United States Department of the Interior

FISH AND WILDLIFE SERVICE
Washington Fish and Wildlife Office
510 Desmond Dr. SE, Suite 102
Lacey, Washington 98503

FEB 22 2011

Honorable Kimberly D. Bose
Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington D.C. 20426

Dear Secretary Bose:

This document transmits the U.S. Fish and Wildlife Service's (FWS) Biological Opinion (Opinion) based on our review of the proposed issuance of a new 45-year Federal Energy Regulatory Commission (FERC) hydropower license for the Henry M. Jackson Hydroelectric Project (Project) located on the Sultan River in Snohomish County, Washington. We evaluate the Project's effects on marbled murrelet (*Brachyramphus marmoratus*), bull trout (*Salvelinus confluentus*), and bull trout critical habitat in accordance with Section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.). Your request for formal consultation was received on August 13, 2009. The FWS concurs with the FERC's determination in its August 13, 2010, letter that the proposed Project "may affect, but is not likely to adversely affect" the northern spotted owl (*Strix occidentalis caurina*). The FERC also determined that the proposed Project would have "no effect" on grizzly bear (*Ursus arctos*), gray wolf (*Canis lupus*), and Canada lynx (*Lynx canadensis*). Should the action agency determine that there is no effect to listed species or critical habitat, there is no requirement for FWS concurrence, nor do the regulations provide the FWS with the authority to concur with that determination. The determination that there will be no effect to listed species rests with the action agency, and no consultation with the FWS is required. We recommend that the action agency document their analysis on effects to listed species, and maintain that documentation as part of the project file. There is no designated or proposed critical habitat for federally listed terrestrial wildlife species within the action area.

This Opinion is based on information provided in the Biological Assessment, the Draft Environmental Assessment, the Settlement Agreement, the Pre-Application Document, field investigations, and other sources of information. A complete record of this consultation is on file at the FWS Washington Fish and Wildlife Office, Lacey, Washington.

Sincerely,

James L Michaels

for Ken S. Berg, Manager
Washington Fish and Wildlife Office

# Endangered Species Act - Section 7 Consultation
# Biological Opinion

**U.S. Fish and Wildlife Service Reference No. 13410-2010-F-0609**

**Henry M. Jackson Hydroelectric Project**
**Project 2157-000**

**Agency: Federal Energy Regulatory Commission**

**Consultation Conducted By:**
**U.S. Fish and Wildlife Service**
**Washington Fish and Wildlife Office**

**February 2011**

for Ken S. Berg, Manager
Washington Fish and Wildlife Office

Date 2/22/11

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## CONSULTATION HISTORY

The Public Utility District No. 1 of Snohomish County (District) and the City of Everett[1] formally initiated the Integrated Licensing Process for the Henry M. Jackson Hydroelectric Project (Project) on December 1, 2005, by filing a Notice of Intent for a new Federal Energy Regulatory Commission (FERC) License and Pre-Application Document describing the Project and the existing environment (Snohomish County PUD and City of Everett 2005). The District subsequently consulted with the resource agencies and other stakeholders to develop 22 technical studies evaluating Project operations: geomorphology, water resources, fisheries, noxious weeds, wildlife habitat, recreation, cultural resources, and rare, threatened, and endangered species. The District used the results of these studies in combination with extensive stakeholder consultation to develop a Preliminary Licensing Proposal (Snohomish County PUD 2008), which was filed with the FERC on December 31, 2008, and a Final License Application, which was filed on May 29, 2009 (Snohomish County PUD 2009a).

In a separate but parallel process to the Integrated Licensing Process, the District and the stakeholders met regularly in settlement negotiation sessions in an attempt to develop a settlement agreement for the relicensing of the Project. On October 14, 2009, the District filed a Settlement Agreement and Proposed License Articles signed by the District, National Marine Fisheries Service (NMFS), U.S. Forest Service (USFS), U.S. Fish and Wildlife Service (FWS), National Park Service, Washington Department of Fish and Wildlife (WDFW), Washington State Department of Ecology, Tulalip Tribes, Snohomish County, City of Everett, City of Sultan, and American Whitewater (collectively known as the Settlement Parties) (Snohomish County PUD 2009b).

Together, the Settlement Agreement and Proposed License Articles represent a comprehensive package that resolves all relicensing issues among the Settlement Parties. As such, the Settlement Parties (including the FWS and NMFS) view the FERC's adoption of the Proposed License Articles (without material modification) as essential for orderly and timely implementation of the Settlement Agreement.

On May 4, 2010, the FERC published its Draft Environmental Assessment (DEA) (FERC 2010). In the DEA, FERC staff recommended relicensing the Project as proposed by the District with certain staff modifications and additional measures. These modifications and additional measures diverge, in some cases, from what was included in the Settlement Parties' Proposed License Articles. For purposes of this Section 7 consultation, the DEA's *Staff Alternative with Mandatory Conditions* (FERC 2010) is the proposed action and is described in detail in the Description of the Action section below.

While the FERC's DEA typically serves as the Biological Assessment (BA) for the purpose of Section 7 consultation, in a June 18, 2010, letter, the FWS notified the FERC that its DEA did not contain sufficient information for the FWS to complete its Section 7 consultation

1 The District and the City entered into an agreement in 2007 in which the District would be the sole applicant for a new License under the Federal Power Act. Both the District and the City petitioned FERC to issue a declaratory order finding that the District has sufficient rights to the City's properties and facilities that are necessary for Project purposes and that the City need not be a co-applicant for a new License to operate the Project. FERC approved this request on December 20, 2007.

responsibilities. The FWS proposed to work with the District to develop an adequate BA, considering this approach to be the most efficient way to obtain the information needed for analysis and to complete its consultation responsibilities in a timely manner. The FWS also indicated that formal consultation would be initiated upon receipt of a complete BA from the District or the FERC. During a June 16, 2010, conference call with the District, NMFS supported the FWS request regarding the need for a more thorough BA. The FERC submitted the final BA to the FWS on August 13, 2010. FWS considers this date to be when formal consultation was initiated.

# BIOLOGICAL OPINION

## DESCRIPTION OF THE PROPOSED ACTION

### Project Location

The Project is located in the northwestern section of Washington State, on the western slopes of the Cascade Mountains (Figure 1). The Project facilities are sited on the Sultan River between river mile (RM) 4.3 and RM 16.5, and between elevations, 285 and 1,470 feet mean sea level (msl). The Sultan River flows into the Skykomish River at RM 34.4. The Skykomish and Snoqualmie rivers join at Monroe (RM 20.5) to form the Snohomish River. The Snohomish River watershed has a drainage area of 1,980 square miles and is the second largest river basin emptying into Puget Sound (Haring 2002, page 36).

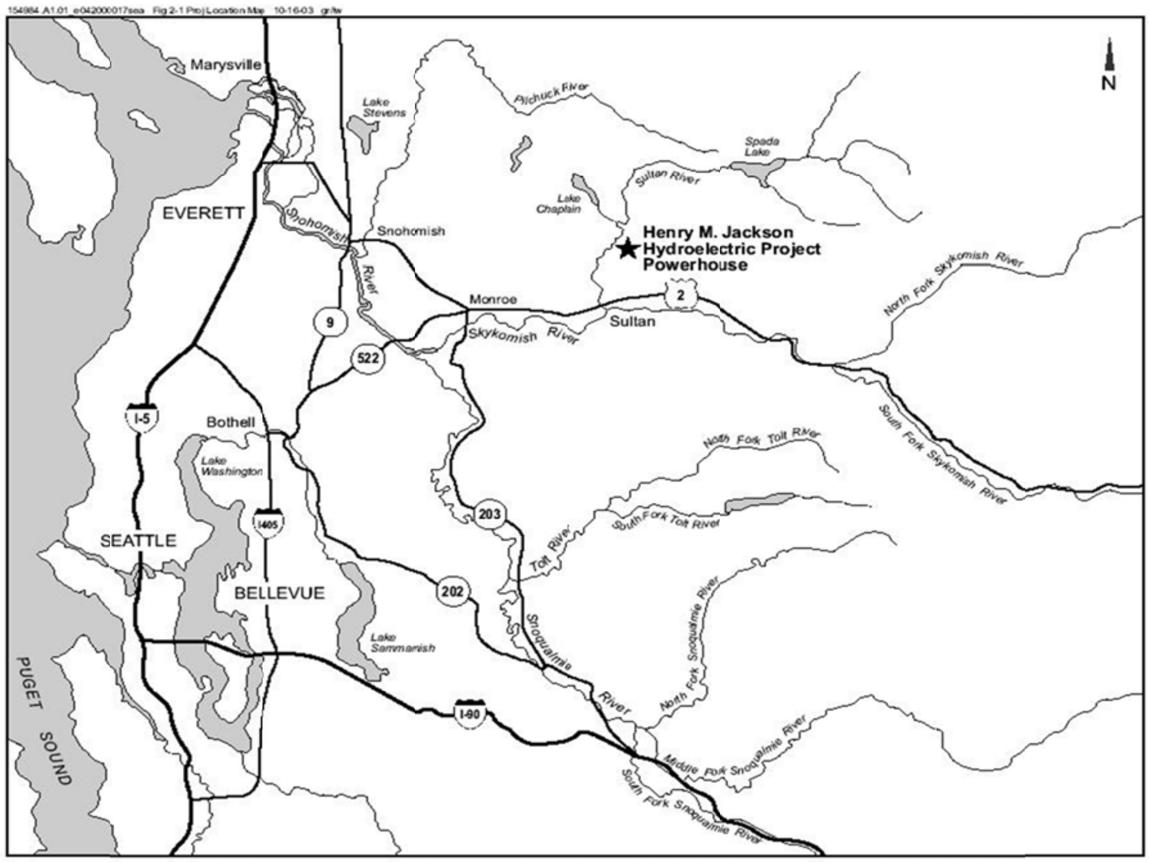


**Figure 1. Project location.**

The Project has an installed capacity of 111.8 megawatts (MW). Project facilities currently include Spada Lake Reservoir, Culmback Dam, the power conduit and Powerhouse, the Lake Chaplain pipeline, Portal 2 structure, Diversion Dam, and a 1-mile-long transmission line extending from the power plant switchyard to the Lake Chaplain Substation. The Project is operated to provide water for municipal water supply; minimum instream flows to protect aquatic resources; power supply; and incidental flood storage during the winter months (Snohomish County PUD 2009a, page E-xv).

## Project Facilities

At 1,450 feet msl, Spada Lake Reservoir has a gross area of 1,908 acres and a gross storage capacity of 153,260 acre-feet. While the maximum operating pool is at elevation 1,450 feet msl, the normal maximum surface elevation is 1,445 feet msl. At this elevation, which typically occurs from June through mid-July, the normal maximum surface area of the lake is 1,802 acres, with a storage capacity of 143,982 acre-feet. Starting in late July, the pool is lowered to elevation 1,415 feet msl by mid-September to avoid spill later in the fall. This provides approximately 58,500 acre-feet of incidental flood storage prior to the onset of the October to December wet season. To avoid vortex stresses in the power tunnel, diversion of water into the power tunnel ceases if the pool elevation drops to 1,380 feet msl or lower (Snohomish County PUD 2009a, page E-5 and E-6).

The Project uses all inflow to Spada Lake Reservoir to generate power except for required minimum instream flow releases (to protect and enhance fisheries) and any incidental spill at Culmback Dam. Water required to meet the City's municipal supply demands and to supplement instream flows for fisheries below the Diversion Dam generates power through two Francis turbine units installed at the Powerhouse, using the 700 feet of elevation difference (head) between Spada Lake Reservoir and Lake Chaplain. Water in excess of the above requirements generates power through two Pelton units discharging directly into the Sultan River, using the 1,000 feet of head between Spada Lake Reservoir and the Powerhouse.

Culmback Dam is an earth and rock-filled dam, located at RM 16.5 on the Sultan River, with a crest elevation of 1,470 feet msl. The crest of the dam is 25 feet wide, 640 feet long, and is 262 feet above the original streambed. A concrete morning glory spillway (Figure 2) is located within the reservoir approximately 250 feet from the right bank. This spillway has a 94-foot-diameter crest, a 38-foot-diameter vertical shaft, and a 700-foot horizontal tunnel section. The morning glory spillway crest elevation is at 1,450 feet msl and is designed to pass the probable maximum flood of 57,790 cubic feet per second (cfs) at elevation 1,464.6 feet msl, or 5.4 feet below the crest of the dam (Snohomish County PUD 2009a, page E-7).

The reservoir outlet works consist of two 48-inch-diameter conduits embedded in the concrete plug of the diversion tunnel that join the horizontal tunnel section of the spillway. The downstream ends of the conduits are equipped with three slide gate valves (two 42-inch-diameter and one 48-inch-diameter) and one 48-inch Howell Bunger valve. A 16-inch-diameter pipeline runs through the right side of the dam at elevation 1,408 feet, then along its downstream face.

This pipeline provides the current 20 cfs minimum flow release when the spillway tunnel is dewatered for maintenance or safety inspections. Normal flow releases are accomplished through a 10-inch cone valve piped upstream of the 48-inch Howell Bunger valve that directs flow into the spillway tunnel.

The Powerhouse intake structure is located near the left abutment, approximately 250 feet upstream of the Dam. The 110-foot-tall concrete structure has three 20-foot moveable panels. Positioning of these panels allows the selective withdrawal of stored water from various depths to facilitate the control of water temperature in the Sultan River below the Powerhouse and the Diversion Dam. A single 9-foot-wide by 14.3-foot-high fixed-wheel gate allows for closure and maintenance of the power tunnel. The gate is operated by a hydraulic cylinder on the access bridge. Hydraulic pressure for the gate operation is provided by a motorized hydraulic power unit located in an enclosure adjacent to the gate hoist.

**Figure 2. Culmback dam and the morning glory spillway.**

The power conduit is a 14-feet-diameter unlined tunnel, extending 3.8 miles from the intake structure through Blue Mountain. The tunnel has 3,140 feet of shotcrete-covered steel reinforcing to protect various soft, rock areas. At the end of the power tunnel is a 150-foot-long rock trap to capture materials that fall into the tunnel. This collector prevents debris from entering the 10-foot-diameter welded steel pipeline that transports water for 3.7 miles to the Powerhouse located on the lower Sultan River (Snohomish County PUD 2009a, page E-9).

The Powerhouse is located adjacent to the left riverbank at RM 4.3 (Figure 3). The structure is reinforced concrete with the top deck at elevation 316 feet msl, approximately 30 feet above peak river level for a 100-year flood. Two Pelton turbines and two Francis turbines are housed inside on the lower generator floor of the two-story structure. The two Pelton turbines discharge directly into 40-foot-long discharge canals that transport water to the main river channel. The Francis turbines re-route a portion of flow under the river via a pipeline (the Lake Chaplain pipeline) to the City's municipal water supply storage, Lake Chaplain, and to the Diversion Dam to supplement and meet minimum instream flows between the Diversion Dam and the Project's Powerhouse (Snohomish County PUD 2009a, page E-9).

**Figure 3. Henry M. Jackson Hydroelectric Project Powerhouse and switchyard.**

The District constructed and continues to maintain a low-head fish-passage berm at the upstream end of the Powerhouse in order to alleviate concerns that at certain flows power generation might confuse adult fish migrating upstream past the Powerhouse. This berm has a passageway or slot near the Powerhouse to concentrate the river flows into an area that is more attractive to and can be more easily detected by migrating fish. The berm has successfully facilitated fish passage upstream of the Powerhouse since its construction in 1983.

The City's water supply requirements are mainly met by diverting water from Spada Lake Reservoir through the Powerhouse's two Francis units. Sufficient pressure is retained, because of the 700-foot elevation difference between Spada Lake Reservoir and Lake Chaplain and the Diversion Dam, to route the water from the Powerhouse through a 72-inch-diameter buried pipeline to the Portal 2 structure located on the shore of Lake Chaplain. The first 500 feet of the pipeline is welded steel construction and the remaining 17,886 feet is reinforced concrete cylinder pipe.  The two Francis units are sized at 170 cfs each to provide water delivery to Lake Chaplain and the minimum instream flow requirements below the Diversion Dam at RM 9.7 (Snohomish County PUD 2009a, page E-9).

Under the current License, the amount of water sufficient to maintain minimum instream flows below the Diversion Dam is returned to the Sultan River via a control structure located at the terminus of the Lake Chaplain pipeline.  From the control structure, the water is forced backward through the existing diversion tunnel to the Diversion Dam.  The control structure is called "Portal 2" because it was built on the lower end of the City's diversion tunnel that originally transported water to Lake Chaplain from the Sultan River Diversion Dam.  Within the base of the Portal 2 control structure, water flowing into Lake Chaplain is constricted by a 5-foot-square slide gate.  The restricted gate opening causes water to build up inside the tower, which then creates enough head to cause the water to back-flow to the Diversion Dam.  By adjusting the Portal 2 gate opening, the required amount of water to be diverted to both Lake Chaplain and to the Diversion Dam can be accurately controlled (Snohomish County PUD 2009a, page E-10).

The diversion tunnel connecting Lake Chaplain to the Sultan River is a 1.5-mile-long horseshoe-shaped and concrete-lined conveyance.  A 72-inch, 2,000-foot-long concrete cylinder pipeline connects the upstream tunnel portal to the Diversion Dam where, under current Project operating conditions, flows are discharged back into the Sultan River to meet the Project instream flow requirements in the reach between the Diversion Dam and the Powerhouse.  Maximum flow return capacity of the existing facilities is 189 cfs (Snohomish County PUD 2009a, page E-10).

The Sultan River Diversion Dam has been in place since 1930.  It was originally used to divert water from the Sultan River into Lake Chaplain for the City of Everett's water supply (Figure 4).  The Diversion Dam creates only a small impoundment measuring a few acres in size.  Water from Portal 2 flows into the forebay and is accurately measured through a weir in the main sluice gate.  All flow below 280 cfs is routed through this weir.  Higher flows are passed over the 120-foot-wide concrete spillway (Snohomish County PUD 2009a, page E-10).

**Figure 4. The Sultan River Diversion Dam at RM 9.7.**

When the power conduit or the Lake Chaplain pipeline is not operational, the City's water requirements can also be met by supplementing Lake Chaplain storage with water diverted from the Sultan River via the Diversion Dam and diversion tunnel to Lake Chaplain.

The Project Powerhouse contains two 47.5 MW Pelton turbines (units 1 and 2) and two 8.4 MW Francis turbines (units 3 and 4). Minimum unit discharge for each Pelton unit is 80 cfs and for each Francis unit, 44 cfs (Snohomish County PUD 2009a, page E-11). The generating units are each equipped with a solid-state static excitation and voltage regulation system. The neutral of each generator is grounded through a single-phase distribution transformer. The generators are protected against possible winding insulation damage due to lighting or switching surge voltages.

Power generated within the Project is delivered to the District's existing transmission system at a switchyard located adjacent to the Powerhouse. The Project's primary transmission system terminates at the three separate oil-filled circuit breakers located within the switchyard; one circuit breaker associated with each Pelton unit and one serving both Francis units (Snohomish County PUD 2009a, page E-12).

From the three-switchyard circuit breakers, power is transmitted to the "Jackson Loop," comprised of two single-circuit 115-kilovolt transmission lines with ACSR 795 conductors on wood poles. The "south transmission line" extends approximately 3.79 miles east and south from the Powerhouse switchyard and follows existing roads for most of the distance into the community of Sultan, where it connects to the District's Sultan Substation. After leaving the Powerhouse switchyard, the "north transmission line," which has never met the standard of a primary transmission line, immediately crosses the Sultan River and connects to the District's Lake Chaplain Substation approximately one mile to the west of the Powerhouse. Together these segments of the Jackson Loop provide dual redundancy to protect the generation facilities from line outages.

**Existing Project Operations**

The Project diverts water from Spada Lake Reservoir to provide water for hydroelectric generation, minimum stream-flow requirements, and the City of Everett's municipal water supply storage reservoir, Lake Chaplain. Flow to the Powerhouse from the intake structure at Spada Lake Reservoir passes through a 7.5-mile-long power conduit. Upon reaching the Powerhouse, flow either passes through the two Pelton turbines and/or the two Francis turbines. Flows passing through the Pelton turbines discharge into the Sultan River at the Powerhouse. Flows passing through the Francis turbines enter the Lake Chaplain pipeline, propelled up gradient by the head differential between Spada Lake Reservoir and Lake Chaplain. At the end of the Lake Chaplain pipeline, the Portal 2 structure regulates both the amount of water to be delivered to Lake Chaplain for consumptive water supply purposes and the amount of water passing through the Sultan River Diversion Dam tunnel and pipeline back to the Sultan River Diversion Dam and released to the bypassed reach to meet aquatic habitat needs. The existing License requires the District to release a 20 cfs minimum flow to the reach of the Sultan River between Culmback Dam (Spada Lake Reservoir) and the Sultan River Diversion Dam. The District provides minimum flows at Culmback Dam through a combination of (1) a 16-inch bypass line through Culmback Dam at elevation 1408 msl which has a discharge capacity of 20 cfs; (2) a 10-inch cone valve connected to the dam outlet works which has a discharge capacity of 5 to 45 cfs; and (3) a second pipe connected to the outlet works leading to the 60-kW turbine generator (5 cfs capacity) that provides local power to the dam.

In 1965, Stage I of Culmback Dam (Spada Lake Reservoir) was built to provide additional storage for the City's municipal water supply; the traditional operation of the Sultan River Diversion Dam and tunnel to Lake Chaplain were essentially unchanged. The function of the Diversion Dam changed with completion of the Stage II Project facilities in 1984. Stage II included a raised Culmback Dam (to its current dimensions), the power tunnel and pipeline, the Powerhouse and Lake Chaplain pipeline, and Portal 2 structure. Prior to the completion of Stage II, water flowed west from the Sultan River Diversion Dam through the tunnel into Lake Chaplain. Currently, water typically flows east through the tunnel between Lake Chaplain and the Sultan River Diversion Dam to meet the minimum instream flow requirements below the Diversion Dam as specified in the existing License.

Project operations are governed by an Operating Plan, which has been modified several times since the power generation facilities were constructed in the early 1980s. Currently, operation of the Powerhouse is dictated by four different reservoir states:

State 1 – Zone of Spill. Above elevation 1,450 feet msl, Spada Lake Reservoir is in a state of spill. Therefore, the District operates the Powerhouse to withdraw at least 1,300 cfs through the power tunnel.

State 2 – Zone of Potential Spill. The District operates the Powerhouse to withdraw at least 1,300 cfs through the power tunnel.

State 3 – Zone of Discretionary Operation. The District may operate the Powerhouse between the extremes of State 2 and State 4 depending on maintenance, power supply, and prudent operation to minimize the impacts to the fishery resources.

State 4 – Zone of Water Conservation. The District operates the Powerhouse to satisfy the requirements of its water supply obligations to the City of Everett and the instream flow requirements in the Sultan River.

The Project is not operated to provide flood storage or specific flood regulation; however, flood control on the Sultan and Skykomish rivers is an incidental benefit of Project operations for electricity generation and water supply.

**Existing Environmental Measures**

In accordance with its current License (Article 54), the District releases 20 cfs to the Sultan River from Culmback Dam on a year-round basis, and 95 to 175 cfs below the Sultan River Diversion Dam and 165 to 200 cfs below the Powerhouse, depending on the season, to protect fishery resources. The District also implements a downramping schedule for releases from the Powerhouse into the Sultan River of 1 to 4 inches per hour (as measured at the Powerhouse gage) depending on the season and time of day (Article 55). Based on studies conducted in 2004 and 2005, the District voluntarily implements a downramping schedule of 1.5 to 6 inches per hour for releases from the Diversion Dam into the Sultan River (Snohomish County PUD 2009a).

As described previously, the District also constructed a berm at the Powerhouse that concentrates flow and facilitates upstream fish passage in accordance with provisions of Article 55. Aquatic and wildlife habitat enhancements and management are conducted in accordance with plans developed pursuant to Article 53 of the current License. The Aquatic Mitigation Plan developed under Article 53 requires the District to fund WDFW to produce 30,000 steelhead smolts that supplement wild stocks and enhance angling opportunities. Recreational opportunities are provided by the District at recreational access sites along the shores of Spada Lake Reservoir and Sultan River pursuant to Article 52. Project operations are modified during the winter steelhead fishing season to enhance angling opportunities in accordance with the approved Project Operating Plan required by Article 57 (Snohomish County PUD 2009a, page E-57).

