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To: Interested Parties

Subject: ODFW Benefit Analysis for the Eugene Water and Electric Board's Fish Passage Waiver Request at Smith Dam, Carmen Smith Hydroelectric Project

The ODFW Hydropower Program in coordination with the ODFW Upper Willamette Watershed District has reviewed a request from the Eugene Water & Electric Board (EWEB) to obtain a fish passage waiver for its Smith Dam, one of the three dams that comprise the Carmen-Smith Hydroelectric Project complex. The Department has been engaged with EWEB in a multi-party settlement negotiation from which the proposed alternative mitigation measures were developed. The Department has reviewed EWEB's proposal for alternative mitigation measures in lieu of fish passage at Smith Dam and concurs that the proposed measures do provide a net benefit to the resource. The Benefit Analysis follows.

BACKGROUND

The three-dam Carmen-Smith Hydroelectric Project (Project) is located in the upper McKenzie River Basin, in Linn and Lane counties, Oregon, approximately 70 miles east of the Eugene/Springfield area. Project construction was initiated in 1958 and completed in 1963, with a 50-year license granted by the Federal Power Commission[1] that expires on November 30, 2008. The three dams include Carmen Diversion Dam on the McKenzie River, Smith Dam on the Smith River, and Trail Bridge Dam on the McKenzie River. None of the dams were constructed with fish passage facilities. EWEB began relicensing its Carmen-Smith Hydroelectric Project in 2003, and agreed to enter into settlement negotiations in January 2007. During the relicensing and negotiations the stakeholders discussed alternatives for fish passage or mitigations in lieu of fish passage the dams.

Smith Dam

EWEB has submitted an application for a fish passage waiver to the Department for Smith Dam. This analysis for mitigation in lieu of fish passage is for Smith Dam. Smith Dam is located on the Smith River, a tributary of the McKenzie River. The dam is located approximately 2.5 miles upstream from the Smith River's historical confluence with the McKenzie River (now Trail Bridge Reservoir). The dam has a height of 235 ft. and is 1,100 ft. long, and impounds a reservoir of approximately 178 acres.

[1] Federal Power Commission replaced by Federal Energy Regulatory Commission (FERC) in 1977.

Trail Bridge Dam
Trail Bridge Dam is the lowermost project dam located at RM 82 on the McKenzie River. The dam has a height of 100 ft. and a length of 1,800 ft. and impounds a reservoir of approximately 71 acres. The dam blocks volitional access to approximately 4.4 miles of spawning, rearing, and foraging habitat for spring Chinook salmon and bull trout and reduces connectivity for other migratory fish species. EWEB has agreed with the settlement parties to provide fish passage and has developed a fish passage plan to construct volitional fish passage facilities at Trail Bridge dam.

Carmen Diversion Dam
The Carmen Diversion Dam is the uppermost project dam on the McKenzie River and has a height of 25 ft., a crest length of 2,100 ft., and impounds a reservoir of approximately 30 acres. The dam is located upstream of a natural waterfall (Tamolich Falls) which is a barrier to upstream fish passage. Cutthroat trout are currently and were historically present above the barrier in this section of the McKenzie River. EWEB has agreed to an adaptive management approach to construct a small fish ladder on this dam between year 10 and 15 of the FERC license if certain biological conditions are met. EWEB is also submitting an application for a fish passage exemption to ODFW in 2008 which will be approved by ODFW in the event the biological criteria are not met (no appreciable benefit) by year 15. The exemption application is separate from this action, and will be evaluated by the Department's Fish Passage Coordinator at a later date (635-412-0025(10)(a)(A)).

BENEFIT ANALYSIS

The information presented in the application is accurate given our current knowledge of the system. The Department participated in development of the relicensing studies to obtain information on fish distribution and abundance, population modeling, stream flows, and habitat. EWEB has cited additional documentation to support information in its application. The Department offers no other specific information that would bear on the analysis of whether providing passage at the mitigation site would provide a net benefit to native migratory fish over providing passage at Smith Dam.

Waiver Site: Smith Dam, Smith River tributary to the McKenzie River
Smith Dam was constructed without fish passage facilities and is a barrier to upstream passage of all fish species. There is a partial migration barrier approximately 2.9 above the dam and a complete migration barrier 3.6 miles above the dam. The reservoir behind the dam inundates approximately 2 miles of the Smith River channel (EWEB 2006). Currently, cutthroat trout, rainbow trout, and mountain whitefish are present above the dam. ODFW Believes that historically, Pacific lamprey, bull trout, and spring Chinook salmon were present. Upper Willamette spring Chinook salmon and bull trout are listed as "Threatened" under the federal Endangered Species Act, and bull trout are listed as "sensitive critical" by the Department. Habitat upstream of Smith Dam is not included in critical habitat designations for either species.

