, 1 May to 31 July, 2006. Graphs above the diagonal show correlations among average hourly metrics (note spillway discharge is lagged by -3 h; and forebay elevation by +6 h); those below the diagonal show correlations among average daily metrics (no lags).**



Daily mean values showed a very strong correlation between total discharge and tailrace elevation (r = 0.99; $P < 0.0001$; Figure 2). Spillway discharge was also correlated with these two metrics (r = 0.85 to 0.88; $P < 0.0001$), as was powerhouse discharge (r = 0.70 to 0.74; $P < 0.0001$; Figure 2). The remaining pair-wise correlations, including all relationships with forebay elevation, were weaker (r = 0.23 to 0.31) but nonetheless statistically significant ($P = 0.0023$ to 0.027; Figure 2). Due to the significant colinearity of the three discharge metric and the tailrace elevation, only one of these four metrics (total discharge) was included in subsequent analyses of seasonal trends. The forebay elevation metric (which was only weakly correlated with the other four metrics) was also included in subsequent seasonal analyses.

Diurnal trends in total discharge were correlated with upstream bull trout passage (r = 0.55; $P = 0.0058$; Figure 3a). Both metrics followed a strong diurnal pattern, showing little activity in the hours before dawn, and the majority of activity in the afternoon. Bull trout upstream passage events decreased quickly in the afternoon, whereas discharge stayed high until about 10 PM and then dropped off precipitously. In general, upstream movements were less likely during periods of low discharge (Figure 3b). Note that this correlation may be coincidental (i.e., not causal), because power use (and hence Project operations) declines at night, and because fish migrations might be inhibited during darkness (i.e., not because of reduced discharge).

Figure 3. **Relationship between diurnal trends in total discharge and bull trout passage at Wells Dam, 1 May to 31 July, 2006. a) Average values, plotted as time series, were standardized for ease of comparison (each observation is shown as a proportion of the range between the minimum and maximum observed values for that metric); b) Scatter-plot of bull trout passage as a function of average hourly total discharge.**

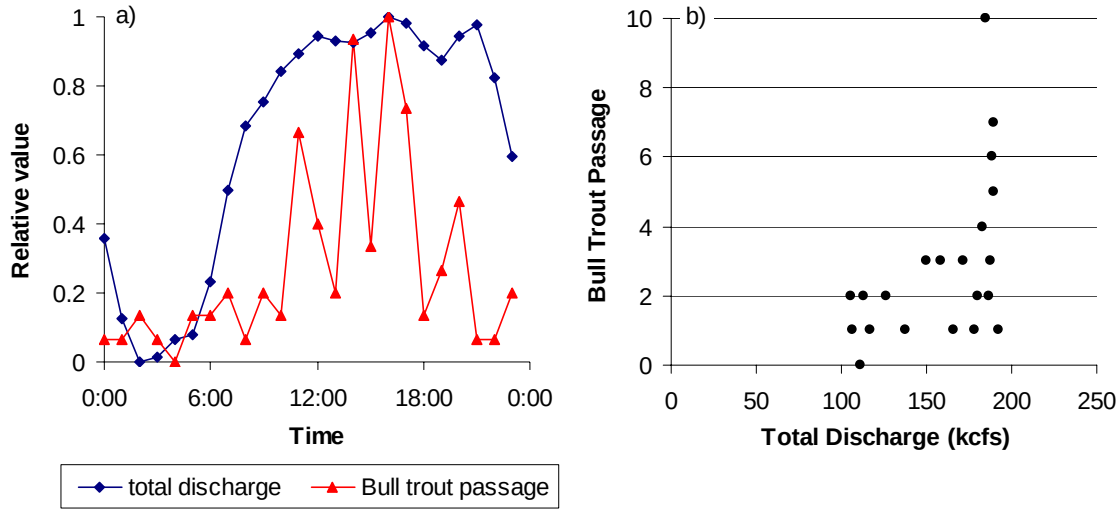
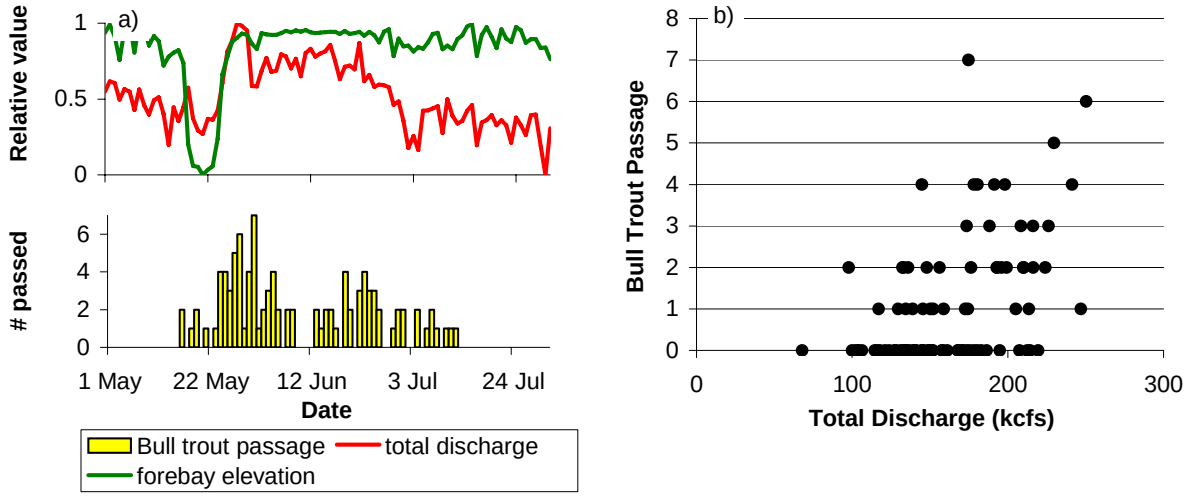