**Action Area**

An action area is defined by 50 CFR §402 as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." Regarding the District's analysis of ESA-listed fish species, the area directly or indirectly affected by the Project includes the Sultan River from Culmback Dam downstream to the Skykomish River. Historically, slightly downstream of the Culmback Dam site represented the upper extent of anadromous fish distribution (Ruggerone 2006, page 1).

In addition to the Sultan River from Culmback Dam downstream to the Skykomish River, the action area for listed terrestrial species includes District-owned lands that would be covered by the District's proposed Terrestrial Resource Management Plan (TRMP) and National Forest System (NFS) lands in the upper Sultan River Canyon (Figure 5).

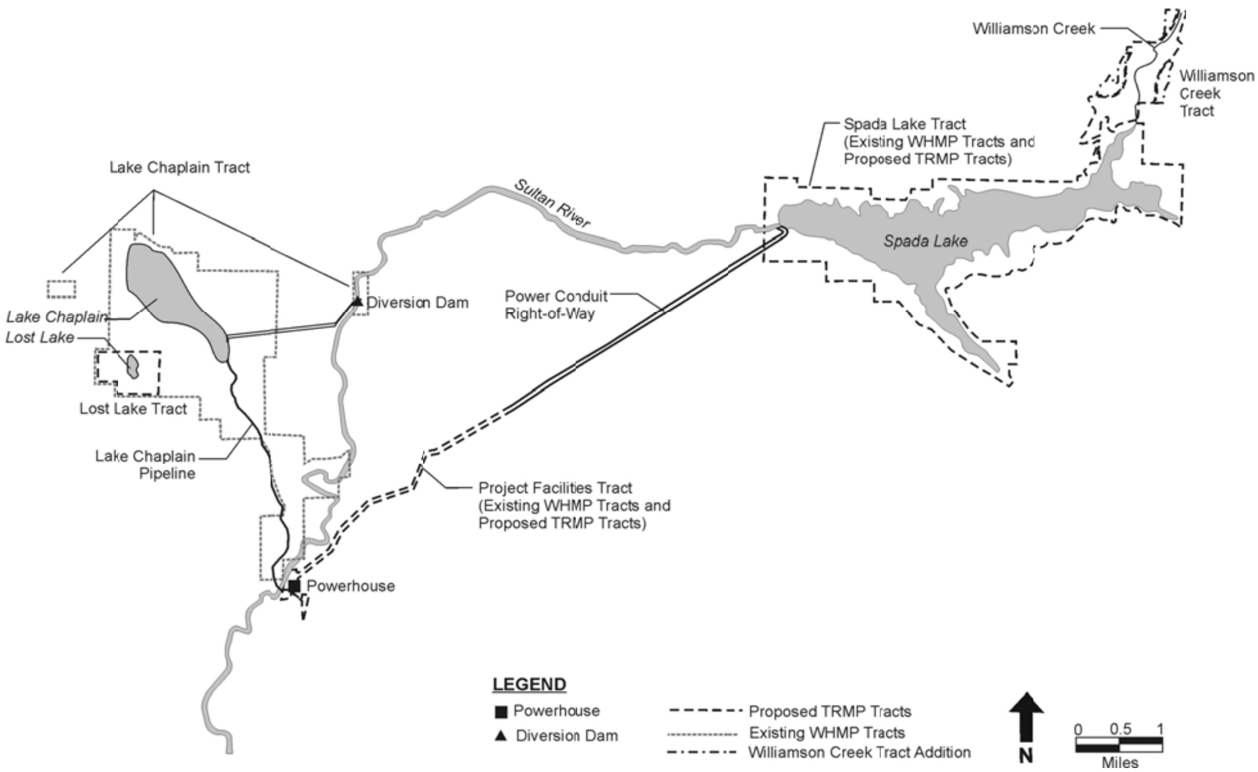


**Figure 5. Action area including lands that would be managed under the District's Terrestrial Resource Management Plan.**

## Proposed Action

For purposes of Section 7 consultation, the proposed action is the issuance of a new 45-year License for continued operation of the Project under the *Staff Alternative with Mandatory Conditions* (staff alternative), as described in the DEA (FERC 2010). To the extent that the staff alternative differs from the measures proposed in the Settlement Agreement, this biological opinion also analyzes the effects of those differences on ESA-listed species.

In addition, this BA addresses the effects of two off-License agreements (the Jackson Off-License Supplementation Program Agreement and the Lake Chaplain Tract Land Management Off-License Agreement), which are considered interrelated actions (i.e., actions that would not occur apart from the proposed action) (see Attachments A and B in Snohomish County PUD [2009b]).

In the Settlement Agreement, the District proposes to remodel the governor and needle-valve controls for the Pelton units to protect the aquatic resources of the Sultan River below the Powerhouse from rapid flow fluctuations when either of the Pelton units trip off-line. The modifications would allow flow continuation through the Powerhouse when either unit is shut down. The modifications would allow independent, controlled operation of the deflector blades and needle closure. The District notified the FERC by letter filed on January 27, 2010, that these proposed modifications are essentially complete with the exception of testing.

**Proposed Project Operations**

The District proposes to modify Project operations to enhance aquatic habitat, provide whitewater boating flows, and ensure that environmental, power generation, and water supply needs are appropriately balanced. Proposed measures to achieve these objectives include: (1) managing releases from Spada Lake Reservoir in accordance with modified rule curves; (2) increasing minimum instream flows in affected reaches of the Sultan River; (3) providing periodic short-term increased flows to promote geomorphologic processes; (4) providing flow releases for whitewater boating; (5) providing temperature conditioning flows from Culmback Dam to Reach 3 of the Sultan River to enhance the suitability of aquatic habitat upstream of the Sultan River Diversion Dam for salmonids; (6) implementing procedures to reduce downramping rates to minimize the potential for stranding of aquatic organisms; (7) providing for adaptive management of Spada Lake Reservoir water in response to anticipated increased demand in domestic water supply; (8) prioritization of water supply and quality requirements over power generation; and (9) managing Project lands for late-seral forests and for the benefit of wildlife species residing on Project lands.

**Proposed Environmental Measures (License Articles) under the Settlement Agreement**

The Settlement Agreement contains a comprehensive set of measures covering the full range of resources in the Sultan River watershed. Table 1 summarizes those measures or proposed License Articles (License Articles) contained in the Settlement Agreement (Snohomish County PUD 2009b). The Settlement Agreement envisions that all License Articles would be included in a new Project License with implementation commencing at the issuance of the new license. These License Articles are consistent with the provisions in the FWS and NMFS Section 18 fishway prescriptions and the USFS Section 4(e) conditions.

The District also filed two off-License agreements on October 14, 2009, for the FERC information (Snohomish County PUD 2009b). Measures associated with these off-License agreements are not intended to be included in a new License for this Project, and are therefore not listed in Table 1. The first agreement is the "Lake Chaplain Tract Management Off-License Agreement between the Public Utility District No. 1 of Snohomish County, City of Everett, and Washington Department of Fish and Wildlife." The second agreement is the "Jackson Off-License Supplementation Program Agreement between Public Utility District No. 1 of Snohomish County, Washington and Washington Department of Fish and Wildlife." Although these agreements would not be included as License Articles, they are analyzed in this Opinion as interrelated actions, which would not occur apart from the proposed action.

**Table 1. Summary of proposed License Articles.**

| License Article included in the Settlement Agreement | Summary of Proposed Environmental Measure |
|---|---|
| Aquatic License Article (A-LA) 1: Aquatic Resource Committee | • Establish and convene an Aquatic Resource Committee, consisting of the Tulalip Tribes, NMFS, FWS, USFS, WDFW, WDOE, the cities of Everett and Sultan, Snohomish County, and American Whitewater, to assist in implementation of aquatic resources License Articles. |
| A-LA 2: Marsh Creek Slide Modification and Monitoring | • Identify methods and schedule for developing a permanent survey control point, conducting a detailed baseline physical survey at low flow, and modifying the slide to facilitate fish passage.<br>• Identify methods and schedule for monitoring fish use and escapement upstream of the Marsh Creek slide area of the Sultan River, located within Reach 2 approximately 2 miles downstream of the Sultan River Diversion Dam.<br>• Identify methods and schedule for conducting surveys of the Marsh Creek slide subsequent to large flow events, and implementing further modifications to the slide subject to the availability of funds in the habitat enhancement account. |
| A-LA 3: Temperature Conditioning in Reach 3 | • Prepare a Water Temperature Conditioning Plan that provides the methods and schedule for a two-phase program to improve water temperature conditions for salmonids and other aquatic resources in Reach 3 between Culmback Dam and the Sultan River Diversion Dam.<br>• Monitor water temperature and aquatic resource response to temperature conditioning.<br>• Report annually on consultation with the Aquatic Resource Committee. |
| A-LA 4: Whitewater Boating Flows | • Provide 12 whitewater boating events in Sultan River downstream of Culmback Dam every 3 years.<br>• Prepare a Whitewater Recreation Plan with provisions for boater notification procedures; methods for assessing boater satisfaction, level of effort, and aquatic resources effects; and dam access. |
| A-LA 5: Downramping Rate Conditions | • Staff the Powerhouse during potential electrical storms during initial testing of flow continuation system, and until the bypass system proves effective at preventing fish stranding.<br>• Implement a mean daily discharge ceiling of 550 cfs during the fall peak spawning period for Chinook salmon to protect spawning redds.<br>• Implement seasonal ramping rates downstream of Culmback Dam, the Sultan River Diversion Dam, and Powerhouse in accordance with criteria specified in the Settlement Agreement. |
| A-LA 6: Large Woody Debris | • Prepare a Large Woody Debris (LWD) Plan with provisions for installing eight LWD structures in the Sultan River within 5 years of plan approval, and up to four additional structures after year 10 of License issuance; and monitoring the effectiveness of the LWD structures. |

| License Article included in the Settlement Agreement | Summary of Proposed Environmental Measure |
|---|---|
| A-LA 7: Side Channel Projects | • Enhance a minimum of 10,000 linear feet of side channel area to provide a minimum of 3 acres of additional rearing habitat along Reach 1 of the Sultan River downstream of the Powerhouse.<br>• Prepare a Side Channel Enhancement Plan that includes provisions for: restoring and maintaining year-round flow connectivity between the Sultan River and identified side channels; enhancing and maintaining other off-channel habitat; using LWD collected at Culmback Dam to add structure and function within the side channels; and monitoring, maintaining, and reporting on side channel enhancement measures. |
| A-LA 8: Process Flow Regime | • Implement periodic process flows to provide for channel maintenance, channel forming and flushing, and upstream and downstream fish migration flows to the Sultan River.<br>• Prepare a Process Flow Plan with provisions for Aquatic Resource Committee consultation; timing controlled flow releases with natural flow events and other flow enhancement measures; minimizing adverse flow-related effects on aquatic resources and the City of Sultan; and monitoring and adaptively managing the process flow releases. |
| A-LA 9: Minimum Flows | • Implement a new minimum instream flow regime for Reach 2 downstream of the Sultan River Diversion Dam and Reach 1 downstream of the Powerhouse.<br>• In consultation with Aquatic Resource Committee, provide an annual water budget of 20,362 acre-feet for flow releases to Reach 3 immediately downstream of Culmback Dam through June 2020. Increase annual budget to 23,831 acre-feet after June 2020. |
| A-LA 10: Spada Lake Recreational Fishery | • Develop a Spada Lake Recreational Fishery Plan with provisions for: removing barriers to fish passage in tributaries to Spada Lake Reservoir; improving the boat launch at the South Fork Recreation Site on Spada Lake Reservoir; attempting to maintain a minimum lake elevation above 1,430 feet msl during the summer; preparing a recreational fishing brochure for Spada Lake Reservoir; and conducting fish sampling in Spada Lake Reservoir every 5 years. |
| A-LA 12: Fish Habitat Enhancement Plan | • Develop a Fish Habitat Enhancement Plan with funding provisions for a habitat enhancement account and additional provisions for: potential fish habitat improvement projects primarily in the Sultan River Basin and potentially in the Snohomish River Basin; future modifications to the plan; and evaluation and reporting requirements. |

| License Article included in the Settlement Agreement | Summary of Proposed Environmental Measure |
|---|---|
| A-LA 13: Diversion Dam Volitional Passage | • Construct upstream volitional fish passage at the Sultan River Diversion Dam if spawning escapement meets the passage trigger.<br>• Facilitate downstream fish passage at the Sultan River Diversion Dam by curtailing flow diversions from the Sultan River to Lake Chaplain when spawning escapement exceeds certain thresholds.<br>• Develop a Diversion Dam Volitional Fish Passage Plan with provisions for methods, schedule, and criteria for achieving upstream and downstream fish passage; monitoring annual spawning escapement; testing and verifying fish passage effectiveness at the Sultan River Diversion Dam; and annual monitoring, reporting, and Aquatic Resource Committee consultation requirements. |
| A-LA 14: Reservoir Operations | • Implement revised reservoir rule curves with provisions for reporting temporary and emergency modifications. |
| A-LA 15: Adaptive Management Plan | • Develop an Adaptive Management Plan with provisions for resolving conflicting water demands and creating a process for evaluating and managing such conflicts |
| A-LA 16: Steelhead Planting Program | • Provide funds to WDFW to annually stock 30,000 steelhead smolts in the Sultan River until volitional fish passage is provided at the Sultan River diversion dam. |
| A-LA 17: Fisheries and Habitat Monitoring Plan | • Develop a Fisheries and Habitat Monitoring Plan to inform the implementation of other aquatic environmental measures and to provide for monitoring of: riverine fish habitat; water temperature; fish spawner abundance, distribution, and timing; and juvenile fish production, distribution, and habitat use. |
| A-LA 18: Water Supply | • Operate the Project so that the City of Everett's water supply and water quality requirements have precedence over power generation to the extent specified within the Supplemental Agreement Between Public Utility District No. 1 of Snohomish County and the City of Everett, Washington, October 17, 2007, Part E. 1 and Exhibit 1. |
| Cultural License Article (C-LA )1: Historic Properties Management Plan | • Implement the Historic Properties Management Plan. |
| Recreation License Article (R-LA) 1: Recreation Resources Management Plan | • Implement the Recreational Resources Management Plan. |
| Terrestrial License Article (T-LA) 1: Terrestrial Resource Management Plan | • Implement the Terrestrial Resources Management Plan. |
| T-LA 2: Noxious Weed Management Plan | • Implement the Noxious Weed Management Plan. |
| T-LA 3: Marbled Murrelet Habitat Protection Plan | • Implement the Marbled Murrelet Habitat Protection Plan. |

| License Article included in the Settlement Agreement | Summary of Proposed Environmental Measure |
|---|---|
| Water Quality License Article (W-LA) 1: Water Quality Monitoring License Article | • Develop a Water Quality Protection Plan with provisions for water-quality protection measures for construction or maintenance activities; spill prevention and containment procedures; procedures for application of herbicides, pesticides, fungicides, and disinfectants; compliance monitoring and reporting procedures; water quality sampling parameters; a map of sampling locations; and procedures for quality control. |

### Additional Measures Recommended by the FERC

Under the FERC staff alternative with mandatory conditions, the FERC included all of the District's proposed measures in the Settlement Agreement except for A-LA 12 (Fish Habitat Enhancement Plan) (FERC 2010, page 27). The FERC also included the modifications and additional measures discussed in the following list.

Annually stock 30,000 steelhead smolts in the Sultan River until volitional fish passage is provided at the Sultan River Diversion Dam (proposed measure A-LA 16), and prepare and file an annual report that documents compliance with the smolt stocking program (rather than just fund WDFW to implement the program).

Include in the annual fisheries and habitat monitoring report documentation of protective measures for Chinook salmon spawning.

Develop and implement an Operational Compliance Monitoring Plan that specifies the methods that would be used to measure minimum flows and ramping rates in Reach 3, ensures continued operation of two Sultan River U.S. Geological Survey (USGS) gages, and provides for filing an annual compliance monitoring report.

Modify the proposed Side Channel Enhancement Plan to include a provision to file a report within 180 days of the completion of the five side-channel enhancement projects that documents the amount of habitat enhanced and specifies any proposed additional side channel enhancement projects.

Modify the Marsh Creek Slide Monitoring and Modification Plan to include provisions for filing a report within 180 days of completion of the initial 6-year slide modification monitoring period specifying whether additional slide modifications are proposed.

Coordinate with the USFS regarding other federally authorized uses of NFS lands (USFS 4(e) condition 3).

Develop site-specific plans for habitat- or ground-disturbing activities on NFS lands (USFS 4(e) condition 3).

Evaluate Culmback Dam for National Register eligibility by 2015.

## CONCURRENCE FOR THE NORTHERN SPOTTED OWL

The FWS concurs with the SnoPUD's determination that the proposed action as described in the BA, "may affect, but is not likely to adversely affect" the northern spotted owl. The rationale for our concurrence is discussed below.

### Northern Spotted Owl

Very few northern spotted owl sites are currently known in the Project vicinity. A single resident northern spotted owl site is documented on the Pilchuck River drainage about 3 miles northwest of Culmback Dam (WDFW 2009) outside of the action area. A previously active site of a reproductive pair is located over 1 mile northeast of the Williamson Creek Tract, although the current status of the site is unknown. To further evaluate habitat conditions and potential owl occurrence in the Project area, the District conducted focused surveys for northern spotted owls in the action area in 2007 and 2008 (Biota Pacific 2008a). Based on these surveys, no northern spotted owls are present anywhere within the action area. Given the absence of owls in the action area, the small number of northern spotted owls thought to nest in western Washington at the current time, and declines in population throughout western Washington; northern spotted owl distribution may not change in the action area within the new License period, even with current levels of forest protection in the action area. In addition, all suitable nesting habitat will be protected under the terms of the Settlement Agreement and License.

## ANALYTICAL FRAMEWORK FOR THE JEOPARDY AND ADVERSE MODIFICATION DETERMINATIONS

### Jeopardy Determination

In accordance with policy and regulation, the jeopardy analysis in this Opinion relies on four components: (1) the *Status of the Species*, which evaluates the species name rangewide condition, the factors responsible for that condition, and its survival and recovery needs; (2) the *Environmental Baseline*, which evaluates the condition of the species in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the species; (3) the *Effects of the Action*, which determines the direct and indirect effects of the proposed Federal action and the effects of any interrelated or interdependent activities on the species; and (4) *Cumulative Effects*, which evaluates the effects of future, nonfederal activities in the action area on the species.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed Federal action in the context of the species current status, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of the species in the wild.

The jeopardy analysis in this Opinion emphasizes consideration of the rangewide survival and recovery needs of the species and the role of the action area in the survival and recovery of the species. It is within this context that we evaluate the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the jeopardy determination.

### Adverse Modification Determination

This Opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statutory provisions of the ESA to complete the following analysis with respect to critical habitat.

In accordance with policy and regulation, the adverse modification analysis in this Opinion relies on four components: (1) the *Status of Critical Habitat*, which evaluates the range-wide condition of designated critical habitat for the species in terms of primary constituent elements (PCEs), the factors responsible for that condition, and the intended recovery function of the critical habitat overall; (2) the *Environmental Baseline*, which evaluates the condition of the critical habitat in the action area, the factors responsible for that condition, and the recovery role of the critical habitat in the action area; (3) the *Effects of the Action*, which determines the direct and indirect effects of the proposed Federal action and the effects of any interrelated or interdependent activities on the PCEs and how that will influence the recovery role of affected critical habitat units; and (4) *Cumulative Effects*, which evaluates the effects of future, nonfederal activities in the action area on the PCEs and how that will influence the recovery role of affected critical habitat units.

For purposes of the adverse modification determination, the effects of the proposed Federal action on species critical habitat are evaluated in the context of the rangewide condition of the critical habitat, taking into account any cumulative effects, to determine if the critical habitat rangewide would remain functional (or would retain the current ability for the PCEs to be functionally established in areas of currently unsuitable but capable habitat) to serve its intended recovery role for the species.

The analysis in this Opinion places an emphasis on using the intended rangewide recovery function of species critical habitat and the role of the action area relative to that intended function as the context for evaluating the significance of the effects of the proposed action, taken together with cumulative effects, for purposes of making the adverse modification determination.

## STATUS OF THE SPECIES (Bull Trout)

### Listing Status

The coterminous United States population of the bull trout (*Salvelinus confluentus*) was listed as threatened on November 1, 1999 (64 FR 58910). The threatened bull trout generally occurs in the Klamath River Basin of south-central Oregon; the Jarbidge River in Nevada; the Willamette River Basin in Oregon; Pacific Coast drainages of Washington, including Puget Sound; major rivers in Idaho, Oregon, Washington, and Montana, within the Columbia River Basin; and the St. Mary-Belly River, east of the Continental Divide in northwestern Montana (Bond 1992, p. 4; Brewin and Brewin 1997, pp. 209-216; Cavender 1978, pp. 165-166; Leary and Allendorf 1997, pp. 715-720).

Throughout its range, the bull trout are threatened by the combined effects of habitat degradation, fragmentation, and alterations associated with dewatering, road construction and maintenance, mining, grazing, the blockage of migratory corridors by dams or other diversion structures, poor water quality, entrainment (a process by which aquatic organisms are pulled through a diversion or other device) into diversion channels, and introduced non-native species (64 FR 58910). Although all salmonids are likely to be affected by climate change, bull trout are especially vulnerable given that spawning and rearing are constrained by their location in upper watersheds and the requirement for cold water temperatures (Battin et al. 2007; Rieman et al. 2007). Poaching and incidental mortality of bull trout during other targeted fisheries are additional threats.

The bull trout was initially listed as three separate Distinct Population Segments (DPSs) (63 FR 31647; 64 FR 17110). The preamble to the final listing rule for the United States coterminous population of the bull trout discusses the consolidation of these DPSs with the Columbia and Klamath population segments into one listed taxon and the application of the jeopardy standard under section 7 of the Act relative to this species (64 FR 58910):

> Although this rule consolidates the five bull trout DPSs into one listed taxon, based on conformance with the DPS policy for purposes of consultation under section 7 of the Act, we intend to retain recognition of each DPS in light of available scientific information relating to their uniqueness and significance. Under this approach, these DPSs will be treated as interim recovery units with respect to application of the jeopardy standard until an approved recovery plan is developed. Formal establishment of bull trout recovery units will occur during the recovery planning process.

## Current Status and Conservation Needs

In recognition of available scientific information relating to their uniqueness and significance, five segments of the coterminous United States population of the bull trout are considered essential to the survival and recovery of this species and are identified as interim recovery units: 1) Jarbidge River, 2) Klamath River, 3) Columbia River, 4) Coastal-Puget Sound, and 5) St. Mary-Belly River (USFWS 2002a; 2004a; 2004b). Each of these interim recovery units is necessary to maintain the bull trout's distribution, as well as its genetic and phenotypic diversity, all of which are important to ensure the species' resilience to changing environmental conditions.

A summary of the current status and conservation needs of the bull trout within these interim recovery units is provided below and a comprehensive discussion is found in the FWS's draft recovery plans for the bull trout (USFWS 2002a; 2004a; 2004b).

The conservation needs of bull trout are often generally expressed as the four "Cs": cold, clean, complex, and connected habitat. Cold stream temperatures, clean water quality that is relatively free of sediment and contaminants, complex channel characteristics (including abundant large wood and undercut banks), and large patches of such habitat that are well connected by unobstructed migratory pathways are all needed to promote conservation of bull trout at multiple scales ranging from the coterminous to local populations (a local population is a group of bull trout that spawn within a particular stream or portion of a stream system). The recovery planning process for bull trout (USFWS 2002a; 2004a; 2004b) has also identified the following conservation needs: 1) maintenance and restoration of multiple, interconnected populations in diverse habitats across the range of each interim recovery unit, 2) preservation of the diversity of life-history strategies, 3) maintenance of genetic and phenotypic diversity across the range of each interim recovery unit, and 4) establishment of a positive population trend. Recently, it has also been recognized that bull trout populations need to be protected from catastrophic fires across the range of each interim recovery unit (Rieman et al. 2003).