The net benefit determination for mitigation compared to fish passage at Smith Dam is primarily based on the conceptual population dynamics models developed to evaluate production of spring Chinook salmon and bull trout from habitat and management options specific to the project area. The modeling was developed by Stillwater (2006) (EWEB consultants) in consultation with the fishery agencies. The alternatives that were modeled included;

- Increased stream flows in the lower Carmen Bypass Reach and Smith Bypass Reach
- Large woody debris placements in the bypass reaches
- Increased spawning gravel and/or quality in the bypass reaches
- Habitat projects in Trail Bridge Reservoir, the Carmen Smith Spawning Channel, or mainstem McKenzie
- Fish passage facilities at Trail Bridge and Smith dams.

We did not apply a population model specific for other species of native migratory fish, but utilized the modeling for spring Chinook salmon and bull trout to determine a *Net Benefit Analysis* comparison. The modeling suggests that providing fish passage at Smith Dam in the 2.9 miles of accessible habitat above the dam will increase smolt production for Chinook by approximately 20 percent over current conditions and increase subadult and adult bull trout by approximately 98 percent (Table 1).

Table 1. Summary of model results estimating benefits of population benefits for Chinook and bull trout with passage at Smith Dam.

	Passage at Smith Dam
Total miles of Chinook salmon and bull trout habitat	2.9
Primary benefits for Chinook Salmon	Access to spawning and rearing habitat
Primary benefits for bull trout	Access to foraging habitat
Estimated production of Chinook salmon smolts	1,500 (20% increase over no passage)
Estimated population of adult bull trout upstream of Trail Bridge Dam	• 218 subadults/adults (98% increase over current) with no spawning upstream of Smith Reservoir • 470 juveniles (0% increase over no passage)

The Department does not expect that passage at Smith Dam will result in significant increases in population abundance for the other species of native migratory fish because habitat in Smith River upstream of Smith Reservoir currently has abundant populations of native trout and whitefish that do not appear to be limited by recruitment from downstream areas.

Mitigation Sites

EWEB and ODFW identified five fish passage mitigation measures with a strong project nexus as described below.

1. Lower Carmen Bypass Reach (McKenzie River upstream of Trail Bridge Reservoir to Tamolitch Falls)

The goal for the implementation of fish passage mitigation measures in lower Carmen Bypass Reach is to increase the area of spawning habitat for spring Chinook salmon throughout the reach to a minimum of 300 m2, if reasonably practicable, and then to maintain this amount (or higher as described below) of spawning habitat for the term of the license. To achieve this goal, EWEB will implement the following actions:

- addition of gravel in the lower Carmen Bypass Reach,

- placement and maintenance of a Large Woody Debris (LWD) average frequency of at least 80 pieces per mile in the lower Carmen Bypass Reach between Trail Bridge Reservoir and the confluence with Kink Creek, and

Although not quantitatively defined, the lower Carmen Bypass Reach settlement measures that EWEB implements will also increase rearing and other habitat (in addition to spawning habitat for Chinook salmon) for Chinook salmon, bull trout, other native fish species, and macroinvertebrate forage for these fish within the reach.

2. Smith Bypass Reach (Smith River upstream from Trail Bridge Reservoir to Smith Dam).

These fish passage mitigation measures are intended to increase the area of spawning habitat for Chinook salmon throughout the reach to a minimum total of 320 m2 (3,444 ft2) if reasonably practicable, and then to maintain this amount of spawning habitat for the term of the license. To achieve this goal, EWEB would implement the following measures:

1) Construct up to 30 engineered Chinook salmon spawning habitat structures in the Smith Bypass Reach. Because the actual number of engineered structures EWEB will be able to construct may be limited by the feasibility of constructing structures in certain locations in the Smith Bypass Reach. EWEB in consultation with the Fisheries Work Group (FWG), may determine that fewer than 30 can be feasible constructed but at least 25 engineered structures will be constructed.

2) Add an initial maximum of 2,000 tons of gravel.

3) Place and maintain large woody debris (LWD) at a frequency of at least 80 pieces per mile.

