



**M E M O R A N D U M**  
**Oregon Department of Fish and Wildlife**

**Date:** March 23, 2010

**To:** Greg Apke, State Fish Passage Program Coordinator

**From:** Todd Alsbury, District Fish Biologist, North Willamette Watershed District

**Subject:** City of Portland/Bull Run Water Supply Fish Passage Waiver – Net Benefit Analysis

This analysis is for the City of Portland's (the City) request for a waiver from fish passage requirements (ORS 509.585) at Bull Run Dam #1, Bull Run Dam #2, and Headworks diversion Dam and associated rock weir. The information presented in the application is accurate given our current knowledge of the Bull Run Watershed and greater Sandy River Basin. We are basing our analysis on whether the proposed alternative mitigation described in the City's Habitat Conservation Plan (HCP) for the Bull Run Water Supply would provide a net benefit to native migratory fish over providing passage into the upper Bull Run Watershed above the City's water supply reservoirs and associated dams.

The ODFW North Willamette Watershed District (the Department) has reviewed a request from the City for a fish passage waiver for its Bull Run water supply operations, covering three dams and a rock weir on the Bull Run River. The Department engaged with the City in multi-party negotiations to develop the Bull Run Water Supply HCP, which the City prepared to come into compliance with the Endangered Species Act (ESA) and the Clean Water Act (CWA). The negotiations settled on a package of HCP measures that fully mitigate for the impacts of the City's municipal water supply operations in the Bull Run watershed. The Department has reviewed the City's proposal for providing these mitigation measures in lieu of providing fish passage around the three Bull Run dams and rock weir and concurs that the proposed package of measures does provide a net benefit to the native migratory fish species discussed. The following is the Benefit Analysis.

## **Background**

The City of Portland has been working cooperatively with ODFW, the National Marine Fisheries Service (NMFS), US Forest Service (USFS), Bureau of Land Management (BLM), and a number of other partners in the Sandy River basin since 1998 to develop a suite of measures to improve aquatic habitat for fish listed under the Endangered Species Act, and to address its compliance responsibilities under the Clean Water Act. The measures comprise the City's 50-year Bull Run Water Supply HCP. The listed fish species addressed in the Bull Run HCP are fall-run Chinook salmon, spring-run Chinook salmon, coho salmon, and winter steelhead.<sup>1</sup> These species are listed as "Threatened" under the Endangered Species Act. The HCP also addresses the habitat needs of Pacific eulachon (proposed for listing), cutthroat and rainbow trout, and several lamprey species all of which are native migratory fish species as defined in Oregon Administrative Rule 635-412-0005(32).

Forty-nine conservation measures are described in the City's Bull Run Water Supply HCP. The HCP measures include actions in the Bull Run subbasin and restoration of portions of the Sandy River basin as mitigation in lieu of providing fish passage. The HCP was approved by the National Marine Fisheries Service (NMFS) in April 2009, causing a change in permit status for the Bull Run dams, triggering a review of fish passage conditions.

The City is applying for a passage waiver for Bull Run Dam 1, Bull Run Dam 2, the Headworks diversion dam, and a rock weir. This benefit analysis addresses all dams on the Bull Run River that the City uses to store and divert water for municipal water supply.

Bull Run Dam 1 (at river mile (RM) 11.1) is a concrete gravity-arch dam, impounding a reservoir 4 miles long and up to 190 feet deep. Bull Run Dam Number 2 (RM 6.5) is an earthfill dam, creating a reservoir 4.5 miles long and as much as 130 feet deep. It was completed in 1964. Both Dam 2 and Dam 1 have hydroelectric power generation facilities as a secondary product of water storage and transmission. The Headworks diversion dam (RM6), built in 1921, is 37 feet high and diverts water from the diversion pool into the City's water conduits. The diversion pool behind the Headworks diversion dam is approximately 620 feet in length. A 15-foot-high rock weir (RM 5.8) has been the downstream barrier to anadromous fish runs since its construction in 1962. The weir was washed away during the 1964 flood and rebuilt. None of these dams has ever provided passage for native migratory fish.