Central to the survival and recovery of bull trout is the maintenance of viable core areas (USFWS 2002a; 2004a; 2004b). A core area is defined as a geographic area occupied by one or more local bull trout populations that overlap in their use of rearing, foraging, migratory, and overwintering habitat. Each of the interim recovery units listed above consists of one or more core areas. There are 121 core areas recognized across the coterminous range of the bull trout (USFWS 2002a; 2004a; 2004b).

Jarbidge River Interim Recovery Unit

This interim recovery unit currently contains a single core area with six local populations. Less than 500 resident and migratory adult bull trout, representing about 50 to 125 spawning adults, are estimated to occur in the core area. The current condition of the bull trout in this interim recovery unit is attributed to the effects of livestock grazing, roads, incidental mortalities of released bull trout from recreational angling, historic angler harvest, timber harvest, and the introduction of non-native fishes (USFWS 2004b). The draft bull trout recovery plan (USFWS 2004b) identifies the following conservation needs for this interim recovery unit: 1) maintain the current distribution of the bull trout within the core area, 2) maintain stable or increasing trends in abundance of both resident and migratory bull trout in the core area, 3) restore and maintain suitable habitat conditions for all life history stages and forms, and 4) conserve genetic diversity and increase natural opportunities for genetic exchange between resident and migratory forms of the bull trout. An estimated 270 to 1,000 spawning bull trout per year are needed to provide for the persistence and viability of the core area and to support both resident and migratory adult bull trout (USFWS 2004b).

Klamath River Interim Recovery Unit

This interim recovery unit currently contains three core areas and seven local populations. The current abundance, distribution, and range of the bull trout in the Klamath River Basin are greatly reduced from historical levels due to habitat loss and degradation caused by reduced water quality, timber harvest, livestock grazing, water diversions, roads, and the introduction of non-native fishes (USFWS 2002b). Bull trout populations in this interim recovery unit face a high risk of extirpation (USFWS 2002b). The draft Klamath River bull trout recovery plan (USFWS 2002b) identifies the following conservation needs for this interim recovery unit: 1) maintain the current distribution of bull trout and restore distribution in previously occupied areas, 2) maintain stable or increasing trends in bull trout abundance, 3) restore and maintain suitable habitat conditions for all life history stages and strategies, 4) conserve genetic diversity and provide the opportunity for genetic exchange among appropriate core area populations. Eight to 15 new local populations and an increase in population size from about 2,400 adults currently to 8,250 adults are needed to provide for the persistence and viability of the three core areas (USFWS 2002b).

<u>Columbia River Interim Recovery Unit</u>

The Columbia River interim recovery unit includes bull trout residing in portions of Oregon, Washington, Idaho, and Montana. Bull trout are estimated to have occupied about 60 percent of the Columbia River Basin, and presently occur in 45 percent of the estimated historical range (Quigley and Arbelbide 1997, p.1177). This interim recovery unit currently contains 97 core areas and 527 local populations. About 65 percent of these core areas and local populations occur in central Idaho and northwestern Montana. The Columbia River interim recovery unit has declined in overall range and numbers of fish (63 FR 31647). Although some strongholds still exist with migratory fish present, bull trout generally occur as isolated local populations in headwater lakes or tributaries where the migratory life history form has been lost. Though still widespread, there have been numerous local extirpations reported throughout the Columbia River basin. In Idaho, for example, bull trout have been extirpated from 119 reaches in 28 streams (Idaho Department of Fish and Game *in litt*. 1995). The draft Columbia River bull trout recovery plan (USFWS 2002d) identifies the following conservation needs for this interim recovery unit: 1) maintain or expand the current distribution of the bull trout within core areas, 2) maintain stable or increasing trends in bull trout abundance, 3) restore and maintain suitable habitat conditions for all bull trout life history stages and strategies, and 4) conserve genetic diversity and provide opportunities for genetic exchange.

This interim recovery unit currently contains 97 core areas and 527 local populations. About 65 percent of these core areas and local populations occur in Idaho and northwestern Montana. The condition of the bull trout within these core areas varies from poor to good. All core areas have been subject to the combined effects of habitat degradation and fragmentation caused by the following activities: dewatering; road construction and maintenance; mining; grazing; the blockage of migratory corridors by dams or other diversion structures; poor water quality; incidental angler harvest; entrainment into diversion channels; and introduced non-native species. The FWS completed a core area conservation assessment for the 5-year status review and determined that, of the 97 core areas in this interim recovery unit, 38 are at high risk of extirpation, 35 are at risk, 20 are at potential risk, 2 are at low risk, and 2 are at unknown risk (USFWS 2005).

Coastal-Puget Sound Interim Recovery Unit

Bull trout in the Coastal-Puget Sound interim recovery unit exhibit anadromous, adfluvial, fluvial, and resident life history patterns. The anadromous life history form is unique to this interim recovery unit. This interim recovery unit currently contains 14 core areas and 67 local populations (USFWS 2004a). Bull trout are distributed throughout most of the large rivers and associated tributary systems within this interim recovery unit. Bull trout continue to be present in nearly all major watersheds where they likely occurred historically, although local extirpations have occurred throughout this interim recovery unit. Many remaining populations are isolated or fragmented and abundance has declined, especially in the southeastern portion of the interim recovery unit. The current condition of the bull trout in this interim recovery unit is attributed to the adverse effects of dams, forest management practices (e.g., timber harvest and associated road building activities), agricultural practices (e.g., diking, water control structures, draining of wetlands, channelization, and the removal of riparian vegetation), livestock grazing, roads, mining, urbanization, poaching, incidental mortality from other targeted fisheries, and the introduction of non-native species. The draft Coastal-Puget Sound bull trout recovery plan (USFWS 2004a) identifies the following conservation needs for this interim recovery unit: 1) maintain or expand the current distribution of bull trout within existing core areas, 2) increase bull trout abundance to about 16,500 adults across all core areas, and 3) maintain or increase connectivity between local populations within each core area.

St. Mary-Belly River Interim Recovery Unit

This interim recovery unit currently contains six core areas and nine local populations (USFWS 2002c). Currently, bull trout are widely distributed in the St. Mary-Belly River drainage and occur in nearly all of the waters that it inhabited historically. Bull trout are found only in a 1.2-mile reach of the North Fork Belly River within the United States. Redd count surveys of the North Fork Belly River documented an increase from 27 redds in 1995 to 119 redds in 1999. This increase was attributed primarily to protection from angler harvest (USFWS 2002c). The current condition of the bull trout in this interim recovery unit is primarily attributed to the effects of dams, water diversions, roads, mining, and the introduction of non-native fishes (USFWS 2002c). The draft St. Mary-Belly bull trout recovery plan (USFWS 2002c) identifies the following conservation needs for this interim recovery unit: 1) maintain the current distribution of the bull trout and restore distribution in previously occupied areas, 2) maintain stable or increasing trends in bull trout abundance, 3) restore and maintain suitable habitat conditions for all life history stages and forms, 4) conserve genetic diversity and provide the opportunity for genetic exchange, and 5) establish good working relations with Canadian interests because local bull trout populations in this interim recovery unit are comprised mostly of migratory fish, whose habitat is mostly in Canada.

## Life History

Bull trout exhibit both resident and migratory life history strategies. Both resident and migratory forms may be found together, and either form may produce offspring exhibiting either resident or migratory behavior (Rieman and McIntyre 1993). Resident bull trout complete their entire life cycle in the tributary (or nearby) streams in which they spawn and rear. The resident form tends to be smaller than the migratory form at maturity and also produces fewer eggs (Fraley and Shepard 1989; Goetz 1989). Migratory bull trout spawn in tributary streams where juvenile fish rear 1 to 4 years before migrating to either a lake (adfluvial form), river (fluvial form) (Fraley and Shepard 1989; Goetz 1989), or saltwater (anadromous form) to rear as subadults and to live as adults (Cavender 1978; McPhail and Baxter 1996; WDFW et al. 1997). Bull trout normally reach sexual maturity in 4 to 7 years and may live longer than 12 years. They are iteroparous (they spawn more than once in a lifetime). Repeat- and alternate-year spawning has been reported, although repeat-spawning frequency and post-spawning mortality are not well documented (Fraley and Shepard 1989; Leathe and Graham 1982; Pratt 1992; Rieman and McIntyre 1996).

The iteroparous reproductive strategy of bull trout has important repercussions for the management of this species. Bull trout require passage both upstream and downstream, not only for repeat spawning but also for foraging. Most fish ladders, however, were designed specifically for anadromous semelparous salmonids (fishes that spawn once and then die, and require only one-way passage upstream). Therefore, even dams or other barriers with fish passage facilities may be a factor in isolating bull trout populations if they do not provide a downstream passage route. Additionally, in some core areas, bull trout that migrate to marine waters must pass both upstream and downstream through areas with net fisheries at river mouths. This can increase the likelihood of mortality to bull trout during these spawning and foraging migrations.

Growth varies depending upon life-history strategy. Resident adults range from 6 to 12 inches total length, and migratory adults commonly reach 24 inches or more (Goetz 1989; Pratt 1985). The largest verified bull trout is a 32-pound specimen caught in Lake Pend Oreille, Idaho, in 1949 (Simpson and Wallace 1982).

### Habitat Characteristics

Bull trout have more specific habitat requirements than most other salmonids (Rieman and McIntyre 1993). Habitat components that influence bull trout distribution and abundance include water temperature, cover, channel form and stability, valley form, spawning and rearing substrate, and migratory corridors (Fraley and Shepard 1989; Goetz 1989; Hoelscher and Bjornn 1989; Howell and Buchanan 1992; Pratt 1992; Rich 1996; Rieman and McIntyre 1993; Rieman and McIntyre 1995; Sedell and Everest 1991; Watson and Hillman 1997). Watson and Hillman (1997) concluded that watersheds must have specific physical characteristics to provide the habitat requirements necessary for bull trout to successfully spawn and rear and that these specific characteristics are not necessarily present throughout these watersheds. Because bull trout exhibit a patchy distribution, even in pristine habitats (Rieman and McIntyre 1993), bull trout should not be expected to simultaneously occupy all available habitats (Rieman et al. 1997). Migratory corridors link seasonal habitats for all bull trout life histories. The ability to migrate is important to the persistence of bull trout (Mike Gilpin *in litt.* 1997; Rieman et al. 1997; Rieman and McIntyre 1993). Migrations facilitate gene flow among local populations when individuals from different local populations interbreed or stray to nonnatal streams. Local populations that are extirpated by catastrophic events may also become reestablished by bull trout migrants. However, it is important to note that the genetic structuring of bull trout indicates there is limited gene flow among bull trout populations, which may encourage local adaptation within individual populations, and that reestablishment of extirpated populations may take a long time (Rieman and McIntyre 1993; Spruell et al. 1999). Migration also allows bull trout to access more abundant or larger prey, which facilitates growth and reproduction. Additional benefits of migration and its relationship to foraging are discussed below under “Diet.”

Cold water temperatures play an important role in determining bull trout habitat quality, as these fish are primarily found in colder streams (below 15 °C or 59 °F), and spawning habitats are generally characterized by temperatures that drop below 9 °C (48 °F) in the fall (Fraley and Shepard 1989; Pratt 1992; Rieman and McIntyre 1993).

Thermal requirements for bull trout appear to differ at different life stages. Spawning areas are often associated with cold-water springs, groundwater infiltration, and the coldest streams in a given watershed (Baxter et al. 1997; Pratt 1992; Rieman et al. 1997; Rieman and McIntyre 1993). Optimum incubation temperatures for bull trout eggs range from 2 °C to 6 °C (35 °F to 39 °F) whereas optimum water temperatures for rearing range from about 6 °C to 10 °C (46 °F to 50 °F) (Buchanan and Gregory 1997; Goetz 1989; McPhail and Murray 1979). In Granite Creek, Idaho, Bonneau and Scarnecchia (1996) observed that juvenile bull trout selected the coldest water available in a plunge pool, 8 °C to 9 °C (46 °F to 48 °F), within a temperature gradient of 8 °C to 15 °C (4 °F to 60 °F). In a landscape study relating bull trout distribution to maximum water temperatures, Dunham et al. (2003) found that the probability of juvenile bull trout occurrence does not become high (i.e., greater than 0.75) until maximum temperatures decline to 11 °C to 12 °C (52 °F to 54 °F).

Although bull trout are found primarily in cold streams, occasionally these fish are found in larger, warmer river systems throughout the Columbia River basin (Buchanan and Gregory 1997; Fraley and Shepard 1989; Rieman et al. 1997; Rieman and McIntyre 1993; Rieman and McIntyre 1995). Availability and proximity of cold water patches and food productivity can influence bull trout ability to survive in warmer rivers (Myrick et al. 2002). For example, in a study in the Little Lost River of Idaho where bull trout were found at temperatures ranging from 8 °C to 20 °C (46 °F to 68 °F), most sites that had high densities of bull trout were in areas where primary productivity in streams had increased following a fire (Bart L. Gamett, Salmon-Challis National Forest, pers. comm. June 20, 2002).

All life history stages of bull trout are associated with complex forms of cover, including large woody debris, undercut banks, boulders, and pools (Fraley and Shepard 1989; Goetz 1989; Hoelscher and Bjornn 1989; Pratt 1992; Rich 1996; Sedell and Everest 1991; Sexauer and James 1997; Thomas 1992; Watson and Hillman 1997). Maintaining bull trout habitat requires stability of stream channels and maintenance of natural flow patterns (Rieman and McIntyre 1993). Juvenile and adult bull trout frequently inhabit side channels, stream margins, and pools with suitable cover (Sexauer and James 1997). These areas are sensitive to activities that directly or indirectly affect stream channel stability and alter natural flow patterns. For example, altered stream flow in the fall may disrupt bull trout during the spawning period, and channel instability may decrease survival of eggs and young juveniles in the gravel from winter through spring (Fraley and Shepard 1989; Pratt 1992; Pratt and Huston 1993). Pratt (1992) indicated that increases in fine sediment reduce egg survival and emergence.

Bull trout typically spawn from August through November during periods of increasing flows and decreasing water temperatures. Preferred spawning habitat consists of low-gradient stream reaches with loose, clean gravel (Fraley and Shepard 1989). Redds are often constructed in stream reaches fed by springs or near other sources of cold groundwater (Goetz 1989; Pratt 1992; Rieman and McIntyre 1996). Depending on water temperature, incubation is normally 100 to 145 days (Pratt 1992). After hatching, fry remain in the substrate, and time from egg deposition to emergence may surpass 200 days. Fry normally emerge from early April through May, depending on water temperatures and increasing stream flows (Pratt 1992; Ratliff and Howell 1992).

Early life stages of fish, specifically the developing embryo, require the highest inter-gravel dissolved oxygen (IGDO) levels, and are the most sensitive life stage to reduced oxygen levels. The oxygen demand of embryos depends on temperature and on stage of development, with the greatest IGDO required just prior to hatching.

A literature review conducted by the Washington Department of Ecology (WDOE 2002) indicates that adverse effects of lower oxygen concentrations on embryo survival are magnified as temperatures increase above optimal (for incubation). In a laboratory study conducted in Canada, researchers found that low oxygen levels retarded embryonic development in bull trout (Giles and Van der Zweep 1996 in Stewart et al. 2007). Normal oxygen levels seen in rivers used by bull trout during spawning ranged from 8 to 12 mg/L (in the gravel), with corresponding instream levels of 10 to 11.5 mg/L (Stewart et al. 2007). In addition, IGDO concentrations, water velocities in the water column, and especially the intergravel flow rate, are interrelated variables that affect the survival of incubating embryos (ODEQ 1995). Due to a long incubation period of 220+ days, bull trout are particularly sensitive to adequate IGDO levels. An IGDO level below 8 mg/L is likely to result in mortality of eggs, embryos, and fry.

Migratory forms of bull trout may develop when habitat conditions allow movement between spawning and rearing streams and larger rivers, lakes or nearshore marine habitat where foraging opportunities may be enhanced (Brenkman and Corbett 2005; Frissell 1993; Goetz et al. 2004). For example, multiple life history forms (e.g., resident and fluvial) and multiple migration patterns have been noted in the Grande Ronde River (Baxter 2002). Parts of this river system have retained habitat conditions that allow free movement between spawning and rearing areas and the mainstem Snake River. Such multiple life history strategies help to maintain the stability and persistence of bull trout populations to environmental changes. Benefits to migratory bull trout include greater growth in the more productive waters of larger streams, lakes, and marine waters; greater fecundity resulting in increased reproductive potential; and dispersing the population across space and time so that spawning streams may be recolonized should local populations suffer a catastrophic loss (Frissell 1999; MBTSG 1998; Rieman and McIntyre 1993).

In the absence of the migratory bull trout life form, isolated populations cannot be replenished when disturbances make local habitats temporarily unsuitable. Therefore, the range of the species is diminished, and the potential for a greater reproductive contribution from larger size fish with higher fecundity is lost (Rieman and McIntyre 1993).

**Diet**

Bull trout are opportunistic feeders, with food habits primarily a function of size and life-history strategy. A single optimal foraging strategy is not necessarily a consistent feature in the life of a fish, because this strategy can change as the fish progresses from one life stage to another (i.e., juvenile to subadult). Fish growth depends on the quantity and quality of food that is eaten (Gerking 1994), and as fish grow, their foraging strategy changes as their food changes, in quantity, size, or other characteristics. Resident and juvenile migratory bull trout prey on terrestrial and aquatic insects, macrozooplankton, and small fish (Boag 1987; Donald and Alger 1993; Goetz 1989). Subadult and adult migratory bull trout feed on various fish species (Brown 1994; Donald and Alger 1993; Fraley and Shepard 1989; Leathe and Graham 1982). Bull trout of all sizes other than fry have been found to eat fish half their length (Beauchamp and VanTassell 2001). In nearshore marine areas of western Washington, bull trout feed on Pacific herring (*Clupea pallasi*), Pacific sand lance (*Ammodytes hexapterus*), and surf smelt (*Hypomesus pretiosus*) (Goetz et al. 2004; WDFW et al. 1997).

Bull trout migration and life history strategies are closely related to their feeding and foraging strategies. Migration allows bull trout to access optimal foraging areas and exploit a wider variety of prey resources. Optimal foraging theory can be used to describe strategies fish use to choose between alternative sources of food by weighing the benefits and costs of capturing one source of food over another. For example, prey often occur in concentrated patches of abundance ("patch model" ; Gerking 1994). As the predator feeds in one patch, the prey population is reduced, and it becomes more profitable for the predator to seek a new patch rather than continue feeding on the original one. This can be explained in terms of balancing energy acquired versus energy expended. For example, in the Skagit River system, anadromous bull trout make migrations as long as 121 miles between marine foraging areas in Puget Sound and headwater spawning grounds, foraging on salmon eggs and juvenile salmon along their migration route (WDFW et al. 1997). Anadromous bull trout also use marine waters as migration corridors to reach seasonal habitats in non-natal watersheds to forage and possibly overwinter (Brenkman and Corbett 2005; Goetz et al. 2004).

<u>Changes in Status of the Coastal-Puget Sound Interim Recovery Unit</u>

Although the status of bull trout in Coastal-Puget Sound interim recovery unit has been improved by certain actions, it continues to be degraded by other actions, and it is likely that the overall status of the bull trout in this population segment has not improved since its listing on November 1, 1999. Improvement has occurred largely through changes in fishing regulations and habitat-restoration projects. Fishing regulations enacted in 1994 either eliminated harvest of bull trout or restricted the amount of harvest allowed, and this likely has had a positive influence on the abundance of bull trout. Improvement in habitat has occurred following restoration projects intended to benefit either bull trout or salmon, although monitoring the effectiveness of these projects seldom occurs. On the other hand, the status of this population segment has been adversely affected by a number of Federal and non-Federal actions, some of which were addressed under section 7 of the Act. Most of these actions degraded the environmental baseline; all of those addressed through formal consultation under section 7 of the Act permitted the incidental take of bull trout.

Section 10(a)(1)(B) permits have been issued for Habitat Conservation Plans (HCP) completed in the Coastal-Puget Sound population segment. These include: 1) the City of Seattle's Cedar River Watershed HCP, 2) Simpson Timber HCP, 3) Tacoma Public Utilities Green River HCP, 4) Plum Creek Cascades HCP, 5) Washington State Department of Natural Resources HCP, 6) West Fork Timber HCP (Nisqually River), and 7) Forest Practices HCP. These HCPs provide landscape-scale conservation for fish, including bull trout. Many of the covered activities associated with these HCPs will contribute to conserving bull trout over the long-term; however, some covered activities will result in short-term degradation of the baseline. All HCPs permit the incidental take of bull trout.

Changes in Status of the Columbia River Interim Recovery Unit

The overall status of the Columbia River interim recovery unit has not changed appreciably since its listing on June 10, 1998. Populations of bull trout and their habitat in this area have been affected by a number of actions addressed under section 7 of the Act. Most of these actions resulted in degradation of the environmental baseline of bull trout habitat, and all permitted or analyzed the potential for incidental take of bull trout. The Plum Creek Cascades HCP, Plum Creek Native Fish HCP, and Forest Practices HCP addressed portions of the Columbia River population segment of bull trout.

Changes in Status of the Klamath River Interim Recovery Unit

Improvements in the Threemile, Sun, and Long Creek local populations have occurred through efforts to remove or reduce competition and hybridization with non-native salmonids, changes in fishing regulations, and habitat-restoration projects. Population status in the remaining local populations (Boulder-Dixon, Deming, Brownsworth, and Leonard Creeks) remains relatively unchanged. Grazing within bull trout watersheds throughout the recovery unit has been curtailed. Efforts at removal of non-native species of salmonids appear to have stabilized the Threemile and positively influenced the Sun Creek local populations. The results of similar efforts in Long Creek are inconclusive. Mark and recapture studies of bull trout in Long Creek indicate a larger migratory component than previously expected.

Although the status of specific local populations has been slightly improved by recovery actions, the overall status of Klamath River bull trout continues to be depressed. Factors considered threats to bull trout in the Klamath Basin at the time of listing – habitat loss and degradation caused by reduced water quality, past and present land use management practices, water diversions, roads, and non-native fishes – continue to be threats today.

Changes in Status of the Saint Mary-Belly River Interim Recovery Unit

The overall status of bull trout in the Saint Mary-Belly River interim recovery unit has not changed appreciably since its listing on November 1, 1999. Extensive research efforts have been conducted since listing, to better quantify populations of bull trout and their movement patterns. Limited efforts in the way of active recovery actions have occurred. Habitat occurs mostly on Federal and Tribal lands (Glacier National Park and the Blackfeet Nation). Known problems due to instream flow depletion, entrainment, and fish passage barriers resulting from operations of the U.S. Bureau of Reclamation's Milk River Irrigation Project (which transfers Saint Mary-Belly River water to the Missouri River Basin) and similar projects downstream in Canada constitute the primary threats to bull trout and to date they have not been adequately addressed under section 7 of the Act. Plans to upgrade the aging irrigation delivery system are being pursued, which has potential to mitigate some of these concerns but also the potential to intensify dewatering. A major fire in August 2006 severely burned the forested habitat in Red Eagle and Divide Creeks, potentially affecting three of nine local populations and degrading the baseline.

**Snohomish-Skykomish Core Area**

The Snohomish-Skykomish core area comprises the Snohomish, Skykomish, and Snoqualmie Rivers and their tributaries. Bull trout occur throughout the Snohomish River system downstream of barriers to anadromous fish. Bull trout are not known to occur upstream of Snoqualmie Falls, upstream of Spada Lake on the Sultan River, in the upper forks of the Tolt River, above Deer Falls on the North Fork Skykomish River, or above Alpine Falls on the Tye River.

Fluvial, resident, and anadromous life history forms of bull trout occur in the Snohomish River/Skykomish core area. A large portion of the migratory segment of this population is anadromous. No lakes within the basin support an adfluvial population of bull trout. However, anadromous and fluvial forms occasionally forage in a number of lowland lakes connected to the mainstem rivers.

The mainstems of the Snohomish, Skykomish, North Skykomish, and South Fork Skykomish Rivers provide important foraging, migrating, and overwintering habitat for subadult and adult bull trout. The amount of key spawning and early rearing habitat is more limited, in comparison with many other core areas, because of the topography of the basin. Rearing bull trout occur throughout most of the accessible reaches of the basin and extensively use the lower estuary, nearshore marine areas, and Puget Sound for extended rearing.

The status of the bull trout core area population is based on four key elements necessary for long-term viability: (1) number and distribution of local populations, (2) adult abundance, (3) productivity, and (4) connectivity (FWS 2004).