Figure 4. **Seasonal time series of bull trout passage events, average daily total discharge, and forebay elevation at Wells Dam, 1 May to 31 July, 2006. a) Average values, plotted as time series, were standardized for ease of comparison (each observation is shown as a proportion of the range between the minimum and maximum observed values for that metric); b) Scatter-plot of bull trout passage as a function of average daily total discharge.**



Seasonal trends in bull trout passage were significantly correlated with daily average total discharge ($r = 0.48$; $P < 0.0001$; Figure 4a), but not with forebay elevation ($r = 0.03$; $P = 0.80$; Figure 4a). A large increase in flows in late May were accompanied by an increase in upstream bull trout passage events. In general, upstream movements were less likely during periods of low discharge (Figure 4b). At daily average total discharge levels below 150 kcfs, the number of upstream bull trout passage never exceed 2 fish.

Too few radio-tagged bull trout moved downstream past Wells in 2006 to draw any conclusions about Project operations. Passage dates were clustered in May (mostly fish that were tagged in 2006, released above Wells, and that moved downstream to spawn in the Entiat) and in November (post spawning movements out of the Methow to reaches areas downstream of Wells Dam).

5.1.3 Strategy 1-3: Off-season fishway passage of adult bull trout

Off-season video monitoring of both Wells Dam fishways for the 2005-2006 winter period began on November 16, 2005 and continued until April 30, 2006. During this period no adult bull trout were observed utilizing the fishways.

5.1.4 Strategy 1-4: Modifications to passage facilities or operations

To date, there have been no problems identified as impacting upstream or downstream passage of adult bull trout. As such, there is no need for Douglas PUD to develop modifications to current passage facilities or operations.

5.2 Objective 2

The second objective was to assess project-related impacts on upstream and downstream passage of sub-adult bull trout. Because of an inability to collect a sufficient sample size of sub-adult bull trout, it is currently not feasible to assess sub-adult passage at Wells Dam. As such, the second objective was addressed using two strategies: (1) sub-adult bull trout were PIT tagged opportunistically when encountered at the Project, or in smolt tributary traps; and (2) video monitoring was used to determine off-season sub-adult bull trout passage through the adult fishways at Wells during the 2005-2006 winter period.