The rock weir serves as the hydraulic control for the Dam 2 spillway plunge-pool. One of the basic assumptions of the HCP was that this weir would remain in place and continue to be the upstream limit of anadromous fish access in the lower Bull Run River. The City, however, now plans to modify the weir in 2010 or 2011 to allow fish passage at all flow levels. Although the City is including the weir as part of its waiver application, the benefits of providing fish passage at the rock weir were not calculated when the HCP was completed. Benefits from rock weir passage would be in addition to those described below.

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<sup>1</sup> Fall and spring Chinook are separate races of the same species (*O. tshawytscha*). In The HCP, The City refers to them as two species.

**Waiver Sites:      **Bull Run Dam #1, Bull Run Dam #2, Headworks diversion dam and rock weir****

The Bull Run River Watershed encompasses 88,962 acres (139 sq miles) and includes nine sub-watersheds (USFS, 1997). The watershed is located approximately 20 miles east of Portland and 5 miles west of Mount Hood. A total of 78,899 acres is federally (USFS and BLM) owned, 4,426 acres owned by the City of Portland, and 5,042 acres owned by private entities. Elevations in the watershed range from 260 to 4,750 feet. Annual precipitation ranges from 52 to 143 inches with snow being rare below 2,000 feet (USFS, 1997).

The Bull Run River is a large clearwater tributary that enters the Sandy River at Dodge Park (RM 19) near the town of Sandy. The mainstem Bull Run River is approximately 25 miles long and originates from Bull Run Lake (elevation 3,160 feet), a large natural lake to the northwest of Mount Hood. There are several important tributary streams draining into the Bull Run Watershed including the North and South forks of the Bull Run River, the Little Sandy River, and Blazed Alder, Fir, Cougar, and Camp creeks

The Bull Run Dam 1, Dam 2, the Headworks diversion dam, and the rock weir are barriers to the upstream passage of all native migratory fish species. Bull Run Dam 1 blocks passage to 4 miles of reservoir habitat and 1.3 miles of mainstem habitat for Chinook and coho salmon and 13 miles of mainstem and tributary habitat for steelhead. Bull Run Dam 2 blocks passage to 4.5 miles of reservoir habitat and 11.5 miles of tributary habitat up to Dam 1. Historically, lower Columbia River Chinook salmon (spring and fall runs), lower Columbia River coho salmon, and lower Columbia River winter steelhead had access to these portions of the river. Collectively the total extent of accessible native migratory fish habitat bisected by the Bull Run complex is 33.2 miles.

**Table 1. Summary of Benefits that would Result from Providing Passage at Bull Run Dams.**

Species	Total Miles Opened	Primary Benefit Types
Fall Chinook	9.8	Access to marginal rearing habitat and some marginal spawning habitat
Spring Chinook	21.3	
Coho	21.3	Access to moderate-quality rearing and spawning habitat
Winter steelhead	33.2	

Other native migratory fish species whose movements are impeded by the Bull Run dams include coastal cutthroat trout, rainbow trout, whitefish, suckers, and Pacific lamprey. Cutthroat and rainbow trout maintain viable, self-sustaining populations above both Bull Run dams 1 and 2. Whitefish and suckers are believed to exist above both dams. The historical distribution of Pacific lamprey is unknown, but it is assumed that the species might have had access to all of the streams used by steelhead. Public access is restricted within the Bull Run watershed boundary. Angling regulations for the Bull Run River allow harvest of adipose fin-clipped Chinook and coho salmon, and steelhead in the river reach outside of the watershed boundary. General zone regulations allow for catch and release of trout throughout the watershed during the general stream open season of late May-October but little if any angling and harvest occurs since the angler would be trespassing if fishing within the watershed boundary.

### ***Instream Habitat Conditions***

Nearly nine miles of the Bull Run River upstream of the rock weir is inundated by reservoirs. The remainder of the stream has a gradient of 1%-3%, is naturally confined, with large bedrock pools, a predominance of cobble and small boulder substrate, little floodplain and few side-channels. The watershed is in a protected, late-seral stage and large wood and spawning gravel quantities are at historic levels, though still moderately low (large wood: 20-30 pcs/mile; gravel in patches and margins). Habitat quality downstream of the existing reservoirs is degraded from reduced instream flows and decreased gravel and large wood recruitment. The channel has a gradient of 1%-3%, is naturally confined, and dominated by bedrock and large boulder substrate. Spawning gravels are rare and subject to scouring. Summer habitat is characterized by large bedrock pools, pocket water and short riffles. Winter habitat offers little cover other than substrate for juveniles, with very few side-channels and little floodplain.

