YRBWEP Fish Passage Subcommittee

Recommendations
Executive Summary

The YRBWEP workgroup (workgroup) organized the Fish Passage Subcommittee and asked subcommittee members to develop a recommended approach to providing fish passage at Yakima Basin Storage Reservoirs: Keechelus, Kachess, Cle Elum, Bumping, Tieton, Rimrock, and Clear Lake. The subcommittee's work relies on existing agreements between Reclamation and WDFW, and Reclamation and the Yakama Nation and associated studies, with near and long-term recommendations provided. The workgroup will consider these recommendations as it determines which projects to include in the proposed Integrated Package.

Recommendations

Near-term

The Fish Passage subcommittee recommends that the YRBWEP workgroup include the following actions in its proposals:

1. Provide clear Congressional authorization for Reclamation to provide fish passage at all six Yakima Storage Dams.
2. Secure funding for final design and construction of fish passage structures at Cle Elum Dam.
3. Secure funding for fish passage structures at Bumping Lake Dam by either:
    a. Option 1 (No Storage Expansion): Secure early funding for environmental analysis, final design and construction of fish passage structures at the existing Bumping Lake Dam (accelerate environmental review scheduled for 2015).
    b. Option 2 (Storage Expansion): Incorporate fish passage facilities into the design of the enlarged or new dam required for Bumping Lake expansion. Expanding Bumping Lake will require mitigation to offset the loss of bull trout spawning and juvenile rearing habitat in Deep Creek.
4. Secure funding for design, evaluation, and construction of modifications to Clear Lake Dam spillway and associated operations that allow unimpeded passage for bull trout (currently the spillway is only passable under limited flow conditions).

Long-term

In cooperation with the Reservoir Fish Passage Core Team, conduct Phase II evaluation of Keechelus, Kachess, and Tieton fish passage alternatives and determine whether to pursue passage improvements at one or more of these facilities, or pursue alternative fish restoration measures.

Expected Salmonid Benefits from Providing Reservoir Fish Passage

Providing for unimpeded adult and juvenile fish migration past the six storage dams in the Yakima Basin would increase the extent of coho, steelhead, and Chinook habitat in the basin, allow for the reintroduction of extirpated sockeye runs, and allow expanded migrations and genetic interchange for listed bull trout and other native fish. The abundance, life history, and genetic diversity of these and other focal species should increase following provision of passage. This would significantly improve prospects for recovering fish populations to levels that can sustain harvest and are resilient to catastrophic events and the potential impacts of climate change.

Effects on TWSA

The following key assumptions guide the fish passage analyses studies:

- There would be no changes to current operations (i.e., quantity and timing of flow releases, but the flow pathway(s) would change to accommodate operation of the new downstream fish passage facilities).
- Fish passage facilities could be designed and operated within the existing operational considerations and constraints
- There would be no impacts to "total water supply available" (TWSA)
- Operations would continue to serve existing Reclamation contracts
- Potential operation changes that might enhance passage without impacting service to existing contracts or TWSA would be considered in the Phase II study

For the Cle Elum Dam passage proposal, both the downstream and upstream passage facilities at Cle Elum would be operated in a manner neutral to TWSA. Reservoir refill and lake level management would remain the same. Release operations would adhere to the required daily release of water from the reservoir to meet winter flow targets or to meet summer irrigation demand. The outlet works flow and juvenile bypass combined flows would not exceed the daily required demands. Water for the upstream passage facility would be provided from the stilling basin by a combination of a pumping plant and gravity flow. The pumped and/or gravity fed flow will immediately return into the stilling basin at the adult fish ladder entrance.

ESA Applicability

Reintroduced coho and sockeye would not be ESA listed species because these were extirpated in the Yakima Basin, and will be reintroduced from a stock not indigenous to the basin. Steelhead and bull trout reintroductions would continue to receive ESA consideration because they are from native stocks. If new sources of water are developed within the basin, then a portion of the additional water would be sought to support fisheries management objectives, such as enhancing adult migration in the summer, and smolt outmigration in the spring for all anadromous species, including reintroduced species.

YRBWEP Fish Passage Subcommittee

Recommendations Report

The YRBWEP workgroup (workgroup) organized the Fish Passage Subcommittee and asked subcommittee members to develop a recommended approach to providing fish passage at Yakima Basin Storage Reservoirs (see Attachment A for description of the Yakima Project storage dams).

The subcommittee's work relies on existing agreements between Reclamation and WDFW, and Reclamation and the Yakama Nation and associated studies, with near and long-term recommendations provided. The workgroup will consider these recommendations as it determines which projects to include in the proposed Integrated Package.