<u>Number and Distribution of Local Populations</u>

Four local populations have been identified: (1) North Fork Skykomish River (including Goblin and West Cady Creeks), (2) Troublesome Creek (resident form only), (3) Salmon Creek, and (4) South Fork Skykomish River. With only four local populations, bull trout in this core area are considered at increased risk of extirpation and adverse effects from random naturally occurring events (see "Life History").

Adult Abundance

The Snohomish-Skykomish core area probably supports between 500 and 1,000 adults and as a result the core area remains at risk of genetic drift. Most of the spawners in the core area occur in the North Fork Skykomish local population. Redd counts within the North Fork Skykomish local population peaked at over 530 in 2002 (FWS 2004), but have recently declined to just over 240 in 2005 and 2006 (WDFW 2007). This is one of two local populations in the core area (the other is South Fork Skykomish River) that supports more than 100 adults, which minimizes the deleterious effects of inbreeding. The Troublesome Creek population is mainly a resident population with few migratory fish. Although adult abundance is unknown in this local population, it is probably stable due to intact habitat conditions. The Salmon Creek local population likely has fewer than 100 adults. Although spawning and early rearing habitat in the Salmon Creek area is in good to excellent condition, this local population is at risk of inbreeding depression because of the low number of adults. Monitoring of the South Fork Skykomish local population indicates increasing numbers of adult migrants. This local population recently exceeded 100 adults and is not considered at risk of inbreeding depression (Chad Jackson, WDFW, *in litt*. 2004).

Productivity

Long-term redd counts for the North Fork Skykomish local population indicate increasing population trends. Productivity of the Troublesome Creek and Salmon Creek local populations is unknown but presumed stable, as the available spawning and early rearing habitats are considered to be in good to excellent condition. In the South Fork Skykomish local population, new spawning and rearing areas are being colonized, resulting in increasing numbers of spawners. Sampling of the North Fork and South Fork Skykomish local population areas indicates the overall productivity of bull trout in the Snohomish-Skykomish core area is increasing.

Connectivity

Migratory bull trout occur in three of the four local populations in the Snohomish-Skykomish core area (North Fork Skykomish, Salmon Creek, and South Fork Skykomish). The lack of connectivity with the Troublesome Creek local population is a natural condition. The connectivity between the other three local populations diminishes the risk of extirpation of the bull trout in the core area from habitat isolation and fragmentation.

Changes in Environmental Conditions and Population Status

Since the listing of bull trout, Federal actions occurring in the Snohomish-Skykomish core area have caused harm to, or harassment of, bull trout. These actions include statewide Federal restoration programs that include riparian restoration, removal of fish-passage barriers, and fish habitat improvement projects; federally funded transportation projects involving repair and protection of roads and bridges; and section 10(a)(1)(B) permits for HCPs addressing forest-management practices. Capture and handling during implementation of section 6 and section 10(a)(1)(A) permits have directly affected bull trout in the Snohomish-Skykomish core area.

The number of nonfederal actions occurring in the Snohomish-Skykomish core area since the bull trout listing is unknown. However, activities conducted on a regular basis, such as emergency flood control, development, and infrastructure maintenance, affect riparian and instream habitat and probably negatively affect bull trout.

Threats

Threats to bull trout in the Snohomish-Skykomish core area include:

- Nearshore foraging habitat has been, and continues to be, affected by development activities.

- Agricultural and livestock practices, including blocking fish passage, altering stream morphology, and degrading water quality in the lower watershed (FMO habitat), have significantly affected the floodplain and bull trout habitat.

- Water quality has been degraded by municipal and industrial effluent discharges and development.

- Illegal harvest or incidental hooking mortality may occur at several campgrounds where recreational fishing is allowed by the WDFW.

- Past timber harvest and harvest-related activities, such as roads, have degraded habitat conditions in the upper watershed.

## STATUS OF CRITICAL HABITAT (Bull Trout)

This Opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statute and the August 6, 2004, Ninth Circuit Court of Appeals decision in Gifford Pinchot Task Force v. U.S. Fish and Wildlife Service (No. 03-35279) to complete the following analysis with respect to critical habitat.

### Legal Status

The FWS published a final critical habitat designation for the coterminous United States population of the bull trout on September 26, 2005 (70 FR 56212); the rule became effective on October 26, 2005. The scope of the designation involved the Klamath River, Columbia River, Coastal-Puget Sound, and Saint Mary-Belly River population segments (also considered as interim recovery units). Rangewide, the FWS designated 143,218 acres of reservoirs or lakes and 4,813 stream or shoreline miles as bull trout critical habitat (Table 2).

Table 2. Stream/shoreline distance and acres of reservoir or lakes designated as bull trout critical habitat by state.

| | Stream/shoreline Miles | Stream/shoreline Kilometers | Acres | Hectares |
|---|---|---|---|---|
| Idaho | 294 | 474 | 50,627 | 20,488 |
| Montana | 1,058 | 1,703 | 31,916 | 12,916 |
| Oregon | 939 | 1,511 | 27,322 | 11,057 |
| Oregon/Idaho | 17 | 27 | | |
| Washington | 1,519 | 2,445 | 33,353 | 13,497 |
| Washington (marine) | 985 | 1,585 | | |

Although critical habitat has been designated across a wide area, some critical habitat segments were excluded in the final designation based on a careful balancing of the benefits of inclusion versus the benefits of exclusion (see Section 3(5)(A) and Exclusions under Section 4(b)(2) in the final rule). This balancing process resulted in all proposed critical habitat being excluded in 9 proposed critical habitat units: Unit 7 (Odell Lake), Unit 8 (John Day River Basin), Unit 15 (Clearwater River Basin), Unit 16 (Salmon River Basin), Unit 17 (Southwest Idaho River Basins), Unit 18 (Little Lost River), Unit 21 (Upper Columbia River), Unit 24 (Columbia River), and Unit 26 (Jarbidge River Basin). The remaining 20 proposed critical habitat units were designated in the final rule. It is important to note that the exclusion of waterbodies from designated critical habitat does not negate or diminish their importance for bull trout conservation.

**Conservation Role and Description of Critical Habitat**

The conservation role of bull trout critical habitat is to support viable core area populations (70 FR 56212). The core areas reflect the metapopulation structure of bull trout and are the closest approximation of a biologically functioning unit for the purposes of recovery planning and risk analyses. Critical habitat units generally encompass one or more core areas and may include foraging, migration, and overwintering (FMO) areas, outside of core areas, that are important to the survival and recovery of bull trout.

Because there are numerous exclusions that reflect land ownership, designated critical habitat is often fragmented and interspersed with excluded stream segments. These individual critical habitat segments are expected to contribute to the ability of the stream to support bull trout within local populations and core areas in each critical habitat unit.

The primary function of individual critical habitat units is to maintain and support core areas which 1) contain bull trout populations with the demographic characteristics needed to ensure their persistence and contain the habitat needed to sustain those characteristics (Rieman and McIntyre 1993); 2) provide for persistence of strong local populations, in part, by providing habitat conditions that encourage movement of migratory fish (Rieman and McIntyre 1993; MBTSG 1998); 3) are large enough to incorporate genetic and phenotypic diversity, but small enough to ensure connectivity between populations (Rieman and McIntyre 1993; Hard 1995; Healey and Prince 1995; MBTSG 1998); and 4) are distributed throughout the historic range of the species to preserve both genetic and phenotypic adaptations (Rieman and McIntyre 1993; Hard 1995; MBTSG 1998; Rieman and Allendorf 2001).

The Olympic Peninsula and Puget Sound critical habitat units are essential to the conservation of amphidromous bull trout, which are unique to the Coastal-Puget Sound bull trout population. These critical habitat units contain nearshore and freshwater habitats, outside of core areas, that are used by bull trout from one or more core areas. These habitats, outside of core areas, contain Primary Constituent Elements (PCEs) that are critical to adult and subadult foraging, overwintering, and migration.

Within the designated critical habitat areas, the PCEs for bull trout are those habitat components that are essential for the primary biological needs of foraging, reproducing, rearing of young, dispersal, genetic exchange, or sheltering. Note that only PCEs 1, 6, 7, and 8 apply to marine nearshore waters identified as critical habitat; and all except PCE 3 apply to FMO habitat identified as critical habitat.

The PCEs are as follows:

(1) Water temperatures that support bull trout use. Bull trout have been documented in streams with temperatures from 32º to 72 ºF (0º to 22 ºC) but are found more frequently in temperatures ranging from 36º to 59 ºF (2º to 15 ºC). These temperature ranges may vary depending on bull trout life-history stage and form, geography, elevation, diurnal and seasonal variation, shade, such as that provided by riparian habitat, and local groundwater influence. Stream reaches with temperatures that preclude bull trout use are specifically excluded from designation.

(2) Complex stream channels with features such as woody debris, side channels, pools, and undercut banks to provide a variety of depths, velocities, and instream structures.

(3) Substrates of sufficient amount, size, and composition to ensure success of egg and embryo overwinter survival, fry emergence, and young-of-the-year and juvenile survival. This should include a minimal amount of fine substrate less than 0.25 inch (0.63 centimeter) in diameter.

(4) A natural hydrograph, including peak, high, low, and base flows within historic ranges or, if regulated, currently operate under a biological opinion that addresses bull trout, or a hydrograph that demonstrates the ability to support bull trout populations by minimizing daily and day-to-day fluctuations and minimizing departures from the natural cycle of flow levels corresponding with seasonal variation.

(5) Springs, seeps, groundwater sources, and subsurface water to contribute to water quality and quantity as a cold water source.

(6) Migratory corridors with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and foraging habitats, including intermittent or seasonal barriers induced by high water temperatures or low flows.

(7) An abundant food base including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.

(8) Permanent water of sufficient quantity and quality such that normal reproduction, growth, and survival are not inhibited.

Critical habitat includes the stream channels within the designated stream reaches, the shoreline of designated lakes, and the inshore extent of marine nearshore areas, including tidally influenced freshwater heads of estuaries.

In freshwater habitat, critical habitat includes the stream channels within the designated stream reaches, and includes a lateral extent as defined by the ordinary high-water line. In areas where ordinary high-water line has not been defined, the lateral extent will be defined by the bankfull elevation. Bankfull elevation is the level at which water begins to leave the channel and move into the floodplain and is reached at a discharge that generally has a recurrence interval of 1 to 2 years on the annual flood series. For designated lakes, the lateral extent of critical habitat is defined by the perimeter of the water body as mapped on standard 1:24,000 scale topographic maps.

In marine habitat, critical habitat includes the inshore extent of marine nearshore areas between mean lower low-water (MLLW) and minus 10 meters (m) mean higher high-water (MHHW), including tidally influenced freshwater heads of estuaries. This refers to the area between the average of all lower low-water heights and all the higher high-water heights of the two daily tidal levels. The offshore extent of critical habitat for marine nearshore areas is based on the extent of the photic zone, which is the layer of water in which organisms are exposed to light. Critical habitat extends offshore to the depth of 33 feet (10 m) relative to the MLLW.

Adjacent stream, lake, and shoreline riparian areas, bluffs, and uplands are not designated as critical habitat. However, it should be recognized that the quality of marine and freshwater habitat along streams, lakes, and shorelines is intrinsically related to the character of these adjacent features, and that human activities that occur outside of the designated critical habitat can have major effects on physical and biological features of the aquatic environment.

Activities that cause adverse effects to critical habitat are evaluated to determine if they are likely to “destroy or adversely modify” critical habitat by altering the PCEs to such an extent that critical habitat would not remain functional to serve the intended conservation role for the species (70 FR 56212, USFWS 2004). The FWS’s evaluation must be conducted at the scale of the entire critical habitat area designated, unless otherwise stated in the final critical habitat rule (USFWS and NMFS 1998). Therefore, adverse modification of bull trout critical habitat is evaluated at the scale of the final designation, which includes the critical habitat designated for the Klamath River, Columbia River, Coastal-Puget Sound, and Saint Mary-Belly River population segments.

## Current Condition Rangewide

The condition of bull trout critical habitat varies across its range from poor to good. Although still relatively widely distributed across its historic range, the bull trout occurs in low numbers in many areas, and populations are considered depressed or declining across much of its range (67 FR 71240). This condition reflects the condition of bull trout habitat.

There is widespread agreement in the scientific literature that many factors related to human activities have impacted bull trout and their habitat, and continue to do so. Among the many factors that contribute to degraded PCEs, those which appear to be particularly significant and have resulted in a legacy of degraded habitat conditions are as follows: 1) fragmentation and isolation of local populations due to the proliferation of dams and water diversions that have eliminated habitat, altered water flow and temperature regimes, and impeded migratory movements (Rieman and McIntyre 1993; Dunham and Rieman 1999); 2) degradation of spawning and rearing habitat and upper watershed areas, particularly alterations in sedimentation rates and water temperature, resulting from forest and rangeland practices and intensive development of roads (Fraley and Shepard 1989; MBTSG 1998); 3) the introduction and spread of nonnative fish species, particularly brook trout and lake trout, as a result of fish stocking and degraded habitat conditions, which compete with bull trout for limited resources and, in the case of brook trout, hybridize with bull trout (Leary et al. 1993; Rieman et al. 2006); 4) in the Coastal-Puget Sound region where amphidromous bull trout occur, degradation of mainstem river FMO habitat, and the degradation and loss of marine nearshore foraging and migration habitat due to urban and residential development; and 5) degradation of FMO habitat resulting from reduced prey base, roads, agriculture, development, and dams.

# STATUS OF THE SPECIES (Marbled Murrelets)

## Legal Status

The marbled murrelet (murrelet) was federally listed as a threatened species in Washington, Oregon, and northern California effective September 28, 1992 (57 FR 45328 [October 1, 1992]). The final rule designating critical habitat for the murrelet (61 FR 26256 [May 24, 1996]) became effective on June 24, 1996. The FWS recently proposed a revision to the 1996 murrelet critical habitat designation (71 FR 44678 [July 31, 2008]). A final rule is expected in 2009. The species' decline has largely been caused by extensive removal of late-successional and old-growth coastal forests which serve as nesting habitat for murrelets. Additional listing factors included high nest-site predation rates and human-induced mortality in the marine environment from gillnets and oil spills.

The FWS determined that the California, Oregon, and Washington distinct population segment of the murrelet does not meet the criteria set forth in the FWS's 1996 Distinct Population Segment policy (61 FR 4722 [May 24, 1996]; (Beissinger and Nur 1997 in USFWS 2004). However, the murrelet retains its listing and protected status as a threatened species under the Act until the original 1992 listing decision is revised through formal rule-making procedures, involving public notice and comment.

Critical habitat was designated for the murrelet to addresses the objective of stabilizing the population size. To fulfill that objective, the Marbled Murrelet Recovery Plan (USFWS 1997b) (Recovery Plan), focuses on protecting adequate nesting habitat by maintaining and protecting occupied habitat and minimizing the loss of unoccupied but suitable habitat (USFWS 1997b, p. 119). The Recovery Plan identified six Conservation Zones throughout the listed range of the species: Puget Sound (Conservation Zone 1), Western Washington Coast Range (Conservation Zone 2), Oregon Coast Range (Conservation Zone 3), Siskiyou Coast Range (Conservation Zone 4), Mendocino (Conservation Zone 5), and Santa Cruz Mountains (Conservation Zone 6).

As explained in the Endangered Species Consultation Handbook (USFWS and NMFS 1998) and clarified for recovery units through Memorandum (USFWS 2006), jeopardy analyses must always consider the effect of proposed actions on the survival and recovery of the listed entity. In the case of the murrelet, the FWS's jeopardy analysis will consider the effect of the action on the long-term viability of the murrelet in its listed range (Washington, Oregon, and northern California), beginning with an analysis of the action's effect on Conservation Zones 1 and 2 (described below).

Conservation Zone 1

Conservation Zone 1 includes all the waters of Puget Sound and most waters of the Strait of Juan de Fuca south of the U.S.-Canadian border and extends inland 50 miles from the Puget Sound, including the north Cascade Mountains and the northern and eastern sections of the Olympic Peninsula. Forest lands in the Puget Trough have been predominately replaced by urban development and the remaining suitable habitat in Zone 1 is typically a considerable distance from the marine environment, lending special importance to nesting habitat close to Puget Sound (USFWS 1997b).

Conservation Zone 2

Conservation Zone 2 includes waters within 1.2 miles of the Pacific Ocean shoreline south of the U.S.-Canadian border off Cape Flattery and extends inland to the midpoint of the Olympic Peninsula. In southwest Washington, the Zone extends inland 50 miles from the Pacific Ocean shoreline. Most of the forest lands in the northwestern portion of Zone 2 occur on public (State, county, city, and Federal) lands, while most forest lands in the southwestern portion are privately owned. Extensive timber harvest has occurred throughout Zone 2 in the last century, but the greatest loss of suitable nest habitat is concentrated in the southwest portion of Zone 2 (USFWS 1997b). Thus, murrelet conservation is largely dependent upon Federal lands in northern portion of Zone 2 and non-Federal lands in the southern portion.

**Life History**

Murrelets are long-lived seabirds that spend most of their life in the marine environment, but use old-growth forests for nesting. Detailed discussions of the biology and status of the murrelet are presented in the final rule listing the murrelet as threatened (57 FR 45328 [October 1, 1992]), the Recovery Plan, Ecology and Conservation of the Marbled Murrelet (Ralph et al. 1995), the final rule designating murrelet critical habitat (61 FR 26256 [May 24, 1996]), and the Evaluation Report in the 5-Year Status Review of the Marbled Murrelet in Washington, Oregon, and California (McShane et al. 2004).

Physical Description

The murrelet is taxonomically classified in the family Alcidae (alcids), a family of Pacific seabirds possessing the ability to dive using wing-propulsion. The plumage of this relatively small (9.5 in to 10 in) seabird is identical between males and females, but the plumage of adults changes during the winter and breeding periods providing some distinction between adults and juveniles. Breeding adults have light, mottled brown under-parts below sooty-brown upperparts contrasted with dark bars. Adults in winter plumage have white under-parts extending to below the nape and white scapulars with brown and grey mixed upperparts. The plumage of fledged young is similar to the adult winter plumage (USFWS 1997b).

Distribution

The range of the murrelet, defined by breeding and wintering areas, extends from the northern terminus of Bristol Bay, Alaska, to the southern terminus of Monterey Bay in central California. The listed portion of the species' range extends from the Canadian border south to central California. Murrelet abundance and distribution has been significantly reduced in portions of the listed range, and the species has been extirpated from some locations. The areas of greatest concern due to small numbers and fragmented distribution include portions of central California, northwestern Oregon, and southwestern Washington (USFWS 1997b).

Reproduction

Murrelet breeding is asynchronous and spread over a prolonged season. In Washington, the murrelet breeding season occurs between April 1 and September 15 (Figure 6). Egg laying and incubation occur from late April to early August and chick rearing occurs between late May and late August, with all chicks fledging by early September (Hamer et al. 2003).

Murrelets lay a single-egg clutch (Nelson 1997), which may be replaced if egg failure occurs early (Hebert et al. 2003; McFarlane-Tranquilla et al. 2003). However, there is no evidence a second egg is laid after successfully fledging a first chick. Adults typically incubate for a 24-hour period, then exchange duties with their mate at dawn. Hatchlings appear to be brooded by an adult for one to two days and are then left alone at the nest for the remainder of the rearing period, except during feedings. Both parents feed the chick, which receives one to eight meals per day (Nelson 1997). Most meals are delivered early in the morning while about a third of the food deliveries occur at dusk and intermittently throughout the day (Nelson and Hamer 1995b). Chicks fledge 27 to 40 days after hatching. The initial flight of a fledgling appears to occur at dusk and parental care is thought to cease after fledging (Nelson 1997).

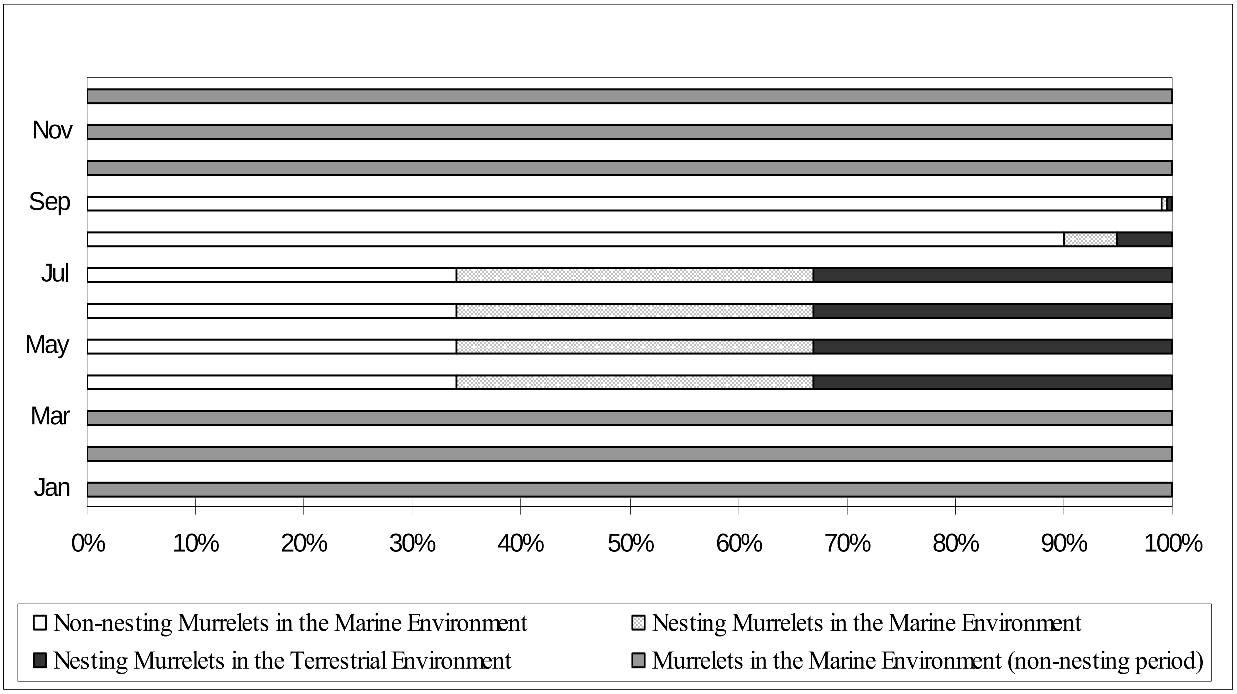


**Figure 6. The seasonal changes in the relative proportion of breeding and non-breeding murrelets in the marine and terrestrial environments[2] within Washington State (Conservation Zones 1 and 2)**

Vocalization

Murrelets are known to vocalize between 480 Hertz and 4.9 kilohertz and have at least 5 distinct call types (Suzanne Sanborn, pers. comm. 2005). Murrelets tend to be more vocal at sea compared to other alcids (Nelson 1997). Individuals of a pair vocalize after surfacing apart from each other, after a disturbance, and during attempts to reunite after being separated (Strachan et al. 1995).

MURRELETS IN THE MARINE ENVIRONMENT

Murrelets are ususally found within 5 miles (8 kilometers) from shore, and in water less than 60 meters deep (Ainley et al. 1995; Burger 1995; Strachan et al. 1995; Nelson 1997; Day and Nigro 2000; Raphael et al. 2007). In general, birds occur closer to shore in exposed coastal areas and farther offshore in protected coastal areas (Nelson 1997). Courtship, foraging, loafing, molting, and preening occur in marine waters. Beginning in early spring, courtship continues throughout

[2] Demographic estimates were derived from Peery et al. (2004) and nesting chronology was derived from Hamer and Nelson (1995) and Bradley et al. (2004) where April 1 is the beginning of the nesting season, September 15 is the end of the nesting season, and August 6 is the beginning of the late breeding season when an estimated 70 percent of the murrelet chicks have fledged.

summer with some observations even noted during the winter period (Speckman 1996; Nelson 1997). Observations of courtship occurring in the winter suggest that pair bonds are maintained throughout the year (Speckman 1996; Nelson 1997). Courtship involves bill posturing, swimming together, synchronous diving, vocalizations, and chasing in flights just above the surface of the water. Copulation occurs both inland (in the trees) and at sea (Nelson 1997).