The USFS (1997) evaluated habitat types for the Bull Run Watershed using data from the SMART database on presence and quantity of channel habitat types (e.g. riffles, glides, pools, side channels). With the exception of the Little Sandy River, riffles dominated the habitat composition for mainstem channels within the watershed. USFS (1997) concluded anadromous fish bearing stream in the watershed exhibited a high percentage of riffle and large pool habitat but were limited in side channel habitat. The agency hypothesized that habitat conditions favored steelhead and Chinook salmon over coho salmon due to the relative confinement of the watershed and corresponding lack of suitable off-channel rearing habitat. The upper Bull Run River exhibited a high percentage of riffle habitat that is suitable for resident cutthroat and rainbow trout (historically winter steelhead when anadromous access was not restricted) but lacks suitable pool and glide habitat for other native fish species.

Streamflow upstream of the reservoirs is natural and completely unregulated. Summer low flows in the mainstem Bull Run are typically around 70 cfs, with bankfull flows of approximately 4,000 cfs. Downstream of the reservoirs, flows are regulated, with 20-40 cubic feet per second (cfs) minimum flows from July through September, increasing to 70 cfs or 50% of reservoir inflows through October, 150 cfs or 40% of reservoir inflows in November, and a minimum of 120 cfs from December through mid-June, when down-ramping begins. Bankfull flows are approximately 8,000 cfs. Winter flows, when the reservoirs are full, follow a near-natural hydrograph, modified by the removal of roughly 100 cfs for municipal water use.

### **Mitigation Sites:**

The City's HCP includes a suite of mitigation measures that, when implemented, will provide a net benefit of smolt and adult salmon and steelhead production that is greater than the estimated benefits for providing fish passage at the Bull Run dams. These measures are located in the lower Bull Run watershed and throughout the greater Sandy River basin. The measures were selected based on limiting factors analyses. The City and the Partners evaluated the benefits of the proposed mitigation package using the Ecosystem Diagnosis and Treatment (EDT) model, developed by Mobrand Biometrics, Inc., and widely used by fisheries managers in the Pacific Northwest to guide habitat restoration and preservation decisions. Benefits were evaluated relative to four primary covered species, fall Chinook, spring Chinook, coho, and winter

steelhead<sup>2</sup>. EDT is a predictive model that draws on a database of habitat attributes for a given stream network and a set of biological rule-sets drawn from the scientific literature that relate habitat attributes to survival of various fish species at key stages of their lifecycles.

EDT facilitates the analysis of limiting factors in a stream or stream network and was used in part to design the HCP mitigation package. It also provides a means by which to evaluate the population effects of habitat restoration and preservation options relative to one another. For the purposes of the HCP, EDT provides estimates of fish productivity, diversity, and abundance for the four primary covered fish species in the Sandy River basin. Productivity in this case is the number of adults in the offspring generation per number of adults in the parent generation at very low population densities (i.e. without density-dependent effects). Diversity is the percentage of possible life-histories that could be self-sustaining in a given stream or stream network. Abundance is the equilibrium population of adults predicted for a given stream or stream network, given the habitat's capacity to support fish and the fish population's productivity.

The analysis presented below uses EDT to compare the benefits of two alternatives to the population productivity, diversity, and abundance of the four primary covered species relative to what would be expected if neither option were implemented ("no action"):

- 1) The HCP mitigation package. Individual mitigation measures and their anticipated cumulative benefits to instream habitat conditions are summarized in the subsequent sections of the application.
- 2) Providing full upstream passage for adults and downstream passage for smolts (and kelts, in the case of steelhead).

The major mitigation measures are grouped by sub-watershed and described below.