Background

Anadromous salmonids, including sockeye salmon (*Oncorhynchus nerka*), coho salmon (*O. kisutch*), Chinook salmon (*O. tshawytscha*), and steelhead (*O. mykiss*), historically occupied the four natural lakes in the Yakima River basin (Keechelus, Kachess, Cle Elum, and Bumping lakes) and their upstream tributaries, as did resident fish including bull trout (*Salvelinus confluentus*). Timber crib dams, constructed between 1904 and 1910 at the outlets of these four natural glacial lakes, blocked fish passage to tributaries upstream from the dams. Reclamation later constructed larger storage dams over the timber crib dams, beginning in 1910, and built a fifth new dam on the Tieton River that created Rimrock Lake. Clear Lake Dam, above Rimrock reservoir, was constructed in 1914. Construction of the timber dams, the larger Reclamation storage dams, and Clear Lake Dam eliminated access to extensive spawning and rearing habitat for anadromous salmonids and resident fish, and inundated a considerable amount of pristine, high-quality habitat.

Several watershed assessment and planning efforts have recognized the lack of fish passage at Yakima River basin storage facilities as a significant limiting factor for efforts to recover salmon, steelhead, and bull trout populations in the basin. The Northwest Power and Conservation Council's (NPCC) Fish and Wildlife Program funded the 1987 to 1993 Cle Elum Lake Anadromous Salmon Restoration Feasibility Study which assessed the feasibility of reestablishing sockeye salmon above Cle Elum Lake and concluded that adequate spawning habitat existed. A report prepared for the Washington State Conservation Commission in 2001, pursuant to the State's Salmon Recovery Act of 1998, cited the lack of anadromous fish passage at Yakima River basin storage dams as one of the most critical habitat concerns in the Yakima River basin. The NPCC's *2004 Yakima Subbasin Plan* identified fish passage at Yakima River basin dams as a Tier 1 (or top level) high priority need in the basin (NPCC 2004).

<u>Fish Passage Objectives and Expected Benefits</u>
Providing for unimpeded adult and juvenile fish migration past the six storage dams in the Yakima Basin would increase the extent of coho, steelhead, and Chinook habitat in the basin,

allow for the reintroduction of extirpated Sockeye runs, and allow expanded migrations and genetic interchange for listed bull trout and other native fish. The abundance and life history and genetic diversity of all focal species should increase following provision of passage. This would significantly improve prospects for recovering fish populations to levels that can sustain harvest and are resilient to catastrophic events and the potential impacts of climate change. Sockeye salmon historically played a substantial ecological role in the upper mainstem Yakima River (Reclamation 2007b,d). The infusion of marine-derived nutrients from these returning sockeye and other salmon species would contribute to the overall productivity of the Yakima Basin.

Estimates of potential anadromous fish production have been made for Bumping and Cle Elum Lakes. Reclamation (2007a) estimated potential coho production capacity of habitat above Bumping Lake at 422 to 486 adults annually. Passage at Cle Elum would provide access to habitat capable of supporting 1,540 adult coho (Reclamation 2007c). Reclamation estimated that Cle Elum Lake could produce 30,000 to 50,000 adult sockeye (Reclamation 2007d), while Bumping Reservoir could produce 10,000 to 17,000 adult sockeye (Reclamation 2007b).

Restoring connectivity among presently isolated populations of bull trout would allow for dispersion of fish among local populations, providing a mechanism for supporting weaker populations or reestablishing those that have become extinct. It would also allow for gene flow among populations, which prevents the loss of genetic variation insuring survival in variable environments and thereby decreasing the probability of local extirpations. The USFWS (2002) draft bull trout recovery plan emphasizes the need to provide fish passage at the storage dams.

Mitigation and Settlement Agreements, and Initiation of Storage Dam Fish Passage Assessments

When, in 2001, Reclamation proposed reconstructing Keechelus Dam to address dam safety issues, many Yakima River basin interest groups advocated for including fish passage facilities in the project design. Reclamation determined that fish passage facilities could not be added under existing Safety of Dams (SOD) authority. However, in the January 2002, *Record of Decision (ROD) for Keechelus Dam Modification* (Reclamation 2002), Reclamation committed to seek funding under its existing authority (Act of December 28, 1979; 93 Stat. 1241, P.L. 96-162, Feasibility Study – Yakima River Basin Water Enhancement Project) to conduct a feasibility study for fish passage at all Yakima Project storage dams. Subsequent to issuance of the ROD, Reclamation signed negotiated agreements and agreed to construction permit conditions for the Keechelus Dam SOD reconstruction that called for assessing the feasibility of providing fish passage at all five reservoirs.

Mitigation Agreement - Washington Department of Fish and Wildlife and Reclamation

The Mitigation Agreement between the USDI Bureau of Reclamation and Washington Department of Fish and Wildlife regarding Keechelus Dam Construction Issues Including Fish Passage (Mitigation Agreement) was signed in April 2002. Major provisions included:

- Conduct an assessment of fish passage, potential fish production, and sustainability at each Yakima Project storage dam and reservoir.

- Examine engineering feasibility at dams where the assessment determined fish passage was desirable and practicable.
- Negotiate with WDFW to determine alternatives to fish passage where the assessment determined it was impracticable or infeasible.
- Seek funds to ensure timely implementation of identified fish passage and alternative fish restoration measures.
- Provide interim passage (trap and haul) until fish passage facilities are constructed.