*Loafing*

When murrelets are not foraging or attending a nest, they loaf on the water, which includes resting, preening, and other activities during which they appear to drift with the current, or move without direction (Strachan et al. 1995). Strachan et al. (1995) noted that vocalizations occurred during loafing periods, especially during the mid-morning and late afternoon.

*Molting*

Murrelets go through two molts each year. The timing of molts varies temporally throughout their range and are likely influenced by prey availability, stress, and reproductive success (Nelson 1997). Adult (after hatch-year) murrelets have two primary plumage types: alternate (breeding) plumage and basic (winter) plumage. The pre-alternate molt occurs from late February to mid-May. This is an incomplete molt during which the birds lose their body feathers but retain their ability to fly (Carter and Stein 1995; Nelson 1997). A complete pre-basic molt occurs from mid-July through December (Carter and Stein 1995; Nelson 1997). During the pre-basic molt, murrelets lose all flight feathers somewhat synchronously and are flightless for up to two months (Nelson 1997). In Washington, there is some indication that the pre-basic molt occurs from mid-July through the end of August (Chris Thompson, pers. comm. 2003).

*Flocking*

Strachan et al. (1995) defines a flock as three or more birds in close proximity which maintain that formation when moving. Various observers throughout the range of the murrelet report flocks of highly variable sizes. In the southern portion of the murrelet's range (California, Oregon, and Washington), flocks rarely contain more than 10 birds. Larger flocks usually occur during the later part of the breeding season and may contain juvenile and subadult birds (Strachan et al. 1995).

Aggregations of foraging murrelets are probably related to concentrations of prey. In Washington, murrelets are not generally found in interspecific feeding flocks (Strachan et al. 1995). Strong et al. (in Strachan et al. 1995) observed that murrelets avoid large feeding flocks of other species and presumed that the small size of murrelets may make them vulnerable to kleptoparasitism or predation in mixed species flocks. Strachan et al. (1995) point out that if murrelets are foraging cooperatively, the confusion of a large flock of birds could reduce foraging efficiency.

*Foraging Behavior*

Murrelets are wing-propelled pursuit divers that forage both during the day and at night (Carter and Sealy 1986; Gaston and Jones 1998; Henkel et al. 2003; Kuletz 2005). Murrelets typically forage in pairs, but have been observed to forage alone or in groups of three or more (Carter and Sealy 1990; Strachan et al. 1995; Speckman et al. 2003). Strachan et al. (1995) believe pairing enhances foraging success through cooperative foraging techniques. For example, pairs consistently dive together during foraging and often synchronize their dives by swimming towards each other before diving (Carter and Sealy 1990) and resurfacing together on most dives. Strachan et al. (1995) speculate pairs may keep in visual contact underwater. Paired foraging is common throughout the year, even during the incubation period, suggesting that breeding murrelets may temporarily pair up with other foraging individuals (non-mates) (Strachan et al. 1995; Speckman et al. 2003).

Murrelets can make substantial changes in foraging sites within the breeding season, but many birds routinely forage in the same general areas and at productive foraging sites, as evidenced by repeated use over a period of time throughout the breeding season (Carter and Sealy 1990; Whitworth et al. 2000; Becker et al. 2001; Hull et al. 2001; Mason et al. 2002; Piatt et al. 2007). Murrelets are also known to forage in freshwater lakes (Nelson 1997). Activity patterns and foraging locations are influenced by biological and physical processes that concentrate prey, such as weather, climate, time of day, season, light intensity, up-wellings, tidal rips, narrow passages between islands, shallow banks, and kelp (*Nereocystis* spp.) beds (Ainley et al. 1995; Strong et al. 1995; Burger 1995; Speckman 1996; Nelson 1997).

Juveniles are generally found closer to shore than adults (Beissinger 1995) and forage without the assistance of adults (Strachan et al. 1995). Kuletz and Piatt (1999) found that in Alaska, juvenile murrelets congregated in kelp beds. Kelp beds are often with productive waters and may provide protection from avian predators (Kuletz and Piatt 1999). McAllister (in litt. in Strachan et al. 1995) found that juveniles were more common within 328 feet of shorelines, particularly, where bull kelp was present.

Murrelets usually feed in shallow, near-shore water less than 30m (98 feet) deep (Huff et al. 2006), but are thought to be able to dive up to depths of 47 m (157 feet) (Mathews and Burger 1998). Variation in depth and dive patterns may be related to the effort needed to capture prey. Thick-billed murres (*Uria lomvia*) and several penguin species exhibit bi-modal foraging behavior in that their dive depths mimic the depth of their prey, which undergo daily vertical migrations in the water column (Croll et al. 1992; Butler and Jones 1997). Jodice and Collopy's (1999) data suggest murrelets follow this same pattern as they forage for fish that occur throughout the water column but undergo daily vertical migrations (to shallower depths at night and back to deeper depths during the day). Murrelets observed foraging in deeper water likely do so when upwelling, tidal rips, and daily activity patterns concentrate the prey near the surface (Strachan et al. 1995).

The duration of dives appears to depend upon age (adults vs. juveniles), water depth, visibility, and depth and availability of prey. Murrelet dive duration ranges from 8 seconds to 115 seconds, although most dives last between 25 and 45 seconds (Thorensen 1989; Jodice and Collopy 1999; Watanuki and Burger 1999; Day and Nigro 2000).

Adults and subadults often move away from breeding areas prior to molting and must select areas with predictable prey resources during the flightless period (Carter and Stein 1995; Nelson 1997). During the non-breeding season, murrelets disperse and can be found farther from shore (Strachan et al. 1995). Little is known about marine-habitat preference outside of the breeding season, but use during the early spring and fall is thought to be similar to that preferred during the breeding season (Nelson 1997). During the winter there may be a general shift from exposed outer coasts into more protected waters (Nelson 1997), for example many murrelets breeding on the exposed outer coast of Vancouver Island appear to congregate in the more sheltered waters within the Puget Sound and the Strait of Georgia in fall and winter (Burger 1995). However, in many areas, murrelets remain associated with the inland nesting habitat during the winter months (Carter and Erickson 1992) and throughout the listed range, murrelets do not appear to disperse long distances, indicating they are year-round residents (McShane et al. 2004).

*Prey Species*

Throughout their range, murrelets are opportunistic feeders and utilize prey of diverse sizes and species. They feed primarily on fish and invertebrates in marine waters although they have also been detected on rivers and inland lakes (Carter and Sealy 1986); 57 FR 45328 [October 1, 1992]). In general, small schooling fish and large pelagic crustaceans are the main prey items. Pacific sand lance *(Ammodytes hexapterus)*, northern anchovy *(Engraulis mordax),* immature Pacific herring *(Clupea harengus)*, capelin *(Mallotus villosus)*, Pacific sardine (*Sardinops sagax*), juvenile rockfishes (*Sebastas* spp.) and surf smelt (Osmeridae) are the most common fish species taken. Squid (*Loligo* spp.), euphausiids, mysid shrimp, and large pelagic amphipods are the main invertebrate prey. Murrelets are able to shift their diet throughout the year and over years in response to prey availability (Becker et al. 2007). However, long-term adjustment to less energetically-rich prey resources (such as invertebrates) appears to be partly responsible for poor murrelet reproduction in California (Becker and Beissinger 2006).

Breeding adults exercise more specific foraging strategies when feeding chicks, usually carrying a single, relatively large (relative to body size) energy-rich fish to their chicks (Burkett 1995; Nelson 1997), primarily around dawn and dusk (Nelson 1997; Kuletz 2005). Freshwater prey appears to be important to some individuals during several weeks in summer and may facilitate more frequent chick feedings, especially for those that nest far inland (Hobson 1990). Becker et al. (Becker et al. 2007) found murrelet reproductive success in California was strongly correlated with the abundance of mid-trophic level prey (e.g. sand lance, juvenile rockfish) during the breeding and postbreeding seasons. Prey types are not equal in the energy they provide; for example parents delivering fish other than age-1 herring may have to increase deliveries by to up 4.2 times to deliver the same energy value (Kuletz 2005). Therefore, nesting murrelets that are returning to their nest at least once per day must balance the energetic costs of foraging trips with the benefits for themselves and their young. This may result in murrelets preferring to forage in marine areas in close proximity to their nesting habitat. However, if adequate or appropriate foraging resources (i.e., “enough” prey, and/or prey with the optimum nutritional value for themselves or their young) are unavailable in close proximity to their nesting areas, murrelets may be forced to forage at greater distances or to abandon their nests (Huff et al. 2006, p. 20). As a result, the distribution and abundance of prey suitable for feeding chicks may greatly influence the overall foraging behavior and location(s) during the nesting season, may affect reproductive success (Becker et al. 2007), and may significantly affect the energy demand on adults by influencing both the foraging time and number of trips inland required to feed nestlings (Kuletz 2005).

*Predators*

At-sea predators include bald eagles (*Haliaeetus leucocephalus*), peregrine falcons (*Falco peregrinus*), western gulls (*Larus occidentalis*), and northern fur seals (*Callorhinus ursinus*) (McShane et al. 2004). California sea lions (*Zalophus californianus*), northern sea lions (*Eumetopias jubatus*), and large fish may occasionally prey on murrelets (Burger 2002).

Murrelets in the Terrestrial Environment

Murrelets are dependent upon old-growth forests, or forests with an older tree component, for nesting habitat (Ralph et al. 1995; Hamer and Nelson 1995; McShane et al. 2004). Sites occupied by murrelets tend to have a higher proportion of mature forest age-classes than do unoccupied sites (Raphael et al. 1995). Specifically, murrelets prefer high and broad platforms for landing and take-off, and surfaces which will support a nest cup (Hamer and Nelson 1995). The physical condition of a tree appears to be the important factor in determining the tree’s suitability for nesting (Ralph et al. 1995); therefore, presence of old-growth in an area does not assure the stand contains sufficient structures (i.e. platforms) for nesting. In Washington, murrelet nests have been found in conifers, specifically, western hemlock (*Tsuga heterophylla*), Sitka spruce (*Picea sitchensis*), Douglas-fir (*Pseudotsuga menziesii*), and western red cedar (*Thuja plicata*) (Hamer and Nelson 1995; Hamer and Meekins 1999). Nests have been found in trees as small as 2.6 feet in diameter at breast height on limbs at least 65 feet from the ground and 0.36 feet in diameter (Hamer and Meekins 1999).

Murrelet populations may be limited by the availability of suitable nesting habitat. Although no data are available, Ralph et al. (1995) speculate the suitable nesting habitat presently available in Washington, Oregon, and California may be at or near carrying capacity based on: 1) at-sea concentrations of murrelets near suitable nesting habitat during the breeding season, 2) winter visitations to nesting sites, and 3) the limitation of nest sites available in areas with large amounts of habitat removal.

Murrelets have been observed visiting nesting habitat during non-breeding periods in Washington, Oregon, and California (Naslund 1993; Nelson 1997) which may indicate adults are defending nesting sites and/or stands (Ralph et al. 1995). Other studies provide further insight to the habitat associations of breeding murrelets, concluding that breeding murrelets displaced by the loss of nesting habitat do not pack in higher densities into remaining habitat (McShane et al. 2004). Thus, murrelets may currently be occupying nesting habitat at or near carrying capacity in highly fragmented areas and/or in areas where a significant portion of the historic nesting habitat has been removed (Ralph et al. 1995).

Unoccupied stands containing nesting structures are important to the population for displaced breeders or first-time breeding adults. Even if nesting habitat is at carrying capacity, there will be years when currently occupied stands become unoccupied as a result of temporary disappearance of inhabitants due to death or to irregular breeding (Ralph et al. 1995). Therefore, unoccupied stands will not necessarily indicate that habitat is not limiting or that these stands are not murrelet habitat (Ralph et al. 1995) and important to the species persistence.

Radar and audio-visual studies have shown murrelet habitat use is positively associated with the presence and abundance of mature and old-growth forests, large core areas of old-growth, low edge and fragmentation, proximity to the marine environment, total watershed area, and increasing forest age and height (McShane et al. 2004). In California and southern Oregon, areas with abundant numbers of murrelets were farther from roads, occurred more often in parks protected from logging, and were less likely to occupy old-growth habitat if it was isolated (more than 3 miles or 5 km) from other nesting murrelets (Meyer et al. 2002). Meyer et al. (2002) also found at least a few years passed before birds abandoned fragmented forests.

Murrelets do not form dense colonies which is atypical of most seabirds. Limited evidence suggests they may form loose colonies or clusters of nests in some cases (Ralph et al. 1995). The reliance of murrelets on cryptic coloration to avoid detection suggests they utilize a wide spacing of nests in order to prevent predators from forming a search image (Ralph et al. 1995). However, active nests have been seen within 328 feet (100 m) of one another in the North Cascades in Washington and within 98 feet (30 m) in Oregon (Kim Nelson, Oregon State University, pers. comm. 2005). Estimates of murrelet nest densities vary depending upon the method of data collection. For example, nest densities estimated using radar range from 0.007 to 0.104 mean nests per acre (0.003 to 0.042 mean nests per ha), while nest densities estimated from tree climbing efforts range from 0.27 to 3.51 mean nests per acre (0.11 to 1.42 mean nests per ha) (Nelson 2005).

There is little data available regarding murrelet nest site fidelity because of the difficulty in locating nest sites and observing banded birds attending nests. However, murrelets have been detected in the same nesting stands for many years (at least 20 years in California and 15 years in Washington), suggesting murrelets have a high fidelity to nesting areas, most likely at the watershed scale (Nelson 1997). Use of the same nest platform in successive years as well as multiple nests in the same tree have been documented, although it is not clear whether the repeated use involved the same birds (Nelson and Peck 1995; Divoky and Horton 1995; Nelson 1997; Manley 2000; Hebert et al. 2003). The limited observed fidelity to the same nest depression in consecutive years appears to be lower than for other alcids, but this may be an adaptive behavior in response to high predation rates (Divoky and Horton 1995). Researchers have suggested fidelity to specific or adjacent nesting platforms may be more common in areas where predation is limited or the number of suitable nest sites are fewer because large, old-growth trees are rare (Nelson and Peck 1995; Singer et al. 1995; Manley 1999).

Ralph et al. (1995) speculated that the fidelity to nest sites or stands by breeding murrelets may be influenced by the nesting success of previous rearing attempts. Although murrelet nesting behavior in response to failed nest attempts is unknown, nest failures could lead to prospecting for new nest sites or mates. Other alcids have shown an increased likelihood to relocate to a new nest in response to breeding failure (Divoky and Horton 1995). However, murrelets likely remain in the same watershed over time as long as stands are not significantly modified (Ralph et al. 1995).

It is unknown whether juveniles disperse from natal breeding habitat (natal dispersal) or return to their natal breeding habitat after reaching breeding age (natal philopatry). Natal dispersal distance can be expected to be as high or higher than other alcids given 1) the reduced extent of the breeding range, 2) the overlap between the wintering and breeding areas, 3) the distance individuals are known to move from breeding areas in the winter, 4) adult attendance of nesting areas during the non-breeding season where, in theory, knowledge of suitable nesting habitat is passed onto prospecting non-breeders, and 5) the 3-year to 5-year duration required for the onset of breeding age allowing non-breeding murrelets to prospect nesting and forage habitat for several years prior to reaching breeding age (Divoky and Horton 1995). Conversely, Swartzman et al. (1997 in McShane et al. 2004)) suggested juvenile dispersal is likely to be low, as it is for other alcid species. Nevertheless, the presence of unoccupied suitable nesting habitat on the landscape may be important for first-time nesters if they disperse away from their natal breeding habitat.

Murrelets generally select nests within 37 miles (60 kilometers (km) of marine waters (Miller and Ralph 1995). However, in Washington, occupied habitat has been documented 52 miles (84 km) from the coast and murrelets have been detected up to 70 miles (113 km) from the coast in the southern Cascade Mountains (Evans Mack et al. 2003).

When tending active nests during the breeding season (and much of the non-breeding season in southern parts of the range), breeding pairs forage within commuting distance of the nest site. Daily movements between nest sites and foraging areas for breeding murrelets averaged 10 miles in Prince William Sound, Alaska (McShane et al. 2004), 24 miles in Desolation Sound, British Columbia, Canada (Hull et al. 2001), and 48 miles in southeast Alaska. In California, Hebert and Golightly (2003) found the mean extent of north-south distance traveled by breeding adults to be about 46 miles.

Murrelet nests have been located at a variety of elevations from sea level to 5,020 feet (Burger 2002). However, most nests have been found below 3,500 feet. In Conservation Zone 1, murrelets have exhibited “occupied” behaviors up to 4,400 feet elevation and have been detected in stands up to 4,900 feet in the north Cascade Mountains (Peter McBride, WDNR, *in litt*., 2005). On the Olympic Peninsula, survey efforts for nesting murrelets have encountered occupied stands up to 4,000 feet within Conservation Zone 1 and up to 3,500 feet within Conservation Zone 2. Surveys for murrelet nesting at higher elevations on the Olympic Peninsula have not been conducted. However, recent radio-telemetry work detected a murrelet nest at 3,600 feet elevation on the Olympic Peninsula in Conservation Zone 1 (Martin Raphael, USFWS, pers. comm. 2005).

## Population Status in the Coterminous United States

Population Abundance

Research on murrelet populations in the early 1990s estimated murrelet abundance in Washington, Oregon, and California at 18,550 to 32,000 (Ralph et al. 1995). However, consistent population survey protocols were not established for murrelets in the coterminous United States until the late 1990s following the development of the marine component of the Environmental Monitoring (EM) Program for the NWFP (Bentivoglio et al. 2002). As a consequence, sampling procedures have differed and thus the survey data collected prior to the EM Program is unsuitable for estimating population trends for the murrelet (McShane et al. 2004).

The development of the EM Program unified the various at-sea monitoring efforts within the 5 Conservation Zones encompassed by the NWFP. The highest total population estimate for this area (20,500 +/- 4,600 birds at the 95 percent confidence interval) was in 2004 and the lowest total population estimate (17,400 +/- 4,600 birds at the 95 percent confidence interval) was in 2007 (Gary Falxa, *in litt*., 2008). The most recent population estimate for Conservation Zone 6 is 400 (+/- 140 birds at the 95 percent confidence interval) (Peery et al. 2008).

Population Trend

Estimated population trends within each Conservation Zone or for the entire coterminous population are not yet available from the marine survey data. Trend information will eventually be provided through the analysis of marine survey data from the EM Program (Bentivoglio et al. 2002) and from survey data in Conservation Zone 6 once a sufficient number of survey years have been completed. Depending on the desired minimum power (80 or 95 percent), at least 8 to 10 years of successive surveys are required for an overall population estimate and thus detection of an annual decrease, while 7 to 16 years are required for Conservation Zones 1 and 2 (Huff et al. 2003).

In the interim, demographic modeling has aided attempts to analyze and predict population trends and extinction probabilities of murrelets. Incorporating important population parameters and species distribution data (Beissinger 1995; Beissinger and Nur 1997 in USFWS 1997b; Cam et al. 2003; McShane et al. 2004), demographic models can provide useful insights into potential population responses from the exposure to environmental pressures and perturbations. However, weak assumptions or inaccurate estimates of population parameters such as survivorship rates, breeding success, and juvenile-to-adult ratios (juvenile ratios), can limit the use of models. Thus, a cautious approach is warranted when forecasting long-term population trends using demographic models.

Most of the published demographic models used to estimate murrelet population trends employ Leslie Matrix modeling (McShane et al. 2004). Two other more complex, unpublished models (Akcakaya 1997 and Swartzman et al. 1997 in McShane et al. 2004) evaluate the effect of nest habitat loss on murrelets in Conservation Zone 4 (McShane et al. 2004). McShane et al. (2004) developed a stochastic Leslie Matrix model (termed “Zone Model”) to project population trends in each murrelet Conservation Zone. The Zone Model was developed to integrate available demographic information for a comparative depiction of current expectations of future population trends and probability of extinction in each Conservation Zone (McShane et al. 2004). Table 3 lists rangewide murrelet demographic parameter values from four studies all using Leslie Matrix models.

**Table 3. Rangewide murrelet demographic parameter values based on four studies all using Leslie Matrix models**

| Demographic Parameter | Beissinger 1995 | Beissinger and Nur 1997* | Beissinger and Peery *in litt.* 2003 | McShane et al. 2004 |
|---|---|---|---|---|
| Juvenile Ratios | 0.10367 | 0.124 or 0.131 | 0.089 | 0.02 - 0.09 |
| Annual Fecundity | 0.11848 | 0.124 or 0.131 | 0.06-0.12 | (See nest success) |
| Nest Success | | | 0.16-0.43 | 0.38 - 0.54 |
| Maturation | 3 | 3 | 3 | 2 - 5 |
| Estimated Adult Survivorship | 85 % – 90% | 85 % – 88 % | 82 % - 90 % | 83 % – 92 % |

*in (USFWS 1997b)

Regardless of model preference, the overall results of modeling efforts are in agreement, indicating murrelet abundance is declining (McShane et al. 2004, p. 6-27). The rates of decline are highly sensitive to the assumed adult survival rate used for calculation (Steven R. Beissinger and M. Z. Peery *in litt*., 2003). The most recent modeling effort using the “Zone Model” (McShane et al. 2004) suggests the murrelet zonal sub-populations are declining at a rate of 3.0 to 6.2 percent per year.

Estimates of breeding success are best determined from nest site data, but difficulties in finding nests has led to the use of other methods, such as juvenile ratios and radio-telemetry estimations, each of which have biases. The nest success data presented in Murrelet Table 3 under McShane et al. (2004) was derived primarily from radio telemetry studies; however the nests sampled in these studies were not representative of large areas and specifically did not include Washington or Oregon. In general, telemetry estimates are preferred over juvenile ratios for estimating breeding success due to fewer biases (McShane et al. 2004), but telemetry data are not currently available for Washington or Oregon. Therefore, it is reasonable to expect that juvenile ratios derived from at-sea survey efforts best represent murrelet reproductive success in Washington, Oregon, and California.

Beissinger and Peery (Beissinger and Peery, *in litt*., 2003) performed a comparative analysis using data from 24 bird species to predict the juvenile ratios for murrelets of 0.27 (confidence intervals ranged from 0.15 to 0.65). Demographic models suggest murrelet population stability requires a minimum of 0.18 to 0.28 chicks per pair per year (Beissinger and Nur 1997 in USFWS 1997b). The lower confidence intervals for both the predicted juvenile ratio (0.15) and the stable population juvenile ratio (0.18) are greater than the juvenile ratios observed for any of the

Conservation Zones (0.02 to 0.09 chicks per pair) (Beissinger and Nur 1997 in USFWS 1997b; Beissinger and Peery, *in litt*., 2003). Therefore, the juvenile ratios observed in the Conservation

Zones are lower than predicted and are too low to obtain a stable population in any Conservation Zone. This indicates murrelet populations are declining in all Conservation Zones and will continue to decline until reproductive success improves.

Demographic modeling, the observed juvenile ratios, and adult survivorship rates suggests that the number of murrelets in Washington, Oregon, and California are too low to sustain a murrelet population. The rate of decline for murrelets throughout the listed range is estimated to be between 2.0 to 15.8 percent (Beissinger and Nur 1997 in USFWS 1997b; McShane et al. 2004).

Murrelets in Washington (Conservation Zones 1 and 2)

*Population estimates*

Historically, murrelets in Conservation Zones 1 and 2 were "common" (Rathbun 1915 and Miller et al. 1935 in USFWS 1997b), "abundant" (Edson 1908 and Rhoades 1893 in USFWS 1997b), or "numerous" (Miller et al. 1935 in McShane et al. 2004). Conservation Zone 1, encompassing the Puget Sound in northwest Washington, contains one of the larger murrelet populations in the species' listed range, and supports an estimated 41 percent of the murrelets in the coterminous United States (Huff et al. 2003). The 2007 population estimate (with 95 percent confidence intervals) for Conservation Zone 1 is 7,000 (4,100 – 10,400) and Conservation Zone 2 is 2,500 (1,300 – 3,800) (Falxa, *in litt.,* 2008). In Conservation Zone 2, a higher density of murrelets occurs in the northern portion of the Zone (Huff et al. 2003) where the majority of available nesting habitat occurs. In Conservation Zone 1, higher densities of murrelets occur in the Straits of Juan de Fuca, the San Juan Islands, and the Hood Canal (Huff et al. 2003), which are in proximity to nesting habitat on the Olympic Peninsula and the North Cascade Mountains.