### ***Lower Bull Run River***

The lower Bull Run River is defined from its confluence with the Sandy River upstream to the rock weir located at RM 5.8. The Little Sandy River is the only significant tributary to this section of river. Fish habitat in this reach has been impacted by reduced instream flows, warmer water temperatures, rapidly fluctuating flows due to water regulation by upstream dams, and reduced spawning gravel recruitment. These mitigation measures are designed to provide adequate flows and cool water temperatures for spawning and rearing salmon and steelhead, more gradual fluctuations in flow to prevent fish stranding, and to rebuild and maintain spawning gravel in the lower Bull Run River.

1. Measures F-1 and F-2 (HCP Years 1-50)—Minimum Instream Flows, Normal and Critical Water Years. In normal years, the City will maintain a 20-40 cfs summer baseflow from July 1-September 30, depending on water temperature (see measure T-1 below), by releasing water from the reservoirs. Flows in October and November will be determined based on reservoir inflow (50% and 40% of inflow, respectively), with guaranteed minimum flows of 70 cfs and 150 cfs, respectively and maximum required flows of 400 cfs. Guaranteed minimum flows will be 120 cfs for the remainder of the year. In critical years, when reservoir drawdown (municipal water usage+minimum instream flows>reservoir inflow) occurs before June 15, the decrease to summer baseflow will begin as soon as drawdown occurs. If August and September inflows are in the lowest 10% of years on record, summer baseflows will be extended to October 15,

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<sup>2</sup> Fall and spring Chinook are the same species (*O. tshawytscha*), but are treated separately under the ESA because of their evolutionarily divergent life histories.

with guaranteed minimum flows of 30 cfs until November 15 and 70 cfs until November 30.

2. Measure F-3 (HCP Years 1-50)—Flow Downramping. Decreases in flow-stage in the lower Bull Run caused by City operations will not exceed 2 inches per hour.
3. Measure F-4 (w/in HCP Years 1-5)—Little Sandy Flow Agreement. The City will commit to forgoing the exercise of its water right and claims in the Little Sandy River for the term of the HCP. These flows will remain instream.
4. Measures T-1 and T-2 (w/in HCP Years 1-5)—Pre- and Post-infrastructure Temperature Management. The Bull Run Dam 2 intake will be modified to draw water from multiple depths, and therefore water temperatures, in the reservoir. Prior to this infrastructure modification, the City will adjust summer baseflows (see Measure F-1 above) to maintain downstream maximum water temperature at a 7-day moving average of 21 degrees or less. After the infrastructure modification, the downstream 7-day average maximum water temperature will be maintained at the appropriate ODEQ TMDL standard for the time of year or at or below the temperature of the neighboring Little Sandy River (plus a 1.0°C to 1.5°C allowance for greater thermal potential, based on modeling), whichever is greater. Temperature requirements will not apply if the 7-day average of maximum air temperature is in the top 10% of yearly maxima over the historic record or if unforeseen emergencies arise.
5. Measure H-1 (HCP Years 1-5 & 6-50)—Spawning Gravel Placement. The City will add a total of 1,200 yd<sup>3</sup> river rock appropriately sized for salmon and steelhead spawning each year for five years spread over three locations in the lower Bull Run River (HCP Years 1-5). After that, and for the remainder of the HCP, the City will add 600 yd<sup>3</sup> of gravel each year spread over the three locations (HCP Years 6-50).
6. Measure P-1 (w/in HCP Years 1-5)—Walker Creek Fish Passage. The City will provide volitional fish passage to Walker Creek, a historically salmon and steelhead-bearing tributary to Bull Run with approximately 0.2 miles of habitat.
7. Measure H-2 (HCP Years 1-50)—Riparian Land Protection. The City will manage its properties adjacent to the lower Bull Run River for the conservation of riparian habitat. The City will not cut coniferous trees ( $\geq 12$  inches dbh) on City property within 200 ft of the lower Bull Run River unless it is necessary to develop, maintain, or protect infrastructure or to improve riparian habitat.