WDFW also issued the *Hydraulic Project Approval for Safety of Dams Reconstruction of Keechelus Dam* on April 17, 2002. The HPA contains 65 provisions requiring compliance during and after the SOD reconstruction of Keechelus Dam. Provisions 56, 57, and 58 of the HPA contain essentially the same provisions as the Mitigation Agreement but also include specific milestone dates for completion of certain activities.

Reclamation and Yakama Nation Settlement Agreement
In April 2002, the Yakama Nation filed a 60-Day Notice of Intent to File a Claim under the ESA regarding the Keechelus Dam SOD reconstruction and later initiated a lawsuit. The Court rendered a judgment in favor of the United States in January 2003. Shortly thereafter, the Yakama Nation appealed the Court's decision. The Yakama Nation and Reclamation entered into mediation procedures which resulted in a Settlement Agreement signed in 2006. The major provisions of the 2006 settlement agreement are:

- Use existing Congressional authority and funding to implement interim downstream fish passage measures at Cle Elum Dam until permanent fish passage is implemented or Reclamation concludes permanent passage is infeasible.
- Reclamation and the Yakama Nation agreed to study and develop feasible measures, if any, for permanent downstream and upstream fish passage implementation at Cle Elum and Bumping Lake Dams.
- Provide annual funding to the Yakama Nation for cooperative planning activities by the Yakama Nation Fisheries Resource Management Program.
- Prepare a technical plan and planning report with regard to feasibility of implementing permanent fish passage at Cle Elum and Bumping Lake Dams.

Within six months of completing the planning report for Cle Elum and Bumping Lake Dams, Reclamation and the Yakama Nation will meet and determine whether the Yakima Basin Storage Fish Passage Technical Work Group (Core Team) should study and develop additional plans (consistent with federal law and applicable planning principles and standards) with regard to the feasibility of implementing permanent adult (upstream) and juvenile (downstream) fish passage at Keechelus, Kachess, and Tieton Dams within the Yakima River Basin. If Reclamation and Yakama Nation agree that additional plans are warranted, they shall attempt to negotiate a memorandum of agreement outlining the process and establish deadlines for the completion of additional plans addressing passage at Kachess, Keechelus, and Tieton Dams.

The Core Team consists of biologists and engineers from Reclamation, Yakama Nation, irrigation interests, NOAA Fisheries, the U.S. Fish and Wildlife Service (USFWS), the U.S.

Forest Service (USFS), Bonneville Power Administration (BPA), and WDFW. The Core Team also involves representatives from area cities and counties, and the public. This Core Team provides technical assistance in the development of biological and engineering measures for anadromous fish passage and reintroduction of anadromous fish above Yakama Project storage dams. The Core Team will also provide technical assistance in the evaluation and monitoring of such measures upon implementation.

Phase I Assessment

As a first step in meeting the settlement agreement conditions, Reclamation conducted a preliminary assessment of fish passage for all the storage dams of the Yakima Project. The purpose of this Phase I assessment was to consolidate and document existing habitat information, evaluate preliminary passage concepts, prepare appraisal-level cost estimates for passage options, and identify uncertainties associated with fish passage at the dams where more data and modeling are needed to determine passage merits. Technical specialists from Reclamation's Pacific Northwest Regional Office and Upper Columbia Area Office prepared the assessment with input from the Core Team.

The following key assumptions were used to guide the analyses describe within the Phase I report:

- There would be no changes to current operations (i.e., quantity and timing of flow releases, but the flow pathway(s) would change to accommodate operation of the new downstream fish passage facilities).
- Fish passage facilities could be designed and operated within the existing operational considerations and constraints
- There would be no impacts to "total water supply available" (TWSA)
- Operations would continue to serve existing Reclamation contracts
- Potential operation changes that might enhance passage without impacting service to existing contracts or TWSA would be considered in the Phase II study

The Phase I Assessment determined that sockeye, steelhead, spring Chinook, coho, and resident fish occurred in the lake prior to dam construction. The assessment considered a number of methods to pass fish up and downstream of the dams and compared the cost of those alternatives to the likely habitat benefits (e.g., number of miles of stream habitat provided the species). Trap and haul, fish ladders with pumped flow, tradition fish ladders, spillway modifications, new fish spillways, fish collection barge, and new outlet works were among those options considered for up and downstream passage. The assessment concluded that the addition of up and downstream migration at each of the reservoirs would benefit all focal species and is technically feasible. Table 1 presents the number of stream miles made available to fish if passage was provided and associated costs with adding passage.