5.2.1 Strategy 2-1: Sub-adult PIT tagging program

Due to the inability to collect a sufficient sample size of sub-adult bull trout and because sub-adult bull trout are not large enough to be radio-tagged, it is not currently feasible to assess effects of Wells Dam on sub-adult bull trout passage. However, Douglas PUD has agreed to indirectly monitor take for sub-adult bull trout through PIT-tagging. This effort includes providing PIT-tags, equipment and facilitated training to enable PIT-tagging of sub-adult bull trout when these fish are incidentally encountered during certain fish sampling operations. Fish sampling operations that could have incidental captures of sub-adult bull trout included the Wells adult fishway, Methow brood stock traps, and juvenile salmonid trapping activities on the Methow and Twisp rivers. Different entities conduct these fish sampling operations, thus the provision of tags, equipment and methodology have been standardized.

Douglas PUD passively collected information from all PIT-tagged fish, including bull trout, as they passed through the fishways at Wells Dam. Douglas PUD also scanned all bull trout incidentally captured at the screw traps and adult brood collection facilities. The information collected at the dam and in the tributaries were posted on the PTAGIS website, which is operated and maintained by the Pacific States Marine Fisheries Commission.

To date (2005 and 2006 activities), no sub-adult bull trout have been PIT-tagged during tagging operations at Wells Dam. As previously mentioned, Douglas PUD provides support for PIT-tagging of bull trout collected at several off-site smolt collection facilities (Twisp and Methow rivers). In 2006, these operations PIT-tagged 20 sub-adult bull trout (all at the Twisp weir). A query of the PTAGIS database shows that none of these PIT-tagged bull trout have since been detected.

5.2.2 Strategy 2-2: Off-season fishway passage of sub-adult bull trout

Off-season video monitoring of both Wells Dam fishways for the 2005-2006 winter period began on November 16, 2005 and continued until April 30, 2006. During this period no sub-adult bull trout were observed utilizing the fishways.

5.3 Objective 3

The third objective was to investigate the potential for sub-adult entrapment or stranding in off-channel or backwater areas of the Wells Reservoir. This objective was addressed by evaluating Wells inflow patterns, reservoir elevations, and backwater curves to determine the extent of stranding or entrapment of sub-adult bull trout (if any).

5.3.1 Strategy 3-1: Inflow patterns, reservoir elevations, and backwater curves

From 17 May 11:00 PM to 18 May 8:00 AM, 2006 the elevation of the Wells Reservoir was reduced to an elevation of 772 mean sea level (msl) as part of the Methow River flood control program in order to accommodate flood flows in the Methow River. Douglas PUD conducted a field survey on 18 May from 10:00 AM to 4:00 PM towards gathering information on the potential for sub-adult bull trout stranding. Detailed bathymetric maps produced in 2005 combined with Wells Reservoir hydraulic information identified several locations where stranding of sub-adult bull trout could potentially occur. In total, 5 potential stranding locations were identified. These locations were the Methow River mouth, the Okanogan River mouth, the Kirk Islands, the shallow water habitat in the Columbia River directly across from the mouth of the Okanogan River, and the off-channel areas of the Bridgeport Bar Islands. Boat and foot surveys were conducted and included a combination of shoreline transects and inspection of isolated sanctuary pools. No bull trout, sub-adult or adult, were observed during the survey which suggests that in the event of a Wells reservoir drawdown, bull trout are able to avoid stranding and entrapment areas.

5.4 Objective 4

The fourth objective was to identify the Core Areas and Local Populations, as defined in the USFWS's Draft Bull Trout Recovery Plan, of those bull trout that utilize the Project area. This objective was addressed using 2 strategies: (1) genetic samples were gathered from radio tagged and PIT tagged fish for comparison to baseline genetic samples from Local Populations and Core Areas; and (2) in cooperation with other agencies, the locations of radio-tagged fish outside the Project area were recorded, and related to the distribution of local populations.

5.4.1 Strategy 4-1: Genetic sampling program

Douglas PUD provided the equipment and facilitated training to enable genetic sampling of bull trout during bull trout radio-tagging operations and when bull trout were incidentally collected during other fish sampling operations (on-site and off-site). Fish sampling operations that could have incidental captures of bull trout included the Wells adult fishway and juvenile and sub-adult salmonid trapping activities on the Methow and Twisp rivers. Since different entities conduct these fish sampling operations, provision of equipment and methodology were standardized. Ideally these genetic samples will be compared, by the USFWS, to genetic baseline samples when those baselines become available.