### ***Little Sandy River***

The Little Sandy River is a tributary of the Bull Run River. The confluence of the Little Sandy with the Bull Run is below the lowest dam at approximately RM 3. This mitigation measure is designed to improve fry colonization and provide refuge from swift stream flows, based on a limiting factors analysis:

1. Measure H-3 (during HCP Years 6-50)—Little Sandy 1 and 2 LW Placement. A minimum of 50 key large wood pieces ( $\geq 12$  inches diameter and at least 30 feet long) will be placed in the lower 1.8 miles of the Little Sandy River. These structures will be designed to accumulate additional wood.

### ***Lower Sandy River***

The lower Sandy River extends from the mouth to approximately RM 18. Significant tributaries with anadromous access include Beaver Creek (7 miles), Gordon Creek (7.2 miles), and Trout Creek (0.8 mile). The following mitigation measures were designed to improve the river's

connections with the riparian zone and side-channels and rehabilitate its riparian zone to provide shading and food inputs:

1. Measure H-8 (w/in HCP Years 6-10)—Sandy 1 Reestablishment of River Mouth. The City will contribute \$1.1 million for the removal of a dike that blocks flow to one of two main historic channels in the Sandy River delta.
2. Measure H-9 (w/in HCP Years 6-10)—Sandy 1 Channel Reconstruction. The inlet to a side-channel of the Sandy River will be modified to improve flow and at least 25 logs will be added to improve side-channel habitat.
3. Measures H-11 and H-12 (w/in HCP Years 1-5)—Sandy 1 Riparian Easement and Improvement and Sandy 2 Riparian Easement and Improvement. Easements will be acquired to protect at least 73 acres of riparian zone along the Sandy River. Protected land will be managed to increase canopy cover and remove invasive plant species.
4. Measure H-13 (w/in HCP Years 1-5)—Gordon 1A and 1B Riparian Easement and Improvement. Easements will be acquired to protect at least 78 acres of riparian zone along the lower 4 miles of Gordon Creek. Protected land will be managed to increase canopy cover and remove invasive plant species.
5. Measure H-4 (w/in HCP Years 6-10)—Sandy 1 and 2 Log Jams. A minimum of 300 logs will be incorporated into engineered log jams along the Sandy River, designed to accumulate additional pieces of wood and restore flow to side-channels at bankfull flows. At least 2,100 feet of side-channels are expected to be rewatered.
6. Measure H-5 (w/in HCP Years 1-5)—Gordon 1A and 1B LW Placement. At least 300 key wood pieces ( $\geq$  12 inches diameter and at least 30 feet long) will be placed in the lower 4 miles of Gordon Creek at about 75 pieces per mile. These structures will be designed to accumulate additional wood.
7. Measures H-6 and H-7 (w/in HCP Years 1-5)—Trout 1A LW Placement and Trout 2A LW Placement. At least 45 key wood pieces ( $\geq$  12 inches diameter and at least 30 feet long) will be placed in the lower 1 mile of Trout Creek. These structures will be designed to accumulate additional wood.

### ***Middle Sandy River***

The middle Sandy River extends from about RM 18 to about RM 36.7. Significant tributaries include Cedar Creek (13.4 miles), Alder Creek (5.5 miles), and Wildcat Creek (1.6 miles). The following mitigation measures were designed to provide or improve access of fish to stream habitat and to improve habitat quality by adding wood, preserving in-stream flows, and decreasing water temperature:

1. Measure P-4 (w/in HCP Years 1-5)—Cedar Creek 1 Fish Passage. The City will provide ODFW with up to \$3.7 million to restore fish passage at a weir associated with the fish hatchery on Cedar Creek at RM 0.7. Access to approximately 12.7 miles of habitat will be restored.
2. Measures P-2 and P-3 (w/in HCP Years 1-5)—Alder 1 Fish Passage and Alder 1A Fish Passage. Fish passage will be improved or restored at two locations on Alder Creek: a decaying fish ladder at RM 0.9 and a water diversion structure at RM 1.7. Access to approximately 5.5 miles of habitat will be improved or restored.
3. Measure F-5(w/in first 10 years of HCP term) —Cedar Creek Purchase Water Rights. The City will acquire approximately 50% of the current certificated Cedar Creek water rights that affect summer flows. They will be converted to in-stream use for at least the term of the City's HCP.