Table 1. Combined tributary stream length potentially accessible to anadromous salmonids upstream from five Yakima River basin storage dams fish passage and cost
(from Reclamation 2005)

Table 8-1. Estimated cost of three upstream fish passage options at Yakima River basin storage dams; costs per mile, based on estimated construction costs; and miles of accessible tributary habitat

Project	Newly accessible habitat		Estimated cost for upstream passage ($1 millions)			Cost per mile for upstream passage ($1 millions)		
	Miles	Assumed quality	Opt. 1 Trap-and-haul	Opt. 2 Fish ladder w/ pumped flow	Opt. 3 Fish ladder w/ gravity flow	Opt. 1	Opt. 2	Opt. 3
Keechelus	13.80	Good	7.0	8.5	—	0.5	0.6	—
Kachess	2.35	Good	7.0	8.5	—	3.0	3.6	—
Cle Elum	29.40	Good	7.0	8.5	—	0.2	0.3	—
Bumping	6.00	Good	7.0	—	11.0	1.2	—	1.8
Rimrock	36.80	Good	7.0	—	—	0.2	—	—

Table 8-2. Estimated costs of four downstream fish passage options at Yakima River basin storage dams and costs per mile based on estimated construction costs and miles of accessible tributary habitat

Project	Newly accessible habitat		Estimated cost for downstream passage (in $1 millions)				Cost per mile for downstream passage ($1 millions)			
	Miles	Assumed quality	Opt. 1 Spillway modifi-cations	Opt. 2 New spillway	Opt. 3 Fish collection barge	Opt. 4 New outlet works	Opt. 1	Opt. 2	Opt. 3	Opt. 4
Keechelus	13.80	Good	4.5	8.0	11.0	25.0	0.3	0.6	0.8	1.8
Kachess	2.35	Good	5.0	10.0	11.0	25.0	2.1	4.3	4.7	10.6
Cle Elum	29.40	Good	2.2	10.0	11.0	25.0	0.1	0.3	0.4	0.9
Bumping	6.00	Good	1.7	4.6	11.0	20.0	0.3	0.8	1.8	3.3
Rimrock	36.80	Good	2.5	42.0	11.0		0.1	1.1	0.3	—

Table 8-3. Estimated construction costs per mile of combined upstream and downstream passage for three upstream passage options and four downstream passage options
(Numbers reflect summed cost per mile in $1 millions, calculated from tables 8-1 and 8-2).

Upstream options	Downstream options	Keechelus	Kachess	Cle Elum	Bumping	Rimrock
1. Trap-and-haul	1	0.8	5.1	0.3	1.5	0.3
	2	1.1	7.3	0.6	1.9	1.3
	3	1.3	7.7	0.6	3.0	0.5
	4	2.3	13.6	1.1	4.5	—
2. Fish ladder w/ pumped flow	1	1.0	5.7	0.4	—	—
	2	1.2	7.9	0.6	—	—
	3	1.4	8.3	0.7	—	—
	4	2.4	14.2	1.1	—	—
3. Fish ladder w/ gravity flow	1	—	—	—	2.1	—
	2	—	—	—	2.6	—
	3	—	—	—	3.7	—
	4	—	—	—	5.2	—

- No upstream passage Opt. 2 at Bumping Lake Dam and Tieton Dam
- No upstream passage Opt. 3 at Keechelus, Kachess, Cle Elum and Tieton dams.

Table 2 identifies options for each of the dams, and associated costs. The costs in Table 2 reflect 2005 dollars and feasibility level understanding of the design complexity. These cost estimates were used to identify cost to benefits in order to determine which dams should be reviewed during Phase II. Anticipated project costs described later in this document as part of Phase II are more accurate.

Table 2. Estimated Costs of Upstream and Downstream Passage Options (from Reclamation 2005 with represented costs in 2005 dollars). *Note: Costs are comparative purposes only and should not be used for funding purposes or authorization of projects.*

Table 7-1. Estimated costs of upstream and downstream passage options					
	Concept Construction Cost (in $1 millions) **Estimated Annual O&M** (in $1,000s ["k"]) *(Concept No.)*				
Upstream Passage					
	Keechelus	**Kachess**	**Cle Elum**	**Bumping Lake**	**Tieton**
Trap-and-Haul	Const = $7.0 O&M = $250k *(7.1.1)*	Const = $7.0 O&M = $250k *(7.2.1)*	Const = $7.0 O&M = $250k *(7.3.1)*	Const = $7.0 O&M = $250k *(7.4.1)*	Const = $7.0 O&M = $250k *(7.5.1)*
Fish Ladder with Pumped Flow	Const =$8.5 O&M = $260 *(7.1.2)*	Const =$8.5 O&M = $210k *(7.2.2)*	Const =$8.5 O&M = $380k *(7.3.2)*		
Fish Ladder				Const =$11.0 O&M = $15k *(7.4.2)*	
Downstream Passage					
Spillway Modifications	Const =$3.5-4.5 O&M = $20k *(7.1.3; 7.1.4)*	Const = $5.0 O&M = $20k *(7.2.3)*	Const = $2.2 O&M = $20k *(7.3.3)*	Const = $1.7 O&M = $20k *(7.4.3)*	Const = $2.5 O&M = $20k *(7.5.2)*
New Fish Spillway	Const =$8.0 O&M = $20k *(7.1.5)*	Const =$10.0 O&M = $20k *(7.2.4)*	Const =$10.0 O&M = $20k *(7.3.4)*	Const =$4.6 O&M = $20k *(7.4.4)*	Const =$42.0 O&M = $20k *(7.5.3)*
Fish Collection Barge	Const =$11.0 O&M = $340k *(7.1.6)*	Const =$11.0 O&M = $340k *(7.2.5)*	Const =$11.0 O&M = $340k *(7.3.5)*	Const =$11.0 O&M = $340k *(7.4.5)*	Const =$11.0 O&M = $340k *(7.5.4)*
New Outlet Works	Const =$25.0 *O&M = $320k *(7.1.7)*	Const =$25.0 O&M = $320k *(7.2.6)*	Const =$25.0 O&M = $320k *(7.3.6)*	Const =$20.0 O&M = $320k *(7.4.6)*	
* O&M cost for the downstream trap-and-haul method from the New Outlet Works					