4) Increase instream flow releases, as follows:

a) Provide a minimum block flow release of 10 cfs from Smith Dam into the Smith Bypass Reach year-round. (the 10 cfs is also counted in meeting the requirements of 4(b)(c)(d)).

b) Provide a total minimum block flow release of 35 cfs from Smith Dam into the Smith Bypass Reach from 16 August through 31 October.

c) Ensure total minimum instream flows of 30 cfs from 1 November through 15 April, as measured within Smith Bypass Reach.

d) Ensure total minimum instream flows of 25 cfs from 16 April through 15 August, as measured within Smith Bypass Reach.

e) Provide a greater than 500-cfs channel maintenance flow for at least 5 hours at least every 5 years, unless a flow event meeting these criteria has already been exceeded by natural or other causes. Channel maintenance flow frequency, duration, or magnitude may be adjusted by EWEB in consultation with the FWG.

5) Install a 1,000-cfs turbine bypass valve at the Carmen Power Plant to divert up to 1,000 cfs of water from Smith Reservoir to Trail Bridge Reservoir and install a remotely operated gate on the Carmen Diversion Tunnel and operate the Carmen Power Plant at spin no load to protect habitat projects described above from potential high flow releases into the Smith Bypass Reach.

Although not quantitatively defined, the Smith Bypass Reach spawning habitat projects that EWEB would implement as described above would also increase rearing and other habitat for Chinook salmon, bull trout, and other native fish species, and macroinvertebrate forage for these fish within the reach.

3. Smith Reservoir

EWEB will develop a comprehensive implementation plan and schedule for fish passage mitigation measures in Smith Reservoir. EWEB will develop the plan and schedule in consultation with the Fisheries Work Group and with approval by the Fish Agencies and USDA Forest Service. The plan will include:

- type of materials to be used (boulders and/or anchored LWD, stumps/root wads, brush bundles),
- timing of implementation, such that the habitat structures would be placed within 5 years after license issuance,
- source of materials,
- volume and size of materials,
- configurations (including construction drawings/design) and locations for the placement of materials,
- method of placement of materials including access methods,
- detailed long-term monitoring, maintenance, and contingency activities, and
- considerations for recreation and aesthetic interests

EWEB shall install no more than a total of 20 habitat structures, for both adult and juvenile cutthroat trout in Smith Reservoir. The installed habitat structures are intended to be dispersed and of low profile. Both deep-water habitat structures and shallow-water structures are proposed. The goal of the deep-water habitat structures is to improve the quality and quantity of habitat for adult salmonids. The habitat structures are intended to increase adult salmonid abundance; however, increases in abundance are not a measurable objective leading to maintenance actions. EWEB shall provide deep-water habitat structures in the form of LWD, stumps/root wads, and boulders submerged on the reservoir bottom in deep-water areas (between 2538–2568 ft

elevations). The goal of the shallow-water habitat structures is to improve the quality and quantity of fry and juvenile habitat. The habitat structures are intended to increase juvenile salmonid abundance; however, increases in abundance are not a measurable objective leading to maintenance actions. EWEB shall provide shallow-water habitat structures in the form of LWD, stumps/root wads, cobbles, boulders, and bundles of brush and/or small trees in shallow-water areas (between 2575–2582 ft elevations).

EWEB, in consultation with FWG and subject to approval by the Fish Agencies and USDA Forest Service, shall define what constitutes a structure (e.g., number/material type/complexity and an agreed upon distance/spacing apart)

4. Trail Bridge Reservoir

EWEB will develop a comprehensive implementation plan and schedule for habitat structures in Trail Bridge Reservoir after license issuance. EWEB will develop the plan and schedule in consultation with the Fisheries Work Group and with approval by the Fish Agencies and USDA Forest Service. The plan will include:

- type of materials to be used (boulders and/or anchored LWD, stumps/root wads, brush bundles),
- timing of implementation (assumed to be when reservoir is drawn down for fish passage construction), such that the habitat structures would be placed within 5 years after license issuance,
- source of materials,
- volume and size of materials,
- configurations (including construction drawings/design) and locations for the placement of materials,
- method of placement of materials including access methods,
- detailed long-term monitoring activities maintenance, and contingency activities, and
- considerations for recreation and aesthetic interests.

EWEB shall install no more than a total of 40 habitat structures consisting of logs (6 m long and 0.3 m diameter at 1.4 m from the large end) and additional elements as described below, distributed between both shallow and deep water in Trail Bridge Reservoir. The goal of the deep-water habitat structures is to improve the quality and quantity of habitat for adult salmonids (principally subadult and adult bull trout, as well as other adult native trout). The habitat structures are intended to increase adult salmonid abundance; however, increases in abundance are not a measurable objective leading to maintenance actions. EWEB shall provide deep-water habitat structures in the form of anchored LWD, stumps/root wads, and/or boulders, submerged on the bottom at appropriate depths (at or deeper than elevation 2063).