4. Measure H-14 (w/in HCP Years 11-15)—Sandy 3 Riparian Easement and Improvement. Easements will be acquired to protect at least 7 acres of riparian zone along the Sandy River. Protected land will be managed to increase canopy cover and remove invasive plant species.
5. Measure H-15 (w/in HCP Years 6-10)—Cedar 2 and 3 riparian Easement and Improvement. Easements will be acquired to protect at least 49 acres of riparian zone along Cedar Creek. Protected land will be managed to increase canopy cover and remove invasive plant species.
6. Measure H-16 (w/in HCP Years 1-5)—Alder 1A and 2 riparian Easement and Improvement. Easements will be acquired to protect at least 43 acres of riparian zone along Alder Creek. Protected land will be managed to increase canopy cover and remove invasive plant species.
7. Measure H-17 (w/in HCP Years 6-10)—Cedar 2 and 3 LW Placement. At least 600 key wood pieces ( $\geq 12$  inches diameter and at least 30 feet long) will be placed in Cedar Creek between RM 0.7 and RM 9.5 at about 75 pieces per mile. These structures will be designed to accumulate additional wood.

### ***Upper Sandy River***

The upper Sandy River extends from about RM 36.7 to its headwaters at about RM 53.7. Significant tributaries include Clear Creek (6.3 miles), Clear Fork Sandy (4.4 miles), Muddy Fork Sandy (3.7 miles), North Boulder Creek (5.5 miles), Hackett Creek (3 miles), Bear Creek (1.3 miles), Lost Creek (6.7 miles), Horseshoe Creek (1.5 miles), and Rushing Water Creek (1.2 miles). The following mitigation measure was designed to improve spawning and rearing habitat through long-term increases in large wood recruitment:

1. Measure H-18 (w/in HCP Years 11-15)—Sandy 8 Riparian Easement and Improvement. Easements will be acquired to protect at least 25 acres of riparian zone along the Sandy River. Protected land will be managed to increase canopy cover and remove invasive plant species.

### ***Salmon River***

The Salmon River is a tributary to the Sandy River, with its confluence at Sandy RM 36.7. The Salmon River is accessible to anadromous fish for 13.4 miles. Significant tributaries include Boulder Creek (5.8 miles), Cheeney Creek (3 miles), South Fork Salmon (5.5 miles), Sixes Creek (2.3 miles), and Wee Burn Creek (1 mile). These mitigation measures were designed to improve spawning and rearing habitat through long-term increases in large wood recruitment and improved food inputs:

1. Measures H-19, H-20, H-21 (w/in HCP Years 6-10)—Salmon 1 Riparian Easement and Improvement, Salmon 2 Riparian Easement and Improvement, and Salmon 3 Riparian Easement and Improvement. Easements will be acquired to protect a total of at least 71 acres of riparian zone along the length of the Salmon River. Protected land will be managed to increase canopy cover and remove invasive plant species.
2. Measure H-22 (w/in HCP Years 1-5)—Boulder 1 Riparian Easement and Improvement. Easements will be acquired to protect at least 15 acres of riparian zone along Boulder Creek. Protected land will be managed to increase canopy cover and remove invasive plant species.



3. Measure H-23 (w/in HCP Years 6-10)—Salmon 2 Miller Quarry Acquisition. A 40-acre parcel of private land centered at approximately RM 1.6 will be purchased and restored, including reopening 1000 feet of side-channel habitat, adding at least 160 pieces of large wood, and restoring riparian vegetation.
4. Measure H-26 (w/in HCP Years 11-15)—Boulder 0 and 1 LW Placement. At least 65 key wood pieces ( $\geq 12$  inches diameter and at least 30 feet long) will be placed in the lower 1.2 miles of Boulder Creek at about 55 pieces per mile. These structures will be designed to accumulate additional wood.