Phase II - Cle Elum and Bumping Dam Fish Passage Project Descriptions

The Phase II document recommended two dams be further assessed for up and downstream passage. The Reclamation and Yakima Nation 2006 Settlement agreement identified Cle Elum and Bumping facilities for Phase II analysis. The Core Team concurred with that decision in 2006. The Draft Phase II report was made available in 2008. Additional Phase II analysis at Bumping has been put on hold due to budget constraints.

Cle Elum Dam

Two fish passage alternatives were considered at Cle Elum Dam. Alternative 1 was detailed in the Planning Report and includes both downstream juvenile passage and upstream adult passage. The basic concept for downstream passage is provide surface releases in enough volume to attract migrating juvenile fish to an overflow gate in the reservoir that will lead to a conduit and safely discharge the fish downstream from the dam. The proposed downstream fish passage facilities were designed to maximize passage for the majority of the season when smolts are migrating in early March to June, even in drier years.

For upstream passage, the report recommends a trap and haul adult collection facility at Cle Elum in lieu of a long fish ladder that would need to accommodate typical reservoir fluctuations in excess of 100 vertical feet. A barrier dam would guide fish to the fish ladder entrance on the left side of the river. Fish would swim up the ladder into the collection facility. When adequate numbers of fish are collected in the facility, they would be placed into a fish transport truck to haul fish upstream for release in the reservoir and upstream tributaries. The barrier dam and adult collection facility would be operated from early March to late December.

The total construction cost for the Cle Elum Dam fish passage facilities is estimated to be $96 million at January 2008 price levels. Construction of fish passage facilities would take three calendar years. The total annual operations, maintenance, replacement, and power (OMR&P) costs are estimated to be about $300,000 per year.

Alternative 2 was developed in a Value Planning Study conducted in June 2009. It is generally similar to Alternative 1, but places the adult collection facility and juvenile bypass outlet from the left bank to the right bank. Also, the juvenile bypass pipe outlet would be located upstream and adjacent to the adult fish ladder entrance to provide additional attraction flow. The alternative will likely cost less than the first alternative because Alternative 2 removes the need for a bridge and barrier dam. Refined Alternative 2 cost estimates are expected by the end of 2009. Neither alternative would require changing the timing or amounts of reservoir releases as compared to current operations.

Cle Elum Dam Fish Passage – Typical Annual Operation Scenario

Both the downstream and upstream passage facilities at Cle Elum would be operated in a matter neutral to TWSA. Reservoir refill and lake level management would remain the same. Release operations would adhere to the required daily release of water from the reservoir to meet winter flow targets or to meet summer irrigation demand. The outlet works flow and juvenile bypass combined flows would not exceed the daily required demands. Water for the

upstream passage facility would be provided from the stilling basin by a combination of a pumping plant and gravity flow. The pumped and/or gravity fed flow will immediately return into the stilling basin at the adult fish ladder entrance.

Bumping Lake Dam

Proposed fish passage facilities for Bumping Lake Dam include both downstream juvenile passage and upstream adult passage. The downstream fish passage concept is similar to that proposed at Cle Elum Dam. The proposed downstream passage facility would include a reinforced concrete intake structure and a conduit through the dam embankment. The intake structure would include two multilevel folding overshot, or tilting weir, gates set at different elevations to control passage. The downstream fish passage facilities would generally be operated from early April to late June.

A trap and haul system is also proposed to provide adult upstream passage at Bumping Lake Dam in lieu of a fish ladder long enough to accommodate reservoir fluctuations in excess of 30 feet. The barrier and adult collection facility would generally be operated from early April to late November. The total construction cost for the Bumping Lake fish passage facilities is estimated to be about $27 million at January 2008 price levels. This includes field costs of $19 million and noncontract costs of $7.5 million. Construction of the fish passage facilities would take two calendar years. The total OMR&P costs are estimated to be about $150,000 per year. Release volumes may be altered at Bumping Lake Dam, but this should affect Reclamation's ability to meet water supply obligations.

The approach to passage may change if the YRBWEP seeks to enlarge the storage capacity of the Lake. Further analysis of the passage options are on standby until a decision is made. Raising the elevation of Bumping Lake would inundate part of Deep Creek, which supports one of the healthier bull trout populations in the Basin. Increasing storage capacity at Bumping Lake could impact the viability of this population. These impacts need evaluation to determine whether and how they could be mitigated. This mitigation could include but would not necessarily be limited to providing fish passage at other Yakima Basin storage dams (Clear Lake, Tieton, Keechelus and Kachess Dams).