Although population numbers in Conservation Zones 1 and 2 are likely declining, the precise rate of decline is unknown. The juvenile ratio derived from at-sea survey efforts in Conservation Zone 1 is 0.09. The juvenile ratios were not collected in Conservation Zone 2; however, the juvenile ratio for Conservation Zone 3 is 0.08. Therefore, it is reasonable to infer that the juvenile ratio for Conservation Zone 2 is likely between 0.08 and 0.09. These low juvenile ratios infer there is insufficient juvenile recruitment to sustain a murrelet population in Conservation Zones 1 and 2. Beissinger and Peery (Beissinger and Peery, *in litt*., 2003) estimated the rate of decline for Conservation Zone 1 to be between 2.0 to 12.6 percent and between 2.8 to 13.4 percent in Conservation Zone 3. It is likely that the rate of decline in Conservation Zone 2 is similar to that of Conservation Zones 1 and 3.

Juvenile ratios in Washington may be skewed by murrelets coming and going to British Columbia. At-sea surveys are timed to occur when the least number of murrelets from British Columbia are expected to be present. However, recent radio-telemetry information indicates 1) murrelets nesting in British Columbia forage in Washington waters during the breeding season (Bloxton and Raphael 2008) and could be counted during at-sea surveys; and 2) adult murrelets foraging in Washington during the early breeding season moved to British Columbia in mid-June and mid-July (Bloxton and Raphael 2008) and would not have been counted during the at-sea surveys. The movements of juvenile murrelets in Washington and southern British Columbia are unclear. Therefore, until further information is obtained regarding murrelet migration between

British Columbia and Washington, we will continue to rely on the at-sea derived juvenile ratios to evaluate the population status in Conservation Zones 1 and 2.

## Habitat Abundance

Estimates of the amount of available suitable nesting habitat vary as much as the methods used for estimating murrelet habitat. McShane et al. (2004) estimates murrelet habitat in Washington State at 1,022,695 acres, representing approximately 48 percent of the estimated 2,223,048 acres remaining suitable habitat in the listed range. McShane et al. (2004) caution about making direct comparisons between current and past estimates due to the evolving definition of suitable habitat and methods used to quantify habitat. As part of the ongoing pursuit to improve habitat estimates, information was collected and analyzed by the FWS in 2005 resulting in an estimated 751,831 acres in Conservation Zone 1 and 585,821 acres in Conservation Zone 2 (Table 4).

**Table 4. Estimated acres of suitable nesting habitat for the murrelet managed by the Federal and non-Federal land managers in Conservation Zones 1 and 2**

| Conservation Zone | Estimated acres of suitable murrelet habitat by land management category * | | | | |
|---|---|---|---|---|---|
| | Federal | State | Private* | Tribal | Total |
| Puget Sound (Zone 1) | 650,937 | 98,036 | 2,338 | 520 | 751,831 |
| Western Washington Coast Range (Zone 2) | 485,574 | 82,349 | 9,184 | 8,714 | 585,821 |
| Total | 1,136,511 | 180,385 | 11,522 | 9,234 | 1,337,652 |

*Estimated acres of private land represents occupied habitat. Additional suitable nesting habitat considered unoccupied by nesting murrelets is not included in this estimate.

Estimated acreages of suitable habitat on Federal lands in Table 4 are based on modeling and aerial photo interpretation and likely overestimate the actual acres of suitable murrelet habitat because 1) most acreages are based on models predicting spotted owl nesting habitat which include forested lands that do not have structures suitable for murrelet nesting, and 2) neither modeling or aerial photo interpretation can distinguish microhabitat features, such as nesting platforms or the presence of moss, that are necessary for murrelet nesting. The amount of high quality murrelet nesting habitat available in Washington, defined by the FWS as large, old, contiguously forested areas not subject to human influences (e.g., timber harvest or urbanization) is expected to be a small subset of the estimated acreages in Table 4. Murrelets nesting in high-quality nesting habitat are assumed to have a higher nesting success rate than murrelets nesting in fragmented habitat near humans.

<u>Other Recent Assessments of Murrelet Habitat in Washington</u>

Two recent assessments of murrelet potential nesting habitat were developed for monitoring the Northwest Forest Plan (Raphael et al. 2006). This study provides a provincial-scale analysis of murrelet habitat derived from vegetation base maps, and includes estimates of habitat on State and private lands in Washington for the period of 1994 to 1996. Using vegetation data derived from satellite imagery, Raphael et al. (2006) developed two different approaches to model habitat suitability. The first model, or the Expert Judgment Model, is based on the judgment of an expert panel that used existing forest structure classification criteria (e.g., percent conifer cover, canopy structure, quadratic mean diameter, forest patch size) to classify forests into four classes of habitat suitability, with Class 1 indicating the least suitable habitat and Class 4 indicating the most highly suitable habitat. Raphael et al. (2006) found that across the murrelet range, most habitat-capable land (52 percent) is classified as Class 1 (lowest suitability) habitat and 18 percent is classified as Class 4 (highest suitability) habitat. In Washington, they found that there were approximately 954,200 acres of Class 4 habitat in between 1994 and 1996 (Table 5). However, only 60 percent of known nest sites in their study area were located in Class 4 habitat.

The second habitat model developed by Raphael et al. (2006) used the Biomapper Ecological Niche-Factor Analysis model developed by Hirzel et al. (2002). The resulting murrelet habitat suitability maps are based on both the physical and vegetative attributes adjacent to known murrelet occupied polygons or nest locations for each Northwest Forest Plan province. The resulting raster maps are a grid of 269 $feet^2$-cells (25 $m^2$-cells) (0.15 acres per pixel). Each cell in the raster is assigned a value of 0 to 100. Values closer to 100 represent areas that match the murrelet nesting locations while values closer to 0 are likely unsuitable for nesting (Raphael et al. 2006). These maps do not provide absolute habitat estimates, but rather a range of habitat suitability values, which can be interpreted in various ways. Raphael et al. (2006) noted that the results from the Ecological Niche Factor Analysis (ENFA) are not easily compared to results from the Expert Judgment Model because it was not clear what threshold from the habitat suitability ranking to use. Raphael et al. (2006) elected to display habitat suitability scores greater than 60 (HS >60) as a "generous" portrayal of potential nesting habitat and a threshold greater than 80 (HS >80) as a more conservative estimate. In Washington, there were over 2.1 million acres of HS >60 habitat, but only 440,700 acres of HS >80 habitat (Table 5). It is important to note that HS >60 habitat map captures 82 percent of the occupied nests sites in Washington, whereas the HS >80 habitat map only captures 36 percent of the occupied nests in Washington.

**Table 5. Comparison of different habitat modeling results for the Washington nearshore zone (0 to 40 miles inland or Northwest Forest Plan Murrelet Zone 1)**

| Murrelet Habitat Model | Habitat Acres on Federal Reserves (LSRs, Natl.Parks) | Habitat Acres on Federal, Non-Reserves (USFS Matrix) | Total Habitat Acres on Federal Lands | Total Habitat Acres on Non-Federal Lands (City, State, Private, Tribal) | Total Habitat Acres - All Ownerships | Percent of Total Habitat Acres on Non-Federal Lands | Percent of Known Murrelet Nest Sites in Study Area Occurring in this Habitat Classification |
|---|---|---|---|---|---|---|---|
| ENFA* HS >80 | 284,300 | 18,600 | 302,900 | 137,800 | 440,700 | 31% | 36% |
| EJM* Class 4 | 659,200 | 40,700 | 699,900 | 254,300 | 954,200 | 11% | 60% |
| EJM Class 3 and Class 4 | 770,600 | 54,700 | 825,300 | 535,200 | 1,360,500 | 16% | 65% |
| ENFA HS >60 | 927,000 | 85,300 | 1,012,300 | 1,147,100 | 2,159,400 | 53% | 82% |

*ENFA = Ecological Niche Facto Analysis. EJM = Expert Judgment Model. Results were summarized directly from Tables 4 and 5 and Tables 9 and 10 in Raphael et al (2005). All habitat estimates represent 1994-1996 values.

Because the HS >60 model performed best for capturing known murrelet nest sites, Raphael et al. (2006) suggest that the ENFA HS >60 model yields a reasonable estimate of potential murrelet nesting habitat. However, we found that large areas in southwest Washington identified in the HS >60 model likely overestimates the actual suitable habitat in this landscape due to a known lack of old-forest in this landscape. Despite the uncertainties associated with interpreting the various map data developed by Raphael et al. (2006), it is apparent that there is a significant portion of suitable habitat acres located on non-Federal lands in Washington, suggesting that non-Federal lands may play a greater role in the conservation needs of the species than has previously been considered. Using the most conservative criteria developed by Raphael et al. (2006) the amount of high-quality murrelet nesting habitat on non-Federal lands in Washington varies from 11 percent to as high as 31 percent (Table 5).

Raphael et al. (2006) note that the spatial accuracy of the map data are limited and that the habitat maps are best used for provincial-scale analysis. Due to potential errors in vegetation mapping and other potential errors, these maps are not appropriate for fine-scale project mapping.

<u>Conservation Zone 1</u>

The majority of suitable murrelet habitat in Conservation Zone (Zone) 1 occurs in northwest Washington and is found on Forest Service and National Park Service lands, and to a lesser extent on State lands. The majority of the historic habitat along the eastern and southern shores of the Puget Sound has been replaced by urban development resulting in the remaining suitable habitat further inland from the marine environment (USFWS 1997b).

<u>Conservation Zone 2</u>

Murrelet nesting habitat north of Gray's Harbor in Zone 2 occurs largely on State, Forest Service, National Park Service, and Tribal lands, and to a lesser extent, on private lands. Alternatively, the majority of habitat in the southern portion of Zone 2 occurs primarily on State lands, with a small amount on private lands.

**Threats**

Murrelets remain subject to a variety of anthropogenic threats within the upland and marine environment. They also face threats from low population numbers, low immigration rates, high predation rates, and disease.

<u>Threats in the Marine Environment</u>

Threats to murrelets in the marine environment include declines in prey availability; mortality associated with exposure to oil spills, gill net and other fisheries; contaminants suspended in marine waters; and visual or sound disturbance from recreational or commercial watercrafts (57 FR 45328 [October 1, 1992]; (Ralph et al. 1995; USFWS 1997b; McShane et al. 2004). Activities, such as pile driving and underwater detonations, that result in elevated underwater sound pressure levels may also pose a threat to murrelets.

### *Prey Availability*

Many fish populations have been depleted due to overfishing, reduction in the amount or quality of spawning habitat, and pollution. As of 2004, only 50 percent of the Puget Sound herring stocks were classified as healthy or moderately healthy, with north Puget Sound's stock being considered depressed and the Strait of Juan de Fuca's stocks being classified as critical (WDFW 2005d). Natural mortality in some of these stocks has increased (e.g. the mean estimated annual natural mortality rate for sampled stocks from 1987 through 2003 averaged 71 percent, up from 20 to 40 percent in the late 1970s) (WDFW 2005c). There is currently only one commercial herring fishery which operates primarily in south and central Puget Sound (WDFW 2005b) where herring stocks are healthier. Unfortunately, the decline of some herring stocks may be affecting the forage base for murrelets in Puget Sound. There is limited information available for the coastal herring populations, but these populations appear to have relatively high levels of abundance (WDFW 2005a). There are herring fisheries in Willapa Bay and Grays Harbor, but no direct harvest is allowed in the coastal waters.

While there are commercial and recreational fisheries for surf smelt, the amount of harvest does not appear to be impacting the surf smelt stocks (Bargmann 1998). There are no directed commercial fisheries for sand lance (Bargmann 1998). Anchovies are taken commercially within coastal and estuarine waters of Washington. While the current harvest level doesn't appear to be impacting anchovy stocks, there is no current abundance information (Bargmann 1998).

In addition to fishing pressure, oceanographic variation can influence prey availability. While the effects to murrelets from events such as El Niño have not been well documented, El Niño events are thought to reduce overall prey availability and several studies have found that El Niño events can influence the behavior of murrelets (McShane et al. 2004). Even though changes in prey availability may be due to natural and cyclic oceanographic variation, these changes may exacerbate other threats to murrelets in the marine environment.

Shoreline development has affected and will continue to effect coastal processes. Shipping, bulkheads, and other shoreline developments have contributed to the reduction in eelgrass beds and other spawning and rearing areas for forage species.

### *Oil Spills*

Murrelet mortality from oil pollution is a conservation issue in Washington (USFWS 1997b). Most oil spills and chronic oil pollution that can affect murrelets occur in areas of high shipping traffic, such as the Strait of Juan de Fuca and Puget Sound. There have been at least 47 oil spills of 10,000 gal or more in Washington since 1964 (WDOE 2004). However, the number of oil spills has generally declined since passage of the U.S. Oil Pollution Act in 1990. The estimated annual mortality of murrelets from oil spills in Washington has decreased from 3 to 41 birds per year (between 1977 and 1992) to 1 to 2 birds per year (between 1993 and 2003) (McShane et al. 2004).

Since the murrelet was listed, the amount of oil tanker and shipping traffic has continued to increase (USFWS 1997b; Burger 2002). Large commercial ships, including oil tankers, cargo ships, fish processing ships, and cruise ships, enter Washington waters more than 7,000 times each year, bound for ports in Puget Sound, British Columbia, Grays Harbor, and the Columbia River (WDOE 2004). Additionally, 4,500 tank-barge transits, 160,000 ferry transits, and military vessel traffic occur in these same waters each year (WDOE 2004). Individually these vessels may carry up to 33 M gal of crude oil or refined petroleum products, but collectively, they carry about 15.1 B gal across Puget Sound waters each year (WDOE 2004). These numbers are expected to increase as the human population and commerce continues to grow. Currently, there are State and Federal requirements for tug escorts of laden oil tankers transiting the waters of Puget Sound east of Dungeness Spit. However, the Federal requirements do not apply to double-hulled tankers and will no longer be in effect once the single-hull tanker phase-out is complete (WDOE 2005). Washington State is considering revising their tug escort requirements (WDOE 2005); however, the current tug escort requirements remain in place until the Washington State Legislature makes a change.

The U.S. Coast Guard rated the Dungeness area in the Strait of Juan de Fuca as being in the top five high-risk areas of the United States for being impacted by oil spills (USFWS 2003b). Therefore, even though the threat from oil spills appears to have been reduced since the murrelet was listed, the risk of a catastrophic oil spill remains, and could severely impact adult and/or juvenile murrelets in Conservation Zones 1 and 2.

*Gillnets*

Murrelet mortality from gillnet fishing has been considered a conservation issue in Washington (USFWS 1997b; Melvin et al. 1999). Murrelets can also be killed by hooking with fishing lures and entanglement with fishing lines (Carter et al. 1995). There is little information available on murrelet mortality from net fishing prior to the 1990s, although it was known to occur (Carter et al. 1995). In the mid 1990s, a series of fisheries restrictions and changes were implemented to address mortality of all species of seabirds, resulting in a lower mortality rate of murrelets (McShane et al. 2004). Fishing effort has also decreased since the 1980s because of lower catches, fewer fishing vessels, and greater restrictions (McShane et al. 2004), although a regrowth in gill net fishing is likely to occur if salmon stocks increase. In most areas, the threat from gill net fishing has been reduced or eliminated since 1992, but threats to adult and juvenile murrelets are still present in Washington waters due to gill net mortality (McShane et al. 2004).

Entanglement in derelict fishing nets, which are nets that have been lost, abandoned or discarded in the marine environment, may also pose a threat. Derelict gear can persist in the environment for decades and poses a threat to marine mammals, seabirds, shellfish, and fish. A recent survey estimated 3,900 derelict nets need to be removed from Puget Sound annually (Northwest Straits Foundation 2007) and each year the number of new derelict nets increases faster than the number removed. Over 50 percent of the derelict nets in Puget Sound occur in waters where murrelet densities are the highest in Washington. Derelict fishing gear also occurs along the Washington coast and the outer Straits of Juan de Fuca. While this high energy environment may reduce the time a derelict net remains suspended compared to a lower energy environment like the inner

Puget Sound where gear may persist for years (NRC 2007), the amount of time a derelict net poses a threat to marine species depends on the length and type of the net and cause of entanglement.

*Marine Contaminants*

The primary consequence from the exposure of murrelets to contaminants is reproductive impairment. Reproduction can be impacted by food web bioaccumulation of organochlorine pollutants and heavy metals discharged into marine areas where murrelets feed and prey species concentrate (Fry 1995). However, murrelet exposure is likely a rare event because murrelets have widely dispersed foraging areas and they feed extensively on transient juvenile and subadult midwater fish species that are expected to have low pollutant loads (McShane et al. 2004). The greatest exposure risk to murrelets may occur at regular feeding areas near major pollutant sources, such as those found in Puget Sound (McShane et al. 2004).

*Disturbance*

In coastal and offshore marine environments, vehicular disturbance (e.g., boats, airplanes, personal watercraft) is known to elicit behavioral responses in murrelets of all age classes (Kuletz 1996; Speckman 1996; Nelson 1997). Aircraft flying at low altitudes and boating activity, in particular motorized watercraft, are known to cause murrelets to dive and are thought to especially affect adults holding fish (Nelson 1997). It is unclear to what extent this kind of disturbance affects the distribution, movements, foraging efficiency, and overall fitness of murrelets. However, it is unlikely this type of disturbance has decreased since 1992 because the shipping traffic and recreational boat use in the Puget Sound and Strait of Juan de Fuca has continued to increase.

Marine projects that include seismic exploration, pile driving, detonation of explosives and other activities that generate percussive sounds can expose murrelets to elevated underwater sound pressure levels (SPLs). High underwater SPLs can have adverse physiological and neurological effects on a wide variety of vertebrate species (Yelverton et al. 1973; Yelverton and Richmond 1981; Steevens et al. 1999; Fothergill et al. 2001; Cudahy and Ellison 2002; U.S. Department of Defense 2002; Popper 2003). High underwater SPLs are known to injure and/or kill fish by causing barotraumas (pathologies associated with high sound levels including hemorrhage and rupture of internal organs), as well as causing temporary stunning and alterations in behavior (Turnpenny and Nedwell 1994; Turnpenny et al. 1994; Popper 2003; Hastings and Popper 2005). During monitoring of seabird response to pile driving in Hood Canal, Washington, a pigeon guillemot (*Cepphus columba*) was observed having difficulty getting airborne after being exposed to underwater sound from impact pile driving (Entranco and Hamer Environmental 2005). In controlled experiments using underwater explosives, rapid change in SPLs caused internal hemorrhaging and mortality in submerged mallard ducks (*Anas platyrhnchos*) (Yelverton et al. 1973). Risk of injury appears related to the effect of rapid pressure changes, especially on gas filled spaces in the bodies of exposed organisms (Turnpenny et al. 1994). In studies on ducks (*Anas spp.*) and a variety of mammals, all species exposed to underwater blasts had injuries to gas filled organs including eardrums (Yelverton and Richmond 1981). These studies indicate that similar effects can be expected across taxonomical species groups.

Physical injury may not result in immediate mortality. If an animal is injured, death may occur several hours or days later, or injuries may be sublethal. Sublethal injuries can interfere with the ability of an organism to carry out essential life functions such as feeding and predator avoidance. Diving birds are able to detect and alter their behavior based on sound in the underwater environment (Ross et al. 2001) and elevated underwater SPLs may cause murrelets to alter normal behaviors, such as foraging. Disturbance related to elevated underwater SPLs may reduce foraging efficiency resulting in increased energetic costs to all murrelet age classes in the marine environment and may result in fewer deliveries or lower quality food being delivered to nestlings.

Threats in the Terrestrial Environment

*Habitat*

Extensive harvest of late-successional and old-growth forest was the primary reason for listing the murrelet as threatened. Due primarily to extensive timber cutting over the past 150 years, at least 82 percent of the old-growth forests existing in western Washington and Oregon prior to the 1840s have been harvested (Teensma et al. 1991; Booth 1991; Ripple 1994; Perry 1995). About 10 percent of pre-settlement old-growth forests remain in western Washington (Norse 1990; Booth 1991). Although the Northwest Forest Plan has reduced the rate of habitat loss on Federal lands, the threat of continued loss of suitable nesting habitat remains on Federal and non-Federal lands through timber harvest and natural events such as wildfire, insect outbreaks, and windthrow.

Natural disturbance has the potential to affect the amount and quality of murrelet nesting habitat. Wildfire and windthrow result in immediate loss of habitat and can also influence the quality of adjacent habitat. Global warming, combined with long-term fire suppression on Federal lands, may result in higher incidences of stand-replacing fires in the future (McShane et al. 2004). As forest fragmentation increases, the threat of habitat loss due to windthrow is likely to increase. In addition, insects and disease can kill complete stands of habitat and can contribute to hazardous forest fire conditions.

Between 1992 and 2003, the loss of suitable murrelet habitat totaled 22,398 acres in Washington, Oregon, and California combined, of which 5,364 acres resulted from timber harvest and 17,034 acres resulted from natural events (McShane et al. 2004). The data presented by McShane represented losses primarily on Federal lands, and did not include data for most private lands within the murrelets' range. Habitat loss and fragmentation is expected to continue in the near future, but at an uncertain rate (McShane et al. 2004). Raphael et al. (2006) recently completed a change analysis for murrelet habitat on both Federal and non-Federal lands for the period from 1992 to 2003, based on stand disturbance map data developed by Healey et al. (2003). Raphael et al. (2006) estimated that habitat loss ranging from 60,000 acres up to 278,000 acres has occurred across the listed range of the species, with approximately 10 percent of habitat loss occurring on Federal lands, and 90 percent occurring on non-Federal lands. The variation in the acreage estimates provided by Raphael et al. (2006) are dependant upon the habitat model used (Table 5) to evaluate habitat change over time.

Gains in suitable nesting habitat are expected to occur on Federal lands over the next 40 to 50 years, but due to the extensive historic habitat loss and the slow replacement rate of murrelets and their habitat, the species is potentially facing a severe reduction in numbers in the coming 20 to 100 years (USFS and USBLM 1994a; Beissinger 2002). In addition to direct habitat removal, forest management practices can fragment murrelet habitat; this reduces the amount and heterogeneous nature of the habitat, reduces the forest patch sizes, reduces the amount of interior or core habitat, increases the amount of forest edge, isolates remaining habitat patches, and creates "sink" habitats (McShane et al. 2004). There are no estimates available for the amount of suitable habitat that has been fragmented or degraded since 1992. However, the ecological consequences of these habitat changes to murrelets can include effects on population viability and size, local or regional extinctions, displacement, fewer nesting attempts, failure to breed, reduced fecundity, reduced nest abundance, lower nest success, increased predation and parasitism rates, crowding in remaining patches, and reductions in adult survival (Raphael et al. 2002).

*Predation*

Predation is expected to be the principal factor limiting murrelet reproductive success and nest site selection (Ralph et al. 1995; Nelson and Hamer 1995a). Murrelets are believed to be highly vulnerable to nest predation compared to other alcids and forest nesting birds (Nelson and Hamer 1995a; USFWS 1997b). Murrelets have no protection at nest sites other than the ability to remain hidden. Nelson and Hamer (1995a) hypothesized that small increases in murrelet predation will have deleterious effects on murrelet population viability due to their low reproductive rate (one egg clutches).

Known predators of adult murrelets in the forest environment include the peregrine falcon (*Falco peregrinus*), sharp-shinned hawk (*Accipiter striatus*), common raven (*Corvus corax*), northern goshawk (*Accipiter gentilis*), and bald eagle (*Haliaeetus leucocephalus*). Common ravens and Stellar's jays (*Cyanocitta stelleri*) are known to take both eggs and chicks at the nest, while sharp-shinned hawks have been found to take chicks. Common ravens account for the majority of egg depredation, as they appear to be the only predator capable of flushing incubating or brooding adults from a nest (Nelson and Hamer 1995a). Suspected nest predators include great horned owls (*Bubo virginianus*), barred owls (*Strix varia*), Cooper's hawks (*Accipiter cooperi*), northwestern crows (*Corvus caurinus*), American crows (*Corvus brachyrhynchos*), and gray jays (*Perisoreus canadensis*) (Nelson and Hamer 1995a; Nelson 1997; Manley 1999). Predation by squirrels and mice has been documented at artificial nests and these animals cannot be discounted as potential predators on eggs and chicks (Luginbuhl et al. 2001; Raphael et al. 2002; Bradley and Marzluff 2003).