The goal of the shallow-water habitat structures is to improve habitat for fry and juvenile salmonids. The habitat structures are intended to increase fry and juvenile salmonid abundance; however, increases in abundance are not a measurable objective leading to maintenance actions. EWEB shall provide shallow water (e.g., between reservoir elevations 2070–2078) habitat structures in the form of anchored clusters of small whole trees, other woody debris, and/or single large whole trees extending perpendicular from the shore into the reservoir.

The total number of logs to be added to the reservoir shall not exceed 50 to the extent that these logs are available from the Willamette National Forest. The installed habitat structures are intended to be dispersed and of low profile. EWEB, in consultation with the FWG and subject to approval by the Fish Agencies and USDA Forest Service, shall define what constitutes a structure (e.g., number/material type/complexity and an agreed upon distance/spacing apart).

5. McKenzie River Downstream of Trail Bridge Dam

These fish passage mitigation measures are intended to maintain and increase and the quality of spawning, rearing, and foraging habitat for native salmonids in the mainstem McKenzie River downstream of Trail Bridge Dam. To achieve this goal, EWEB would implement the following measures:

- provide funding for habitat projects in side channel sites,
- improved upstream passage at Carmen-Smith Spawning Channel, and
- replacement of a nonfunctional culvert.

Side channel habitat projects

EWEB shall provide monetary funds to the USDA Forest Service for habitat project work in the two McKenzie River side channels downstream of Trail Bridge Dam. Side channel #1 is approximately 800 feet long and 40 feet wide. The general concept for side channel #1 is to add gravel and wood to enhance spawning habitat at the upstream end and add up to 20 pieces of LWD to enhance rearing habitat throughout the remainder of the channel. EWEB shall fund $75,000 (all funding amounts shown in 2008 dollars. All future costs for monitoring and maintenance to be adjusted for inflation) for LWD and gravel acquisition and placement, and $15,000 every 10 years for monitoring and maintenance. The USDA Forest Service will perform acquisition, placement, monitoring and maintenance. Specific actions will include the addition of LWD as necessary (est. 20 pieces) and initial augmentation not to exceed 100 tons of gravel. Three years after installation gravel patch areas will be measured to establish maintenance threshold.

Side channel #2 consists of two channels, a larger channel and a smaller channel. The larger channel is approximately 950 feet long with an average width of 20 feet. Some spawning habitat is present in the upper half of the larger side channel. The smaller side channel is disconnected from the surface flow of the larger side channel. The smaller side channel is approximately 1,000 feet long. EWEB shall fund $25,000 for LWD acquisition, placement, and side-channel opening excavation, and up to $10,000 every 10 years for monitoring, and maintenance. The USDA Forest Service will perform installation, excavation, monitoring and maintenance.

Upstream passage at spawning channel
In consultation with the FWG and subject to approval by the Fish Agencies and USDA Forest Service, EWEB shall design, construct, operate and maintain upstream fish passage with steps no higher than 6 inches at the Carmen-Smith Spawning Channel entrance consistent with NMFS 2008 Criteria (Anadromous Salmonid Fish Passage Facility Design, February 2008) and a facility for upstream passage out of the channel at the spawning channel water control structure for the purpose of supporting safe, timely and effective upstream passage of fish at the spawning channel.

Culvert replacement
EWEB shall replace a nonfunctional culvert site consisting of two 0.61-m (2-ft) diameter corrugated metal culverts located on an unnamed fish-bearing stream that is a tributary to the McKenzie River along the Carmen-Smith Transmission Line between Towers 109 and 110.

Cumulative Benefits of Fish Passage Mitigations

The net benefit analysis can be based on two analyses, one comparing miles of stream above Smith Dam to miles of stream mitigated, and one comparing estimated biological benefit (fish production) for passage and mitigation.

Miles of Habitat
Constructing fish passage at Smith Dam would restore fish passage to approximately 2 miles of reservoir habitat and 0.9 to 1.6 miles of stream habitat above the reservoir, or a maximum of 3.6 miles. The fish passage mitigation actions will be implemented in 3.4 miles of stream habitat in the lower Carmen Bypass Reach and Smith Bypass Reach, 0.1 miles in the Carmen Smith spawning channel, 0.5 miles in two McKenzie River side channels, and 0.4 miles of an unnamed tributary through replacement of culverts. In addition, new habitat in the form of habitat structures in Trail Bridge and Smith reservoirs will provide new habitat which is not easily quantified to a stream distance measurement. The minimum number of stream miles where habitat mitigation and improved fish passage will occur is approximately 4.4 miles (Table 2).