Kachess, Keechelus, and Tieton Dams

For Kachess, Keechelus, and Tieton Dams, additional evaluation is needed beyond the conceptual analysis in the Phase I Assessment. Descriptions of the various alternatives are outlined in the 2005 Phase I Assessment Report. The Core team has generally assumed that passage work at these dams would be evaluated based on the outcomes of the projects at Cle Elum and Bumping Lakes. The USFWS has emphasized the need to pursue passage at these dams in order to increase the connectivity of isolated bull trout populations.

Clear Lake Dam

At its August 26th meeting, the YRBWEP workgroup asked that Clear Lake Dam be added to the list of facilities being considered for fish passage. This would improve the ability of bull trout to pass from Rimrock Reservoir into Clear Lake and 14 miles of high quality spawning and rearing habit in the upper North Fork Tieton River and Clear Creek. Fish passage was not

provided when Clear Lake Dam was constructed in 1914. A fish ladder was added when the dam was rebuilt in the early 1990s. Unfortunately, it has not functioned effectively due to high water velocities and temperatures in sections of the ladder. In 2005, Reclamation developed design concepts for a pool/weir fish ladder on the left abutment of Clear Lake Dam and a temperature control curtain in Clear Lake. The estimated cost was $2.84 million. In 2007, significant bull trout spawning was observed in the North Fork Tieton, making it clear that under certain reservoir level/flow conditions, adult bull trout are passing Clear Lake Dam, though not via the problematic portion of the existing ladder. WDFW, Reclamation, and the USFWS are currently working to determine what conditions allow passage, with the goal of identifying a combination of operational and structural actions that could provide consistent passage for a cost significantly less than the 2005 estimate for a full fish ladder.

Fish Reintroduction Plan for Cle Elum

Installation of the physical infrastructure needed for up and downstream fish passage at storage dams will need to be accompanied by active efforts to reintroduce anadromous fish to the newly accessible habitat. WDFW and the Yakama Nation have prepared a fish reintroduction plan that is designed to accelerate the reintroduction of salmon to habitat above Cle Elum Dam. The plan calls for reintroducing sockeye salmon, coho salmon, spring Chinook salmon, and summer steelhead. In addition, the fish reintroduction plan may promote genetic connectivity of bull trout by connecting the landlocked adfluvial populations in Cle Elum Lake and fluvial populations that reside downstream.

Fish reintroduction will utilize a combination of in-basin and out-of-basin donor broodstock. During Phase I reintroduction, it is anticipated that out-of-basin sources would be utilized for sockeye. Coho and spring Chinook reintroduction will utilize available sources of in-basin donor broodstock collected downstream of Cle Elum Dam. For Phase II reintroduction, a combination of out-of-basin and locally returning adults would be utilized as fish return to Cle Elum Lake. Phase 3 would begin when local or returning sources are solely utilized to supplement fish spawning in the lake and/or tributaries.

Coho Salmon Reintroduction

Coho salmon are the most suitable species for early reintroduction above Cle Elum Dam because of the availability of juveniles and adults. The goals of coho restoration are to establish a self-sustaining coho population, and reintroduce marine-derived nutrients into Cle Elum River watershed. Coho salmon reintroduction will be based on release of hatchery reared fry and parr in Cle Elum Lake and its tributaries and transport of adult coho to the lake from the proposed fish trap at the dam. It will be an expansion of the existing Yakima-Klickitat Fisheries Project (YKFP) coho salmon reintroduction program.

Sockeye Salmon Reintroduction

One of the primary goals of providing fish passage is to reestablish a self-sustaining sockeye salmon in the Yakima Basin that is capable of supporting harvest. This will be achieved when at least 35,000 sockeye return to Cle Elum Lake 10 out of 20 years. Reintroduction will be

achieved through a combination of the release of adult sockeye captured at Priest Rapids Dam, release of juvenile sockeye produced at an out-of-basin hatchery using Okanogan River adults, and the transport of returning adults above the dam using the adult fish passage facilities.

Spring Chinook Salmon Reintroduction

The goal of spring Chinook reintroduction is to increase the life history diversity, geographic distribution, and abundance of Chinook salmon to self-sustaining levels capable of supporting harvest. The goal will be achieved when 3,500 to 5,000 spring Chinook salmon return annually to Cle Elum Lake. Chinook reintroduction will require coordinating with the existing Yakima-Klickitat Fish Program (YKFP) spring Chinook supplementation project to:

- Release up to 2,500 excess pairs of Cle Elum Hatchery "supplementation line" adults captured at Roza Dam.
- Release fed fry raised from surplus "supplementation line" eggs.
- Transport returning adults above the dam using the adult fish passage facilities.