Losses of eggs and chicks to avian predators have been determined to be the most important cause of nest failure (Nelson and Hamer 1995a; McShane et al. 2004). The risk of predation by avian predators appears to be highest in complex structured landscapes in proximity to edges and human activity, where many of the corvid (e.g., crows, ravens) species are in high abundance. Predation rates are influenced mainly by habitat stand size, habitat quality, nest placement (on the edge of a stand versus the interior of a stand), and proximity of the stand to human activity centers. The quality of murrelet nest habitat decreases in smaller stands because forest edge increases in relation to the amount of interior forest, while forest stands near human activity centers (less than 0.62 miles or 1 km), regardless of size, are often exposed to a higher density of corvids due to their attraction to human food sources (Marzluff et al. 2000). The loss of nest contents to avian predators increases with habitat fragmentation and an increase in the ratio of forest edge to interior habitat (Nelson and Hamer 1995a; McShane et al. 2004). For example, Nelson and Hamer (1995a) found successful nests were farther from edges (greater than 55 m) and were better concealed than unsuccessful nests.

The abundance of several corvid species has increased dramatically in western North America as a result of forest fragmentation, increased agriculture, and urbanization (McShane et al. 2004). It is reasonable to infer that as predator abundance has increased, predation on murrelet chicks and eggs has also increased, and murrelet reproductive success has decreased. It is also reasonable to assume that this trend will not be interrupted or reversed in the near future, as forest fragmentation, agriculture, and urbanization continue to occur.

Other Threats

Murrelets are subject to additional threats from diseases, genetics, low population numbers, and low immigration rates. To date, inbreeding (mating between close genetic relatives) and/or hybridizing (breeding with a different species or subspecies) have not been identified as threats to murrelet populations. However, as abundance declines, a corresponding decrease in the resilience of the population to disease, inbreeding or hybridization, and other perturbations may occur. Additionally, murrelets are considered to have low recolonization potential because their low immigration rate makes the species slow to recover from local disturbances (McShane et al. 2004).

The emergence of fungal, parasitic, bacterial, and viral diseases has affected populations of seabirds in recent years. West Nile virus disease has been reported in California which is known to be lethal to seabirds. While the amount of negative impact this disease may bring is unknown, researchers agree that it is only a matter of time before West Nile virus reaches the Washington seabird population. Effects for murrelets from West Nile virus and other diseases are expected to increase in the near future due to an accumulation of stressors such as oceanic temperature changes, overfishing, and habitat loss (McShane et al. 2004).

Murrelets may be sensitive to human-caused disturbance due to their secretive nature and their vulnerability to predation. There are little data concerning the murrelet's vulnerability to disturbance effects, except anecdotal researcher observations that indicate murrelets typically exhibit a limited, temporary behavioral response (if any) to noise disturbance at nest sites and are able to adapt to auditory stimuli (Long and Ralph 1998; Golightly et al. 2002; Singer et al. 1995 in McShane et al. 2004). In general, responses to auditory stimuli at nests sites have been modifications of posture and on-nest behaviors (Long and Ralph 1998). While the unique breeding biology of the murrelet is not conducive to comparison of the reproductive success of other species, studies on other alcid and seabird species have revealed detrimental effects of disturbance to breeding success and the maintenance of viable populations (Cairns 1980; Pierce and Simons 1986; Piatt et al. 1990; Beale and Monaghan 2004).

Research on a variety of other species, including other seabirds, indicate an animal's response to disturbance follows the same pattern as its response to encountering predators, and anti-predator behavior has a cost to other fitness enhancing activities, such as feeding and parental care (Frid and Dill 2002). Some authors indicate disturbance stimuli can directly affect the behavior of individuals and indirectly affect fitness and population dynamics through increased energetic costs (Carney and Sydeman 1999; Frid and Dill 2002). Responses by murrelet adults and chicks to calls from corvids and other potential predators include no response, alert posturing, aggressive attack, and temporarily leaving a nest (adults only) (McShane et al. 2004). However, the most typical behavior of chicks and adults in response to the presence of a potential predator is to flatten against a tree branch and remain motionless (Nelson and Hamer 1995a; McShane et al. 2004). Therefore, researcher's anecdotal observations of little or no physical response by murrelets are consistent with the behavior they will exhibit in response to a predator. In addition, there may have been physiological responses researchers cannot account for with visual observations. Corticosterone studies have not been conducted on murrelets, but studies on other avian species indicate chronic high levels of this stress hormone may have negative consequences on reproduction or physical condition (Wasser et al. 1997; Kitaysky et al. 2001; Marra and Holberton 1998 in McShane et al. 2004).

Although detecting effects of sub-lethal noise disturbance at the population level is hindered by the breeding biology of the murrelet, the effect of noise disturbance on murrelet fitness and reproductive success should not be completely discounted (McShane et al. 2004). In recently completed analyses, the FWS concluded the potential for injury associated with disturbance (visual and sound) to murrelets in the terrestrial environment includes flushing from the nest, aborted feeding, and postponed feedings (USFWS 2003a). These responses by individual murrelets to disturbance stimuli can reduce productivity of the nesting pair, as well as the entire population (USFWS 1997b).

**Conservation Needs**

The Recovery Plan outlines the conservation strategy for the species. In the short-term, specific actions necessary to stabilize the population include maintaining occupied habitat, maintaining large blocks of suitable habitat, maintaining and enhancing buffer habitat, decreasing risks of nesting habitat loss due to fire and windthrow, reducing predation, and minimizing disturbance.

Long-term conservation needs include increasing productivity (abundance, the ratio of juveniles to adults, and nest success) and population size; increasing the amount (stand size and number of stands), quality, and distribution of suitable nesting habitat; protecting and improving the quality of the marine environment; and reducing or eliminating threats to survivorship by reducing predation in the terrestrial environment and anthropogenic sources of mortality at sea. The FWS estimates recovery of the murrelet will require at least 50 years (USFWS 1997b).

The Recovery Plan states that four of the six Conservation Zones (Zones) must be functional in order to effectively recover the murrelet in the short- and long-term; that is, to maintain viable populations that are well-distributed. However, based on the new population estimates, it appears only three of the Zones contain relatively robust numbers of murrelets (Zones 1, 3, and 4). Zones 1 and 4 contain the largest number of murrelets compared to the other four Zones.

This alone would seem to indicate a better condition there, but areas of concern remain. For example, the population in Zone 4 was impacted when oil spills killed an estimated 10 percent of the population (Bentivoglio et al. 2002; Ford et al. 2002), small oil spills continue to occur in Zone 1, and the juvenile ratios in both of these Zones continue to be too low to establish stable or increasing populations (Beissinger and Peery, *in litt*., 2003).

Murrelets in Zones 3, 5, and 6 have suffered variously from past oil spills which killed a large number of murrelets (Zone 3) (Ford et al. 2001), extremely small population sizes (Zones 5 and 6), and alarmingly low reproductive rates (Zone 6) (Peery et al. 2002). These factors have brought the status of the species to a point where recovery in Zones 5 and 6 may be precluded (Beissinger 2002). The poor status of murrelet populations in the southern Zones emphasizes the importance of supporting murrelet populations in Zones 1 and 2 in order to preserve the opportunity to achieve murrelet recovery objectives.

## Conservation Strategy

### Marine Environment

Protection of marine habitat is a component of the recovery strategy. The main threat to murrelets in the marine environment is the loss of individuals through death or injury, generally associated with oil spills and gill-net entanglements. The recovery strategy recommends providing protection within marine waters in such a way as to reduce or eliminate murrelet mortality (USFWS 1997b). The recovery strategy specifically recommends protection within all waters of Puget Sound and Strait of Juan de Fuca, and within 1.2 miles of shore along the Pacific Coast from Cape Flattery to Willapa Bay. However, newer information indicates the majority of murrelet activity along the Washington Coast occurs within 5 miles (8 km) of shore (Raphael et al. 2007), suggesting that protections should be extended to encompass this area. Management strategies could include exclusion of vessels, stricter hull requirements, exclusion of net fisheries, or modification of fishing gear.

In Washington State, the Washington Fish and Game Commission requires the use of alternative gear (i.e., visual alerts within the upper 7 feet of a multifilament net), prohibits nocturnal and dawn fishing for all non-treaty gill-net fisheries, and closes areas to gill-net fishing in order to reduce by-catch of murrelets. The Olympic Coast National Marine Sanctuary was established in 1994 along the outer Washington coast from Cape Flattery south to approximately the Copalis River and extending between 25 miles and 40 miles offshore. Oil exploration and development are prohibited within this Sanctuary (NOAA 1993).

### Terrestrial Habitat Management

The loss of nesting habitat (old-growth/mature forest) has generally been identified as the primary cause of the murrelet population decline and disappearance across portions of its range (Ralph et al. 1995). Logging, urbanization, and agricultural development have all contributed to the loss of habitat, especially at lower elevations.

The recovery strategy for the murrelet is contained within the Marbled Murrelet Recovery Plan (Recovery Plan) (USFWS 1997b) relies heavily on the Northwest Forest Plan (NWFP) to achieve recovery on Federal lands in Washington, Oregon, and California. However, the Recovery Plan also addresses the role of non-Federal lands in recovery, including Habitat Conservation Plans, State forest practices, and lands owned by Native American Tribes. The importance of non-Federal lands in the survival and recovery of murrelets is particularly high in Conservation Zones, where Federal lands, and privately held conservation lands (e.g., The Nature Conservancy Teal Slough, Ellsworth, Washington), within 50 miles of the coastline are sparse, such as the southern half of Conservation Zone 2.

Lands considered essential for the recovery of the murrelet within Conservation Zones 1 and 2 are 1) any suitable habitat in a Late Successional Reserve (LSR), 2) all suitable habitat located in the Olympic Adaptive Management Area, 3) large areas of suitable nesting habitat outside of LSRs on Federal lands, such as habitat located in the Olympic National Park, 4) suitable habitat on State lands within 40 miles of the coast, and 5) habitat within occupied murrelet sites on private lands (USFWS 1997b).

*Northwest Forest Plan*

When the USFS and Bureau of Land Management incorporated the NWFP as the management framework for public lands, a long-term habitat management strategy for murrelets (USFS and USBLM 1994a; USFS and USBLM 1994b) was established. The NWFP instituted pre-project surveys of murrelet habitat in areas planned for timber harvest and the protection of existing habitat at sites determined through surveys to be occupied by murrelets.

In the short-term, all known-occupied sites of murrelets occurring on USFS or Bureau of Land Management lands under the NWFP are to be managed as Late Successional Reserves (LSRs). In the long-term, unsuitable or marginally suitable habitat occurring in LSRs will be managed, overall, to develop late-successional forest conditions, thereby providing a larger long-term habitat base into which murrelets may eventually expand. Thus, the NWFP approach offers both short-term and long-term benefits to the murrelet.

Over 80 percent of murrelet habitat on Federal lands in Washington occurs within land management allocations that protect the habitat from removal or significant degradation. Scientists predicted implementation of the NWFP would result in an 80 percent likelihood of achieving a well-distributed murrelet population on Federal lands over the next 100 years (USFS and USBLM 1994a). Although the NWFP offers protection of known-occupied murrelet sites, concerns over the lingering effects of the historic widespread removal of suitable habitat will remain until the habitat recovers to late-successional characteristics. Habitat recovery will require over 100 years in many LSRs.

*Habitat Conservation Plans*

Four Habitat Conservation Plans (HCP) addressing murrelets in Washington have been completed for private/corporate forest land managers within the range of the murrelet: West Fork Timber Corporation (Murray Pacific Corporation 1993; Murray Pacific Corporation 1995;

USFWS 1995) (Mineral Tree Farm HCP); Plum Creek Timber Company (Plum Creek Timber Company, L.P. 1996; USFWS 1996a; Plum Creek Timber Company, L.P. 1999; USFWS 1999) (Cascades HCP; I-90 HCP); Port Blakely Tree Farms, L.P. (Port Blakely Tree Farms, L.P. 1996; USFWS 1996b) (R.B. Eddy Tree Farm HCP); and Simpson Timber Company (Simpson Timber Company 2000; USFWS 2000b) (Olympic Tree Farm HCP). Habitat Conservation Plans have also been completed for two municipal watersheds, City of Tacoma (USFWS 2001; Tacoma Public Utilities 2001) (Green River HCP) and City of Seattle (USFWS 2000a; City of Seattle 2001) (Cedar River HCP), and the Washington Department of Natural Resources (WDNR 1997; USFWS 1997a). The HCPs which address murrelets cover approximately 500,000 acres of non-Federal (private/corporate) lands, over 100,000 acres of municipal watershed, and over 1.6 million acres of State-managed lands. However, only a portion of these lands contain suitable murrelet habitat.

The WDNR HCP addresses murrelets in Conservation Zones 1 and 2. All of the others address murrelets in Conservation Zone 1. Most of the murrelet HCPs in Washington employ a consistent approach for murrelets by requiring the majority of habitat to be surveyed prior to timber management. Only poor-quality marginal habitat (with a low likelihood of occupancy) is released for harvest without survey. All known occupied habitat is protected to varying degrees, but a “safe-harbor-like” approach is used to address stands which may be retained as, or develop into, suitable habitat and become occupied in the future. This approach would allow future harvest of habitat which is not currently nesting habitat.

*Washington State Forest Practices Regulations*

Under Washington Forest Practices Rules, which apply to all non-Federal lands not covered by an HCP (WFPB 2005), surveys for murrelets are required prior to the harvest of suitable nesting habitat. These criteria vary depending on the location of the stand. For stands found to be occupied or known to be previously occupied, the WDNR makes a decision to issue the permit based upon a significance determination. If a determination of significance is made, preparation of a State Environmental Policy Act Environmental Impact Statement is required prior to proceeding. If a determination of non-significance or mitigated determination of non-significance is reached, the action can proceed without further environmental assessment.

*Tribal Management*

The management strategy of the Bureau of Indian Affairs for the murrelet focuses on working with Tribal governments on a government-to-government basis to develop management strategies for reservation lands and trust resources. The Bureau of Indian Affairs’ management strategy typically focus on avoiding harm to murrelets when feasible, to facilitate the trust responsibilities of the United States. However, other factors must be considered. Strategies must foster Tribal self-determination, and must balance the needs of the species and the environmental, economic, and other objectives of Indian Tribes within the range of the murrelet (Renwald 1993). For example, one of the Bureau of Indian Affairs’ main goals for murrelet protection includes assisting Native American Tribes in managing habitat consistent with tribal priorities, reserved Indian rights, and legislative mandates.

**Summary**

Demographic modeling results indicate murrelet populations are declining within each Conservation Zone and throughout the listed range. The juvenile to adult ratios observed at sea in the Conservation Zones are too low to obtain a stable population in any Conservation Zone, which indicates murrelet abundance in all Conservation Zones will continue to decline until reproductive success improves. In other words, there is insufficient recruitment of juveniles to sustain a murrelet population in the listed range of the species.

Some of the threats to the murrelet population may have been reduced as a result of the species' listing under the Act, such as the passage of the Oil Pollution Act and implementation of the NWFP. However, no threats have been reversed since listing and in some areas threats, such as predation and West Nile Virus, may be increasing or emerging. Threats continue to contribute to murrelet population declines through adult and juvenile mortality and reduced reproduction. Therefore, given the current status of the species and background risks facing the species, it is reasonable to assume that murrelet populations in Conservation Zones 1 and 2 and throughout the listed range have little resilience to deleterious population-level effects and are at high risk of extirpation.

Considering the life history characteristics of the murrelet, with the aggregate effects of inland habitat loss and fragmentation and at-sea mortality, the species' capability to recover from lethal perturbations at the population or metapopulation (Conservation Zone) scale is extremely low. The low observed reproductive rates make the species highly susceptible to local extirpations when exposed to repeated perturbations at a frequency which exceeds the species' loss-replacement rate. Also troublesome is the ineffectiveness of recovery efforts at reversing the ongoing lethal consequences in all demographic classes from natural and anthropogenic sources. Despite the relatively long potential life span of adult murrelets, the annual metapopulation replacement rates needed for long-term metapopulation maintenance and stability is currently well below the annual rate of individuals being removed from each metapopulation. As a result, murrelet metapopulations are currently not self-sustaining or self-regulating.

Accordingly, the FWS concludes the current environmental conditions for murrelets in the coterminous United States appear to be insufficient to support the long-term conservation needs of the species. Although information is not sufficient to determine whether murrelets are nesting at or near the carrying capacity in the remaining nest habitat, activities which degrade the existing conditions of occupied nest habitat or reduce adult survivorship and/or nest success of murrelets will be of greatest consequence to the species. Actions resulting in the further loss of occupied nesting habitat, mortality to breeding adults, eggs, or nestlings will reinforce the current murrelet population decline throughout the coterminous United States.

## ENVIRONMENTAL BASELINE (Bull Trout, Bull Trout Critical Habitat, Marbled Murrelet)

Regulations implementing the ESA (50 CFR 402.02) define the environmental baseline as the past and present impacts of all Federal, State, or private actions and other human activities in the action area. Also included in the environmental baseline are the anticipated impacts of all proposed Federal projects in the action area that have undergone Section 7 consultation, and the impacts of State and private actions which are contemporaneous with the consultation in progress.

### Aquatic Habitat Baseline Conditions

The Sultan River has a watershed area of approximately 110 square miles. The Sultan River Basin is bounded on the east by the Cascade Mountains, on the north and south by lateral ridges extending westward from the Cascade crest, and on the west by the Puget Sound lowlands. Elevations in the basin range from the 6,617-foot summit of Del Campo Peak to 130 feet msl at the confluence of the Sultan and Skykomish rivers. Most human development is limited to the lower portion of the Sultan River Basin, below the Powerhouse. The town of Sultan encroaches upon the floodplain near the mouth of the river. The Project provides flood protection during most storm events, but occasionally the town of Sultan can experience significant flooding.

Downstream of Culmback Dam (RM 16.5), the Sultan River flows through a deep gorge for nearly 14 miles. The steep side-slopes above the channel are densely forested with conifer and deciduous trees. The river channel in this reach is relatively high gradient and confined, containing numerous cascades and rapids separated by short pool-riffle stretches. Much of the streambank is sheer rock face or large rock cuts. The Sultan River Diversion Dam is located at RM 9.7 within this confined reach. Near RM 3.0, the Sultan River emerges from the canyon reach onto a broad, relatively flat valley floor containing intermittent stands or strips of deciduous trees, underbrush and some mixed conifers. The river channel in this reach has a moderate gradient with a number of split channel sections.

Because of the steep topography in much of the basin and intense precipitation, the Sultan River, by nature, is a very "flashy" system, subject to extremes in maximum and minimum flows. The Sultan River Basin annually averages 163 inches of rainfall with variations as high as 214 inches and as low as 120 inches. November, December, and January experience the most intense rainfall with monthly averages of 27, 21, and 23 inches, respectively. Daily precipitation of eight inches or more is not uncommon. The maximum measured daily rainfall of 11.57 inches was measured on November 11, 1990.

The Sultan River provides spawning and rearing habitat for several ESA-listed and non-listed anadromous fish species, including Chinook, coho, pink, and chum salmon; steelhead; and coastal cutthroat trout. Bull trout have not been observed spawning in the Sultan River; however, they are known to use the river as foraging and over-wintering habitat. Each of these species has access to the Sultan River from its mouth to the Diversion Dam at RM 9.7. Culmback Dam (RM 16.5) is located upstream of the historical anadromous zone (Ruggerone 2006, page 13). Resident rainbow trout (*O. mykiss*) reside above the Diversion Dam.

The lower Sultan River can also be divided into three operational reaches (Reach 1, Reach 2, and Reach 3) demarcated by physical structures that regulate flow (i.e., the Powerhouse, Diversion Dam, and Culmback Dam), and therefore, aquatic habitat availability in the lower Sultan River. Because Project water releases to these reaches largely dictate habitat quantity within the lower Sultan River, habitat is summarized in this section by operational reach, rather than by habitat process reach.

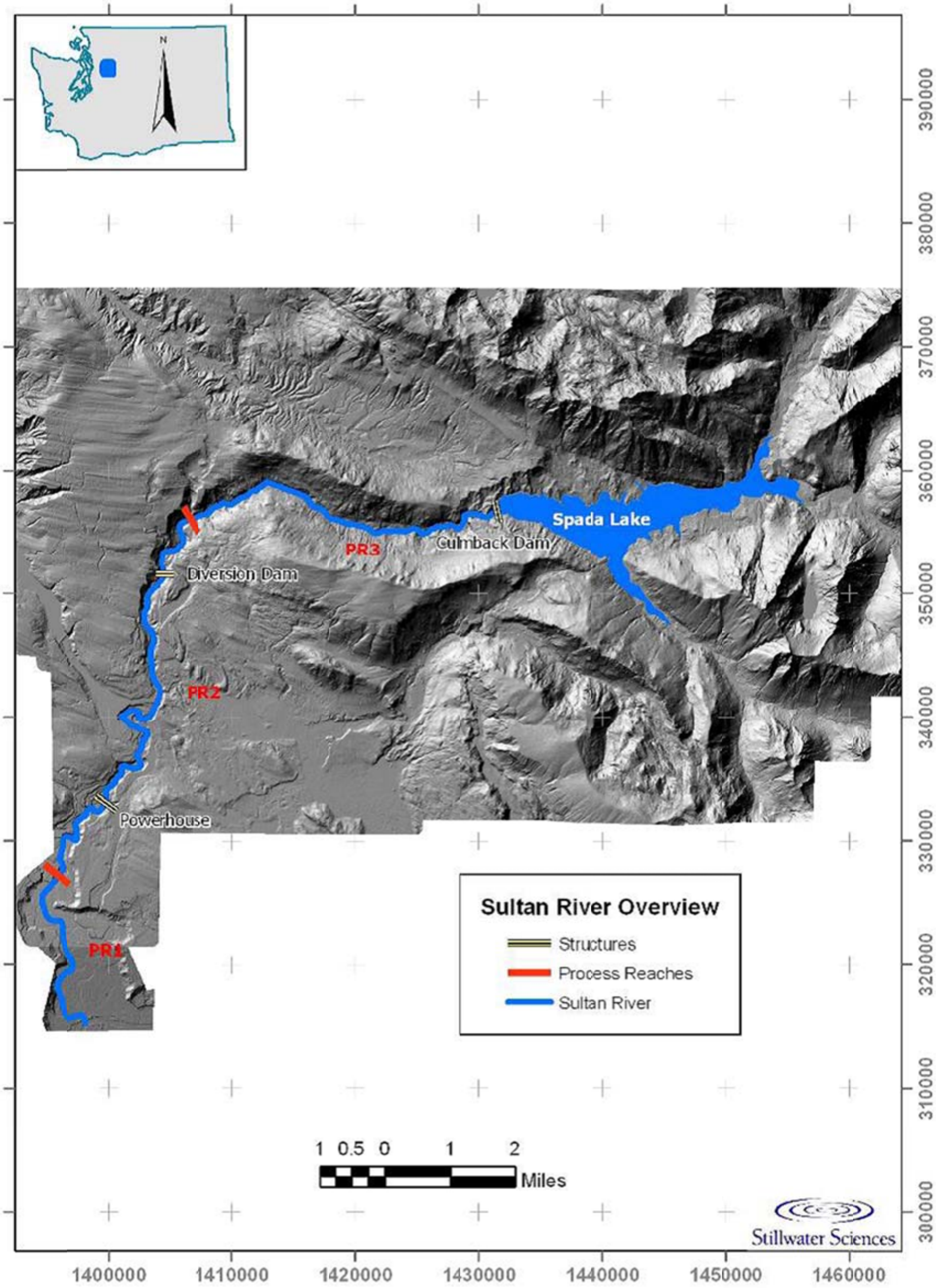


Figure 7. Operational reaches.

*Operational Reach 3*

Reach 3 (the Project bypass reach) is best described as a high gradient, highly confined bedrock gorge characterized by higher rates of sediment transport compared to downstream reaches. The channel is approximately 6.8 miles long and gradients range from 0.7 to 13.7 percent, averaging 1.6 percent. Channel gradient becomes progressively steeper in upper portions of the reach, with the highest gradient near Culmback Dam.