In 2006, ten genetic samples were collected from adult bull trout during radio-tagging operations at Wells Dam. Additionally, 10 genetic samples were collected from smolt trapping operations conducted by the WDFW on the Twisp and Methow rivers. All samples were sent to the USFWS's Abernathy Fish Technology Center for storage and future analysis. Currently, a genetic baseline for mid-Columbia River basin bull trout populations has not yet been developed by the USFWS. More work is required to generate useful information from the collected genetic data.

5.4.2 Strategy 4-2: Destination locations of Wells Dam bull trout

The destinations of Wells Dam bull trout were evaluated from the results of the adult radio-tagging program (see Strategy 1-1). In brief, the program involves the capture and radio-tagging of 10 adult bull trout each year from 2005 to 2007, and tracking until 2008. These fish were tracked in the Wells Reservoir, and into tributary rivers. Since other agencies were performing mobile tracking in areas outside of the Wells Reservoir, Douglas PUD worked cooperatively with these agencies to obtain more detailed locations of the radio-tagged fish.

Of the 10 bull trout tagged in 2006, seven were tracked into the Methow River. The remaining three bull trout returned downstream through Wells Dam and entered the Entiat drainage. The results of the radio-telemetry tracking suggest that 70% of bull trout tagged at Wells Dam in 2006 were associated with the Methow core area and 30% of the Wells bull trout tagged in 2006 were associated with the Entiat Core Area.

6.0 CONCLUSIONS AND RECOMMENDATIONS

As part of the first objective, 10 adult bull trout were radio-tagged at Wells Dam in 2006. Of these, 6 traveled to the Methow River, with a median travel time of 2.4 days (range 9.8 hours to 14.4 days). A seventh fish descended through Wells Dam, re-ascended through the east fishway, and reached the Methow 25.5 days after release. The remaining three bull trout tagged in 2006 passed downstream through Wells Dam, and moved into the Entiat River sometime before a 7 July mobile survey. Tracking of bull trout released by Douglas PUD, Chelan PUD and the USFWS, resulted in the detection of 13 downstream passage events and 8 upstream passage events. Based on these passage events, all of which resulted in the survival of the fish, it was estimated that the rate of incidental take in 2006 was 0%.

The second objective was to assess project-related impacts on upstream and downstream passage of sub-adult bull trout. To this end, opportunistic PIT tagging of sub-adults was successfully completed in 2006. Although no sub-adult bull trout were observed or captured at Wells Dam, 20 sub-adults were PIT-tagged during tributary trapping operations in 2006. Opportunistic PIT tagging of sub-adults should be continued in order to increase the probability of gaining useful data on migrations in the future.

The third objective was to investigate the potential for sub-adult entrapment or stranding in off-channel or backwater areas of Wells Reservoir. In 2006, this objective was addressed through a field survey of potential bull trout stranding sites conducted during a period of low reservoir elevation associated with the Methow River flood control program. High resolution bathymetric

information in combination with Project information (reservoir elevations, backwater curves, inflow patterns) were used to identify potential stranding sites for the survey. No stranded bull trout (sub-adult or adult) were found during the 2006 field survey.

The fourth objective was to identify the Core Areas and Local Populations of those bull trout that utilize the Project area. In 2006, a total of 10 genetic samples have been collected from bull trout during radio-tagging operations at Wells Dam and off-site HCP related fish sampling activities. Genetic samples collected from various sites will be used to develop a genetic baseline against which the data from which bull trout passing Wells Dam may eventually be compared. These samples were provided to the USFWS for analysis. Genetic samples will again be collected from adult and sub-adult bull trout during the 2007 field season.

The 2006 radio-telemetry data indicate that the Core Areas associated with 70% of the radio-tagged bull trout was the Methow River. The Core Area associated with the remaining 30% of the radio-tagged fish was the Entiat River.

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