YKFP is presently supplementing spring Chinook salmon in the basin using a complex, statistically rigorous experimental design to evaluate new supplementation techniques (Busack et. al., 1997). Currently, all smolts produced at the Cle Elum Supplementation and Research Facility (CESRF) are fully allocated to the experimental design and cannot be used for reintroduction experiments at this time. Smolts may be used for reintroduction purposes if they become available in the future. Adult spring Chinook salmon are trapped at Roza Dam. Those fish that can be identified as hatchery fish that were uniquely marked and released above Cle Elum Dam would be transported to Cle Elum Lake. Any fish that enter the Cle Elum Dam fish trap would also be transported above Cle Elum Lake.

Summer Steelhead Salmon Reintroduction

Steelhead is an existing native, wild stock that is listed as threatened under the Endangered Species Act (ESA). There are too few steelhead in the upper Yakima basin to include hatchery production from natural origin returning adults in a Cle Elum Dam reintroduction plan at this time. Efforts to improve steelhead status in the upper Yakima Basin will focus on increasing the status and productivity of the existing steelhead population in the mainstem and tributaries downstream of storage reservoirs. The reintroduction plan above the dam will use offspring of kelts reconditioned under the existing Yakima Nation program. Before any steelhead adults that voluntarily enter the adult fish trap below Cle Elum Dam are handled or transported to the lake above the dam using trap and haul methods, the National Marine Fisheries Service (NMFS) will be consulted to ensure compliance with the ESA.

Bull Trout and other Native Fish

Bull trout and all other native fish (i.e., rainbow trout, cutthroat trout, whitefish, Pacific lamprey, and suckers) that voluntarily enter the proposed Cle Elum Dam adult fish trap would be transported and released into Cle Elum Lake to reestablish a properly functioning ecosystem. Provision of fish passage at the storage dams that allows for fluvial migrations and increased gene flow among isolated populations is identified as a key recovery action in the USFWS draft

recovery plan (2002). There are currently no plans to restore bull trout population through hatchery augmentation.

Fish Reintroduction Plan for Bumping Lake

A fish reintroduction plan has not developed for Bumping Lake, but would be similar to the Cle Elum plan. Providing passage at Bumping Dam also presents a unique opportunity to test how bull trout response to re-establishment of historic migration corridors. Given the known and relatively strong populations of bull trout in Bumping Lake and downstream in the Naches system, it should be possible to determine if 1) fish from the Deep Creek population begin to migrate to and from foraging habitat below the dam, 2) fluvial bull trout from other populations pass into Bumping Lake, and 3) if such migrations result in changes in individual fish condition and population-level genetic diversity and viability. Evaluating the effects of providing passage at Bumping Dam would help subsequent assessments of the potential benefits to bull trout of providing passage at remaining storage dams in the basin.

ESA Requirements Associated with Reintroduced Salmonids

Reintroduced coho and sockeye would not be ESA listed species because these were extirpated in the Yakima Basin, and will be reintroduced from a stock not indigenous to the basin. Steelhead and bull trout reintroductions would continue to receive ESA consideration because they are from native stocks.

If new sources of water are developed within the basin, then a portion of the additional water would be sought to support fisheries management objectives, such as enhancing adult migration in the summer, and smolt outmigration in the spring for all anadromous species, including reintroduced species.

Current Status

Reclamation and Ecology have begun the environmental compliance phase for fish passage at Cle Elum Dam. Reclamation is currently evaluating impacts of construction of the fish passage facilities. Ecology, in cooperation with Yakama Nation and WDFW, is evaluating the impacts of fish reintroduction above Cle Elum Dam. The anticipated schedule will include a Draft Environmental Impact Statement (EIS) in 2010, a Final EIS in 2011, a request for funding for final design from Congress in 2011, and final design and securing construction funding in 2012 to 2013 and start construction in 2014.

Bumping Reservoir enlargement is currently being considered as a way to expand water storage capacity. This would require construction of a new dam downstream of the existing one, which would require altering the proposed design for the fish passage facilities. If Bumping enlargement is not pursued, Reclamation's current planning schedule calls for proceeding with environmental review of the Bumping Lake fish passage facilities in 2015.

Unknowns and Uncertainties

As noted above, the outcomes of the YRBWEP workgroup process will determine which option is chosen for the provision of passage at Bumping Dam. The design and cost of providing passage at Clear Lake Dam will be determined based on the currently ongoing evaluation of bull trout passage conditions currently ongoing. Further evaluation is needed for Keechelus, Kachess, and Tieton Dams. A Phase II analysis would determine design option, costs, and expected benefits to fish. Use initial experiences at Cle Elum and Bumping Lakes to evaluate:

1) The success and scale of sockeye reintroduction.
2) The extent to which steelhead, Chinook and coho successfully make use of the reservoirs and upstream habitats.
3) The degree to which provision of passage at Bumping Dam facilitates changes in migratory patterns and genetic connectivity for bull trout.

All of these species may perform better or worse than anticipated, and monitoring will be required to track this. Evaluating the outcomes of passage at Bumping Lake on bull trout should include baseline monitoring prior to improving passage.