Table 2. Comparison of estimated stream miles affected by constructing fish passage at Smith Dam and waiver mitigation.

Fish Passage at Smith Dam Miles of habitat above Smith Dam		**Waiver Mitigation Miles of stream habitat with mitigation actions**	
Reservoir	2 miles	L. Carmen Bypass	1.4 miles
Stream	1.6 miles	Smith Bypass	2.0 miles
		Smith Reservoir	NA
		Trail Bridge Reservoir	NA
		Spawning Channel	0.1 mile
		Side Channels	0.5 miles
		Culvert Replacement	0.4 miles
Total	**3.6 miles**		**4.4 mile**s

Biological Benefit
The biological net benefit determination is primarily based on the conceptual models developed to evaluate production of spring Chinook salmon and bull trout. We did not apply a population

model specific for other species of native migratory fish, but utilized the modeling for spring Chinook salmon and bull trout in our net benefit analysis comparison. The modeling suggests that providing fish passage at Smith Dam will increase smolt production for Chinook by approximately 20 percent and increase subadult and adult bull trout by 98 percent from current conditions, while implementing the mitigation measures will increase smolt production for Chinook by approximately 444 percent upstream of Trail Bridge Dam and 196 percent below Trail Bridge Dam, and subadult and adult bull trout by 100 percent over current conditions. The resulting net benefit of the mitigation measures over passage at Smith Dam is 252 percent increase for Chinook smolt production, and 2 percent increase for subadult/adult bull trout production.

The Chinook population is primarily limited by available spawning habitat, therefore both passage and non-passage alternatives would likely increase smolt production; however, the mitigation measures are expected to result in a much larger population gain than passage at Smith Dam because of limited spawning habitat and high water temperatures in the Smith River upstream of Smith Dam. The net benefit for bull trout is not as obvious as the benefit for Chinook because their population is limited by adult habitat; however, the information we have available still suggests a net benefit for bull trout, partially because adults using the Smith Reservoir would not have suitable conditions for spawning, and would need to return downstream each fall.

Table 3. Summary of benefits of all proposed fish passage mitigation measures and passage at Smith Dam for Chinook salmon and bull trout.

Scenario	**Estimated Production (Percent increase from current condition)**			
	Chinook Salmon Smolts		**Juvenile Bull Trout**	**Subadult/Adult Bull Trout**
	Upstream of Trail Bridge Dam	**Downstream of Trail Bridge Dam**		
Current Conditions	1,250	2,700 (spawning channel)	470	110
All mitigation measures	6,800 (444%)	8,000 (196%)	470 (0%)	223 (100%)
Passage at Smith Dam	1,500 (20%)	2,700 (0%)	470 (0%)	218(98%)

Other Native Migratory Fish

Conducting a benefit analysis for the other native migratory fish is not as straight forward as for bull trout and Chinook because rainbow trout, cutthroat trout, and whitefish are already present above Smith Dam, so providing passage at the dam would not allow access to new or additional habitat or result in a meaningful population increase. The full array of mitigation measures are expected to result in a biological net benefit over passage at Smith Dam from both ecological improvements from habitat and gravel projects as well as from improved access to some areas. Some of the mitigation measures, such as LWD and spawning gravel placements in the Lower Carmen and Smith bypass reaches are targeted towards spring Chinook salmon; however, we expect benefits to accrue to the other species from new structures and increased habitat resulting from higher stream flow (primarily in the Smith reach). Other measures, such as the 6-inch

entrance steps into the Carmen Smith spawning channel, habitat structures in Smith Reservoir, and culvert replacement on the downstream tributary are aimed specifically at improving access to habitat for these other native species.

Conclusion

Given that the same fish populations will benefit from the mitigation as are affected at the waiver site, and there will be a substantial increase in Chinook smolt production of approximately 252 percent compared to passage at Smith Dam, and a lesser, but still net increase in bull trout populations of at least 2 percent, Department staff determines that the mitigation will provide a net benefit to native migratory fish and recommends that a fish passage wavier for Smith Dam be granted.

Sources of Information

EWEB (Eugene Water & Electric Board). 2006. Final license application, Carmen Smith Hydroelectric Project FERC No. 2242. Eugene Water & Electric Board, Eugene, Oregon.

Stillwater Sciences. 2006. Population dynamics of bull trout and spring Chinook salmon at the Carmen Smith Hydroelectric Project area, upper McKenzie River basin, Oregon. Final report. Prepared by Stillwater Sciences, Arcata, California fro Eugene Water and Electric Board, Eugene, Oregon.