### ***Zigzag River***

The Zigzag River is a tributary to the Sandy River, with its confluence at Sandy RM 42.3. Approximately 9.1 miles of the mainstem of the Zigzag River are accessible to salmon and steelhead. Significant tributaries include Still Creek (15 miles), Camp Creek (6.2 miles), Henry Creek (1.4 miles), Lady Creek (1.2 miles), Devil's Canyon Creek (0.8 miles), and Little Zigzag River (1.4 miles). The following mitigation measures were designed to reconnect artificially constrained portions of the Zigzag River with its floodplain and to improve spawning and rearing habitat through long-term increases in large wood recruitment:

1. Measure H-27 (w/in HCP Years 11-15)—Zigzag 1A Channel Design. One-half mile of historical side-channel will be reopened and flow will be improved to an additional one-half mile of existing side-channel habitat. A minimum of 270 pieces of large wood will be added to the side-channels and the mainstem to improve habitat.
2. Measure H-28(w/in HCP Years 11-15) —Zigzag 1A and 1B Riparian Easement and Improvement. Easements will be acquired to protect at least 12 acres of riparian zone along the Zigzag River. Protected land will be managed to increase canopy cover and remove invasive plant species.

## **Net Benefit Determination: Cumulative Benefits of Fish Passage Mitigations**

### **Analysis Methods**

The net benefit determination for the HCP mitigation measures compared with providing passage at the Bull Run dams is based on the results produced by a widely-used scientific model, Ecosystem Diagnosis and Treatment (EDT). EDT predicts survival of salmon and steelhead at various life stages using measured or estimated attributes of habitat quality coupled with relationships between these attributes and survival provided by the scientific literature. The EDT model runs used for the benefit analysis are the same runs used in the Bull Run Water Supply HCP Environmental Impact Statement (EIS) for both the Passage and Mitigation alternatives.

The analysis for the benefits determination was performed on the scale of the entire Sandy River basin for fall Chinook, spring Chinook, coho, and steelhead. The model compared the total number of smolts and adults predicted to be emigrating from and returning to the Sandy River under two scenarios. The scenarios were

1. Passage around all Bull Run Dams (assumed to be 100% effective)
2. Implementation of the City's HCP mitigation package (no passage at the Bull Run dams)

For all fall and spring Chinook, coho salmon, and steelhead added together, the City's HCP would produce more juvenile and adult fish than from providing complete fish passage in the

Bull Run watershed. Fall and spring Chinook and coho salmon would receive a benefit from the City’s HCP mitigation package that is greater than the benefit from providing fish passage around all of the Bull Run dams. This will result in an overall net benefit to these species. An estimated 58,324 more fall Chinook, 69,240 more spring Chinook, and 17,369 more coho smolts would be produced in the Sandy River basin under the HCP mitigation package than would be produced under the passage alternative. As a result, 472 more adult fall Chinook, 435 more adult spring Chinook, and 539 more adult coho salmon are predicted to return to the Sandy River from the ocean. EDT predicts that the HCP mitigation package would result in 4,293 fewer winter steelhead smolts and 277 fewer adults than providing passage. However, given the City’s additional mitigation plans (described in the previous section) and the fact that it would be difficult to achieve 100% effective passage of adults and smolts past each of the Bull Run River dams, it is feasible that winter steelhead would receive a benefit from the HCP mitigation package that is comparable to providing fish passage around all of the Bull Run dams.

**Table 2. Summary of Estimated Cumulative Benefits**

Species and Life Stage	Provide Fish Passage at Bull Run Dams		Implement Basin –wide HCP Measures		HCP Benefit vs. Bull Run Passage
	Increase in Population Numbers	Percentage Increase	Increase in Population Numbers	Percentage Increase	
<b><i>Fall Chinook</i></b>					
Smolts	7,914	1.0 %	66,238	8.2 %	+58,324
Adults	173	2.8%	645	10.3 %	+472
<b><i>Spring Chinook</i></b>					
Smolts	13,092	2.6%	82,332	16.5%	+69,240
Adults	358	6.0%	793	13.2%	+435
<b><i>Coho</i></b>					
Smolts	1,036	1.3%	18,405	23.8%	+17,369
Adults	36	2.8%	575	24.9%	+539
<b><i>Winter Steelhead</i></b>					
Smolts	9,693	19.4%	5,400	10.8%	-4,193
Adults	647	19.4%	370	11.1%	-277

**Additional Benefits**

Three mitigation measures planned by the City are not included in the EDT benefits analysis. These measures and their benefits include fish passage restoration and improvement at two locations on Alder Creek and placement of large wood pieces on the Little Sandy River.