Recommendations

Near-term

The Fish Passage subcommittee recommends that the YRBWEP workgroup include the following actions in its proposals:

1. Provide clear Congressional authorization for Reclamation to provide fish passage at all six Yakima Storage Dams.
2. Secure funding for final design and construction of fish passage structures at Cle Elum Dam.
3. Secure funding for fish passage structures at Bumping Lake Dam by either:
    a. Option 1 (No Storage Expansion): Secure early funding for environmental analysis, final design and construction of fish passage structures at the existing Bumping Lake Dam (accelerate environmental review scheduled for 2015).
    b. Option 2 (Storage Expansion): Incorporate fish passage facilities into the design of the enlarged or new dam required for Bumping Lake expansion. Expanding Bumping Lake will require mitigation to offset the loss of bull trout spawning and juvenile rearing habitat in Deep Creek.
4. Secure funding for design, evaluation, and construction of modifications to Clear Lake Dam spillway and associated operations that allow unimpeded passage for bull trout (currently the spillway is only passable under limited flow conditions).

Long-term

In cooperation with the Reservoir Fish Passage Core Team, conduct Phase II evaluation of Keechelus, Kachess, and Tieton fish passage alternatives and determine whether to pursue passage improvements at one or more of these facilities, or pursue alternative fish restoration measures.

Key Information Sources

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U.S. Fish and Wildlife Service. 2002. Chapter 21, Middle Columbia Recovery Unit, Washington. 86p. *In*: U.S. Fish and Wildlife Service. Bull Trout (*Salvelinus confluentus*) Draft Recovery Plan. Portland, Oregon.

Attachment A

Yakima Basin Dam Descriptions
Facilities Overview

Cle Elum Dam is located at the lower end of a natural lake at river mile (RM) 8.2 on the Cle Elum River, 8 miles northwest of the city of Cle Elum. Construction of Cle Elum Dam was completed in1935. The earth fill dam forms a reservoir with a capacity of 436,900 acre-feet, with 427,930 acre-feet available for use. The dam has a structural height of 165 feet and a crest length of 1,800 feet. The spillway consists of five 17-foot-tall by 37-foot-wide radial gates and a concrete lined open channel in the right abutment. The outlet works consist of a control tower and concrete lined tunnel through the right abutment.

Bumping Lake Dam is located at the lower end of a natural lake at RM 17 on the Bumping River, about 29 miles northwest of the town of Naches. The earthfill dam was completed in 1910 and has a structural height of 61 feet and a crest length of 2,925 feet. The spillway consists of an uncontrolled concrete ogee crest and concrete-lined channel that extends to a wood flume. The outlet works consist of a gate tower and concrete conduit at the base of the dam. The reservoir has a total capacity of 33,700 acre-feet, with 31,220 acre-feet available for use.

Kachess Dam was constructed at the lower end of a natural lake and completed in 1912; it is located on the Kachess River, 2 miles northwest of the town of Easton. The earthfill dam has a structural height of 115 feet and a crest length of 1,400 feet. The spillway consists of a single 8-foot-tall, 50-foot-wide radial gate and a concrete -lined open channel in the right abutment. The outlet works consists of a conduit at the base of the dam controlled by slide gates. The dam impounds a reservoir with a capacity of 239,000 acre-feet, with up to 222,000 acre-feet available for use. Kachess Lake is operated to meet irrigation demands, flood control, and instream flows for fish. The flood control season extends from mid-November through mid-June. Flood space control releases are normally minimal due to the poor refill ratio of 0.9 to 1 (a refill ratio of less than 1 to 1 means a reservoir will not fill in an “average” year if it starts the year empty).

Keechelus Dam is located at Yakima RM 214.5, about 10 miles northwest of Easton. Keechelus Dam is an earthfill structure situated at the lower end of a natural lake and was completed in 1917. It forms a reservoir with a capacity of 157,800 acre-feet, with 152,170 acre-feet available for use. The spillway consists of an uncontrolled crest concrete weir; the outlet works consist of a control tower with a single hydraulically operated slide gate. Keechelus Lake is operated to meet irrigation demands, flood control, and instream flows for fish.

Tieton Dam is located at RM 21.3 on the Tieton River, about 40 miles northwest of Yakima and was completed in 1925. The dam is an earthfill structure with a concrete core wall. It has a

structural height of 319 feet and a crest length of 920 feet. The spillway consists of a concrete-lined open channel in the left abutment with a concrete side channel weir controlled by six 8-foot-tall by 65-foot-long drum gates. The outlet works consist of a tunnel through the left abutment controlled by jet-flow gates. The dam forms a reservoir with a capacity of 198,000 acre-feet at normal full lake, of which 197,800 acre-feet is available for use. Rimrock Lake is operated to meet irrigation demands, flood control, and instream flow for fish. The prime flood control season extends from mid-November through mid-June.

Clear Lake and Dam is a minor facility located one mile upstream from Rimrock Reservoir. The dam was constructed in 1914 to a height of 62 feet and raised an additional 21 feet in 1918. The dam was reconstructed in 1993 due to deteriorating concrete. The lake holds 5,300 acre-feet.