***Fish passage restoration and improvement at two locations on Alder Creek***

The City will repair a partially-functioning fish ladder at RM 0.9 and restore and improve water diversion structure at RM 1.7. Access to approximately 5.5 miles of habitat will be improved or restored. These two mitigation measures were not included in the above benefits assessment because the extent to which the structures block fish access is not clear. The waterfall barrier directly below a bridge on Highway 26 (RM 0.9) has an existing, though marginal, fish ladder in disrepair. Steelhead have, upon occasion, been observed above this point in Alder Creek. The City of Sandy water diversion weir at RM 1.7 is a complete barrier under most flow conditions, but adult steelhead may pass under certain high-flow conditions. Winter steelhead are expected to benefit greatly from these two measures.

***Placement of at least 50 key large wood pieces (≥ 12 inches diameter and at least 30 feet long) in the lower 1.8 miles of the Little Sandy River.*** This measure was not included in the above benefits assessment because it would be difficult to discern and evaluate the benefits of adding large wood from the benefits of removing the Little Sandy Dam.<sup>3</sup> This measure is expected to benefit fall Chinook, spring Chinook, coho, and winter steelhead.

### **Other Native Migratory Fish**

Other native migratory fish species whose movements are impeded by the Bull Run dams include coastal cutthroat and rainbow trout, mountain whitefish, suckers, Pacific lamprey, western brook lamprey, and possibly river lamprey. The benefits of providing fish passage to cutthroat and rainbow trout, whitefish, sucker species, and western brook lamprey around Bull Run dams is difficult to ascertain because these species already maintain populations in the upper Bull Run basin. The benefits to these species would come generally in the form of increased genetic diversity. Pacific and river lamprey, on the other hand, would gain access to about 33 miles of potential habitat, were passage provided.

The implementation of the City's HCP mitigation package would result in a net benefit to cutthroat and rainbow trout, whitefish, sucker species, and western brook lamprey because each of these species would accrue benefits in terms of increased production and genetic diversity from the improved Sandy River basin habitat. The Cedar Creek and Alder Creek restoration measures (which would open up a total of approximately 18 river miles) and the improvements to habitat quality throughout the Sandy River basin should also provide benefits to Pacific and river lamprey that are comparable to providing passage.

### **Monitoring and Adaptive Management**

The HCP includes a diverse set of habitat conservation measures in multiple locations throughout the Sandy River Basin. The City is committed to demonstrating the effectiveness of the measures in meeting ESA requirements as well as their fish passage mitigation requirements through the state. The City provided a reference condition in the HCP for each measure to assist in evaluation of the effectiveness of habitat conservation measures. These reference conditions include a comparison to the conditions that existed in the Bull Run watershed prior to development of the City's water system in the late nineteenth century. The reference conditions are found in Chapter 8 of the HCP. In addition, the HCP draws on the capabilities of the EDT model to assess the overall effect of the HCP on the key parameters used to judge fish population performance, specifically the Viable Salmonid Population (VSP) metrics of abundance, productivity, and diversity.

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<sup>3</sup> In the fall of 2008, Portland General Electric removed the dam on the Little Sandy River.

## **Conclusions and Recommendation**

Given that the HCP mitigation package would provide benefits to native migratory fish species in the Sandy River basin that are greater than or comparable to benefits from providing fish passage around all Bull Run dams, Department staff recommends that a fish passage waiver for the three Bull Run dams (Bull Run Dam 1 at RM 11.1, Bull Run Dam 2 at RM 6.5, the Headworks diversion dam at RM 6, and the rock weir at RM 5.8) be granted.

## **Sources of Information**

City of Portland. 2008. Bull Bull Run Water Supply Habitat Conservation Plan For the Issuance of a Permit to Allow Incidental Take of Threatened and Endangered Species. Final Draft. Portland, Oregon.

CH2M Hill. 2008. Environmental Impact Statement: Bull Run Water Supply Habitat Conservation Plan. Final Draft. Prepared for National Marine Fisheries Service. Portland, Oregon.

U.S. Forest Service (USFS). 1997. Bull Run Watershed Analysis – Mt. Hood National Forest