Aquatic habitat within Reach 3 is primarily pool and glide habitat types (65 percent). Most of the pool habitat units (38 of 45) are controlled by bedrock formations. Channel substrate is generally coarse with boulder, bedrock, cobble, and large gravels as the dominant substrates.

The active channel width in Reach 3 averages approximately 50 feet. Main channel pools average 263 feet in length, cascades average 140 feet in length, and glides and low gradient riffles average 215 and 250 feet in length, respectively. Islands are rare, likely reflecting the limited tendency of gravel deposits and vegetation to accumulate in this reach due to scouring flood flows. Eight LWD jams were found within Reach 3. A total of 550 pieces of LWD were noted in Reach 3, but only 112 individual pieces were characterized as over 2 feet in diameter. LWD frequency was approximately 102 pieces per mile (SnoPUD 2010).

*Operational Reach 2*

Reach 2 is approximately 5.4 miles long and is largely confined within a narrow, deep canyon with channel gradients ranging from 0.7 to 3.4 percent. Reach 2 is characterized by frequent main channel pools separated by numerous low gradient riffles. Habitat composition is primarily pools (45.9 percent) and low gradient riffles (22.7 percent). More than two-thirds (43 of 60) of the pool habitat units were controlled by bedrock and boulder substrates. Channel substrates were primarily boulder, bedrock, cobble, and large gravels. The active channel width averages nearly 70 feet. Main channel pools average 318 feet long. On average, low gradient riffles are 230 feet long. Glides and rapids average 190 and 201 feet long, respectively.

Of the 10 LWD jams found in Reach 2, two were notably large (each containing nearly 80 pieces) with approximately 586 pieces of woody debris found in the entire reach. Only 55 individual pieces were characterized as over 2 feet in diameter. LWD frequency was 196 pieces per mile in Reach 2.

On December 11, 2004, a landslide occurred within a narrow canyon segment of Reach 2 just downstream from Marsh Creek at RM 7.6. The landslide, referred to as the Marsh Creek slide, temporarily blocked the upstream passage of adult anadromous salmonids. Since then, the characteristics and geometry of the landslide have changed and are currently allowing some fish passage to occur.

*Operational Reach 1*

Reach 1 is approximately 4.3 miles long. The upper-most 1.6 miles are deeply incised and largely confined within a bedrock canyon. Widths in this section range from 40 to 160 feet and channel gradients range from 0.7 to 2.9 percent. The lower 2.7 miles of the reach are largely unconfined within a broad floodplain and a number of split channel sections have formed. Channel gradients range from 0.2 to 0.7 percent. Active channel widths range from 60 to over 200 feet.

Aquatic habitat within Reach 1 is comprised mostly of glide (51.7 percent) and low gradient riffle types (28.4 percent). Glides and low gradient riffles average 463 and 295 feet in length, respectively. Channel substrate in the lower portion of Reach 1 was predominately large and small cobble, coarse gravel, and boulder. The number of LWD pieces was lower per mile than the two upstream reaches; 35 individual pieces over 2 feet in diameter were identified and the frequency of LWD was 80 pieces per mile.

Reach 1 is the only reach that contains side-channel habitat. There are three major (over 1,000 feet long) and several minor side channels within Reach 1. Only the three large side channels support unrestricted fish access (R2 Resource Consultants 2008a, page 3-5). The total length of all side channel habitats is approximately 0.9 miles and accounts for 4.7 percent of the length of all riverine habitat surveyed. Side channel habitat was composed nearly equally of glides (54 percent) and low-gradient riffles (46 percent).

**Bull Trout Status in the Action Area**

There are four bull trout populations in the Snohomish River Basin: North Fork Skykomish, South Fork Skykomish, Salmon Creek, and Troublesome Creek (Shared Strategy Committee 2007, page 63). Three of these populations migrate to the estuary and nearshore for the spring and summer, and immature fish use the lower reaches of the Snohomish River from Ebey Slough to Thomas' Eddy during the winter months. Mature adult fish migrate all the way upriver to spawn primarily in the Upper North Fork Skykomish River and its tributaries. They also spawn in the Foss River, after being trapped and hauled above Sunset, Canyon and Eagle falls by the WDFW.

While all life stages of bull trout have been documented in the Snohomish River Basin, adult and subadult bull trout have only been observed sporadically in the Sultan River, and always downstream of the Diversion Dam at RM 9.7 (CH2M Hill 2005, page 3-9). Bull trout have not been observed in the upper Sultan River Basin (CH2M Hill 2005, page 3-9). Bull trout present in the lower Sultan River are presumed to be foraging sub-adult or adult fish, as it is unlikely that the Sultan River contains any habitat suitable for native char spawning based on its relatively warm temperatures and low elevation.

Migratory bull trout are highly piscivorous and are most likely present at times of the year that overlaps with salmon fry emergence, which occurs annually late winter and spring. They may also feed on eggs during salmon spawning from September through December. Bull trout were not observed during the District's 2007 and 2008 juvenile fish surveys in the lower Sultan River (R2 Resource Consultants 2009). Bull trout abundance in the Sultan River is influenced primarily by factors outside the Sultan River, as spawning and early rearing occur elsewhere within the Snohomish/Skykomish bull trout core area. Factors for their decline outside the Sultan River likely include spawning and rearing habitat degradation, historic overharvest, brook trout presence, and overall reduction in the fish forage base from historic levels. Factors for decline inside the action include spawning and rearing habitat degradation and overall reduction in the fish forage base from historic levels and the reduction and changes in the flows as compared to historic conditions. Regardless of these factors, FWS (2008a, page 35) indicated that the short-term abundance trend of the Snohomish/Skykomish bull trout core area is increasing.

**Conservation Role of the Action Area for Bull Trout**

The Sultan River is a productive salmon stream important to bull trout for seasonal foraging by anadromous and adfluvial bull trout. All habitats below the Diversion Dam (9.7 stream miles) are currently accessible by bull trout and five species of anadromous salmon (FWS 2010).

**Bull Trout Critical Habitat Status in the Action Area**

The FWS proposed critical habitat for Coastal/Puget Sound bull trout on January 10, 2010. The final critical habitat rule was published November 17, 2010. Under the final rule, the mainstem Sultan River downstream of the Diversion Dam (RM 9.7) is designated critical habitat. The lower Sultan River is most likely used by adult and subadult bull trout as foraging, migration, and over-wintering (FMO) habitat. The Project Area is not used by bull trout for spawning or early rearing. Spawning and early rearing occurs in other tributaries to Skykomish River at higher elevations.

The 2010 critical habitat rule identified primary constituent elements needed for bull trout survival. Within the proposed designated critical habitat areas of the Sultan River, the PCEs for bull trout are those habitat components that are essential for the primary biological needs of foraging, dispersal, genetic exchange, or sheltering. The PCEs applicable to the Sultan River in the action area, and their status, are as follows:

> PCE (1): Springs, seeps, groundwater sources, and subsurface water connectivity (hyporheic flows) to contribute to water quality and quantity and provide thermal refugia.
>
> Based on the prevailing fluvial and amphidromous life history in the Snohomish River Basin, bull trout are most likely present in the lower Sultan River during late fall, winter, spring, and early summer. Water temperatures in the lower Sultan River during this period are within bull trout temperature tolerances for adult and sub-adult foraging, migration, and over-wintering. Temperatures are negatively affected by the presence of Culmback Dam.
>
> PCE (2): Migratory habitats with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers.
>
> The Marsh Creek slide likely hinders bull trout migration upstream of RM 7.6 and the Diversion Dam at RM 9.7 prevents bull trout from accessing the upper 6.8 miles of the lower river below Culmback Dam.
>
> PCE (3): An abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.

The Sultan River supports a robust population of pink salmon (odd year run). Bull trout are known to prey heavily on pink salmon fry (Lowery 2009, page 29) and salmon carcass flesh. In even years, the forage PCE is likely impaired to some degree, due to the impairment of spawning and rearing of salmonids.

PCE (4): Complex river, stream, lake, reservoir, and marine shoreline aquatic environments and processes with features such as large wood, side channels, pools, undercut banks and substrates, to provide a variety of depths, gradients, velocities, and structure.

Sultan River habitat is relatively low in complexity due to several factors including a limited amount of LWD, a limited number of side channels, and reduction in flows over historic conditions.

PCE (5): Water temperatures ranging from 2 to 15 °C (36 to 59 °F), with adequate thermal refugia available for temperatures at the upper elevation end of this range. Specific temperatures within this range would vary depending on bull trout life history stage and form; geography; elevation; diurnal and seasonal variation; shade, such as that provided by riparian habitat; and local groundwater influence.

Based on the prevailing fluvial and amphidromous life history in the Snohomish River Basin, bull trout are most likely present in the lower Sultan River during late fall, winter, spring, and early summer. Water temperatures in the lower Sultan River during this period are within bull trout temperature tolerances for adult and sub-adult foraging, migration, and over-wintering

PCE (7): A natural hydrograph, including peak, high, low, and base flows within historical and seasonal ranges or, if flows are controlled, they minimize departures from a natural hydrograph.

The frequency, magnitude, and duration of high flow events (peak flood flows) in the Sultan River below Culmback Dam have been reduced under Stage II operations. While this flow regulation has allowed the establishment, persistence, and in some cases proliferation of salmon below the Diversion Dam, it has also reduced the active channel area and affected the creation and maintenance of side channels in the Reach 1 (alluvial reach) of Sultan River.

PCE (8): Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.

Spawning and rearing of bull trout does not occur in the Sultan River, however, adult and subadult foraging, migration, and overwintering in the Sultan River does not appear to be impaired by water quality and quantity in the Sultan River.

PCE (9): Few or no non-native predatory (e.g., lake trout, walleye, northern pike, smallmouth bass); inbreeding (e.g., brook trout); or competitive (e.g., brown trout) species present.

These species are not known to be present in the lower Sultan River.

**Conservation Role of Critical Habitat in the Action Area**

The Sultan River is a productive salmon stream important to bull trout for seasonal foraging by anadromous and adfluvial bull trout. All habitats below the Diversion Dam (9.7 stream miles) are currently accessible by bull trout and five species of anadromous salmon (FWS 2010).

**Terrestrial Habitat Baseline Conditions**

The action area for murrelets includes all the Sultan River from Culmback Dam downstream to the Skykomish River, lands within the proposed Project boundary, and NFS lands in the upper Sultan River Canyon. Under a new License, Project lands would encompass the Lost Lake, Project Facility Lands, Spada Lake and Williamson Creek tracts, and land adjacent to Williamson Creek that would be added to the Williamson Creek tract.

The Project area lies within the Western Hemlock Zone and Pacific Silver Fir Zone of the Northern Cascades Physiographic Province. The dominant native vegetation is similar in both zones and consists of dense forests of western hemlock, Douglas-fir, and western red cedar (and Pacific silver fir at higher elevations). Scattered throughout the coniferous forests are individual and small stands of red alder, bigleaf maple, and black cottonwood. These hardwoods are found primarily on wet and/or recently disturbed soils. The rugged topography of the Cascade Mountains and foothills dominates the Snohomish River Basin, and lands used for timber production or forest recreation account for 74 percent of the basin area. Agriculture comprises 5 percent of the basin area, with farms covering the floodplains of the Snohomish River valley. The second largest land use in the basin (at 17 percent) is rural residential development, which is scattered across the foothills and valleys.

Most human development is limited to the lower portion of the Sultan River Basin, below the Powerhouse. Most timber harvest in the basin occurred below Big Four Creek (RM 11.2, or about 1.5 miles upstream of the Sultan River Diversion Dam) in the 1920s, and some stands have been harvested again more recently. Areas upstream of Big Four Creek that have been harvested since the 1960s are in various successional stand conditions. Some old-growth forest remains on steep slopes along the Sultan River between the Culmback Dam and Sultan River Diversion Dam, and within the Spada Lake and Williamson Creek tracts managed under the current Project Wildlife Habitat Management Plan (WHMP). Washington DNR's Morning Star NRCA in the upper basin also contains some old-growth forest.

**Status of Marbled Murrelets in the Action Area**

The District conducted a murrelet habitat assessment and field surveys for this species in 2007 and 2008 (Biota Pacific 2008b). Based on the results of the habitat assessment, biologists delineated 884 acres of suitable habitat near Culmback Dam, Olney Pass, the South Fork inlet to Spada Lake Reservoir, Williamson Creek, Lake Chaplain, and Horseshoe Bend.

Old-growth and mature conifer forest in the Spada Lake Tract was assessed as suitable murrelet habitat according to the State Forest Practices Rules definition (WAC-222-12-090) in 2007. The suitable habitat was surveyed for murrelets as four survey areas (Culmback West, Culmback East, Olney Pass and South Fork Spada Inlet) in 2007 and 2008 according to Pacific Seabird

Group protocol ((Evans et al. 2003) (Figure 2-1)). Occupancy was confirmed in the Culmback West survey area, and presence was confirmed in the other three (Biota Pacific 2008). Since Culmback West, Culmback East and Olney Pass survey areas are contiguous, all are considered occupied. While no occupancy detections were made at South Fork Spada Inlet in 2007 or 2008, the survey area is contiguous with occupancy detections on State lands from the 1990s (Northwest ¼ of Section 2, Township 28 North, Range 9 East), and is considered occupied as well.

Stands of contiguous mature and old-growth forest in Williamson Creek were also assessed as suitable. They were surveyed as two survey areas (Williamson Creek North and Williamson Creek South) (Figure 2-2) (Biota Pacific 2008). Occupancy was confirmed in the Williamson Creek North survey area in 2007. While no occupancy or presence detections were made at Williamson Creek South in 2007, the survey area is contiguous with Williamson Creek North, and is considered occupied as well (Figure 8).

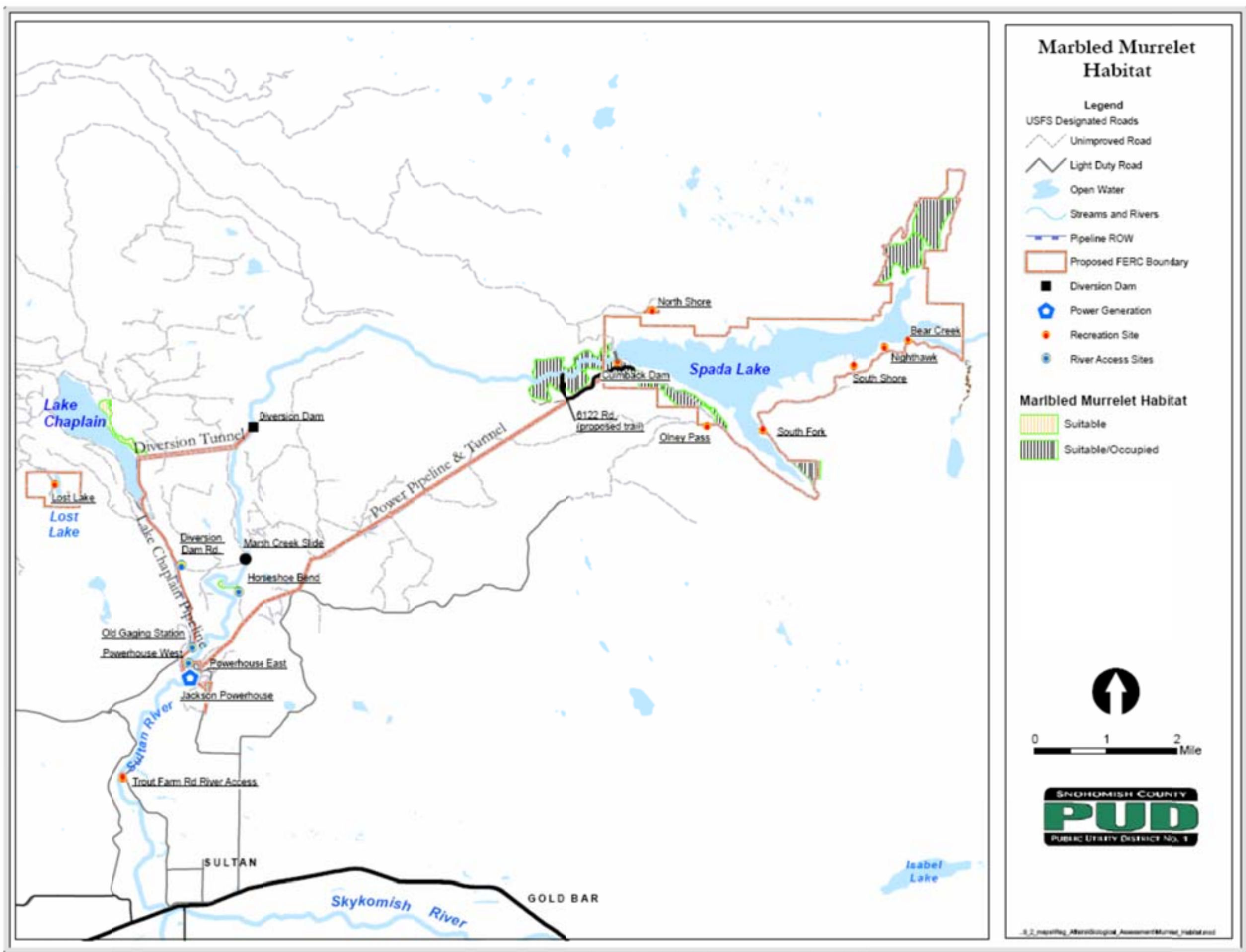


**Figure 8. Suitable and occupied marbled murrelet habitat within the action area.**

## Conservation Role of the Action Area for Marbled Murrelets

Threats to the murrelet in the terrestrial environment include habitat loss and predation. Extensive harvest of late-successional and old-growth forests was the primary reason for listing the murrelet as threatened. Although implementation of the Northwest Forest Plan (NWFP) has significantly reduced the rate of habitat loss on Federal lands, the threat of continued removal of suitable nesting habitat remains imminent on Federal and non-Federal lands through timber harvest and natural events such as wildfire, insect outbreak, and windthrow. Habitat loss is expected to continue in the near future, but at an uncertain rate (McShane et al. 2004). Confounding this issue, murrelets may be less able to respond to the modifications of the native forest landscape (U.S. Fish and Wildlife Service 1997a). Gains in suitable nesting habitat are expected to occur on Federal lands over the next 40 to 50 years, but due to the extensive historic habitat loss and the slow replacement rate of murrelets and their habitat, the species is potentially facing a severe reduction in numbers in the coming 20 to 100 years (U.S. Forest Service and U.S. Fish and Wildlife Service 1994b; Beissinger 2002).

Population trend data for the listed range of this species indicates declines of about 26 percent since 2002 (USFWS 2009, page 19). In Conservation Zone 1, which includes habitat within Snohomish County, annual declines are estimated at about 4.2 percent per year (using 2000-2008 survey data) to 7.9 percent per year (using 2001-2008 survey data) (USFWS 2009, page 19). No historical or long-term data are available that would indicate population trends in the action area itself.

The action area contains approximately 884 acres of suitable habitat. Of that, 820 acres was determined to be occupied during the 2007 and 2008 surveys conducted by SnoPUD (SnoPUD 200). The occupied stands range from 200 to 50 acres in size. All old growth stands, stands 100-years old or older, and stands that will become 100-years old during the license term will be protected providing viable nesting habitat for murrelets in the action area.

## Climate Change

Climate change has the potential to profoundly alter aquatic habitat throughout the Puget Sound (Bisson et al. in press). These effects would be expected to be evident as alterations of water yield, peak flows, and stream temperature. Other effects, such as increased vulnerability to catastrophic wildfires, may occur as climate change alters the structure and distribution of forest and aquatic systems. Given the increasing certainty that climate change is occurring and accelerating (IPCC 2007, Battin et al. 2007), we can no longer assume that climate conditions in the future will resemble those in the past.

In Washington State, most models predict warmer air temperatures, increases in winter precipitation, and decreases in summer precipitation. Average temperatures are likely to increase between 1.7 °C and 2.9 °C (3.1 °F and 5.3 °F) by 2040 (Casola et al. 2005, page 10). Warmer air temperatures will lead to more precipitation falling as rain rather than snow. As the snow pack diminishes, seasonal hydrology will shift to more frequent and severe early large storms, changing streamflow timing and increasing peak river flows, which may limit salmonid survival (NMFS 2008, page 60).

In a study to predict effects of climate change on salmonid habitat in the Snohomish Basin, model results indicate a large negative effect on freshwater salmonid habitat driven by increased winter peak flows that scour the streambed and destroy salmonid eggs (Battin et al. 2007). Higher water temperatures, lower spawning flows, and higher magnitude of winter peak flows are all likely to increase salmonid mortality in the Snohomish Basin and in hydrologically similar watersheds throughout the region. This is expected to make recovery targets for salmonid populations more difficult to achieve. Recommendations to mitigate the adverse effects of climate change on salmonids include (1) restoring connections to historical floodplains and freshwater and estuarine habitats to provide fish refugia and areas to store excess floodwaters; (2) protecting and restoring riparian vegetation to ameliorate stream temperature increases; and (3) purchasing or applying easements to lands that provide important cold water or refuge habitat (ISAB 2007, page 82; Battin et al. 2007, page 6723).

Higher ambient air temperatures will likely cause water temperatures to rise (ISAB 2007, page 2). Salmonids, particularly bull trout, require cold water for spawning and incubation. Suitable spawning habitat is often found in accessible higher elevation tributaries and headwaters of rivers. Thus, as climate change progresses and stream temperatures warm, thermal refugia will be essential to the persistence of many salmonid populations, particularly bull trout. Thermal refugia provide important patches of suitable habitat for salmonids that will allow them to undertake migrations through or to make foraging forays into areas with greater than optimal temperatures. To avoid warmer waters, juvenile rearing may be increasingly found only at the confluence of colder tributaries or other areas of cold water refugia.

There is still a great deal of uncertainty associated with in the timing, location, and magnitude of future climate change. It is likely that the intensity of effects will vary by region (ISAB 2007, page 12); however, several studies indicate that climate change has the potential to affect ecosystems in nearly all tributaries throughout the State (ISAB 2007, page 29; Battin et al. 2007, page 6721; Rieman et al. 2007, page 1558). The cumulative effects from land use change combined with climate change may further hinder bull trout survival and recovery.

In the terrestrial environment, global warming, combined with the long-term fire suppression on Federal lands, may result in higher incidences of stand-replacing fires in the future (McShane et al. 2004). As forest fragmentation increases, the threat of habitat loss due to windthrow is likely to increase. Insects and disease can kill complete stands of habitat and can contribute to hazardous forest fire conditions.

## EFFECTS OF THE ACTION

This section addresses the direct and indirect effects of the proposed action and its interrelated and interdependent activities. The regulations implementing the ESA define “effects of the action” as follows:

> “The direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline.…Indirect effects are those that are

caused by the proposed action and are later in time, but still are reasonably certain to occur. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration" (50 CFR §402.02).

The following effects analysis is organized by species and Project component. Effects of the proposed Project to bull trout and murrelet due to operation and maintenance of the Project including the implementation of the Settlement Agreement, two off-license agreements, USFS 4(e) conditions, FWS and NMFS Section 18 prescriptions, and the FERC's Staff Alternative with Mandatory Conditions could result due to the modification in instream flows, water quality degradation, sound disturbance, and habitat modification. The Settlement Agreement includes aquatic license articles (A-LA) ,terrestrial license articles (T-LA) and recreation license articles (R-LA) that are designed to minimize and mitigate potential adverse effects from license implementation, but are not anticipated to fully avoid their occurrence. Bull trout in the action area are amphidromous subadult and adult bull trout. Effects of the proposed action may result in effects to feeding and over-wintering activities. Young and adult murrelets in the forested environment may also be affected by the proposed Project. Effects of the proposed action may result in effects to feeding, breeding, and sheltering activities.

**Effects to Bull Trout and Bull Trout Critical Habitat**

The following proposed License articles are likely to adversely affect bull trout and its proposed critical habitat:

- Marsh Creek Slide Modification and Monitoring Plan (A-LA 2);
- Temperature Conditioning in Reach 3 (A-LA 3);
- Whitewater Boating Flows (A-LA 4);
- Downramping Rate Conditions (A-LA 5);
- Large Woody Debris (A-LA 6), Side Channel Projects (A-LA 7);
- Process Flow Regime (A-LA 8);
- Minimum Flows (A-LA 9);
- Fish Habitat Enhancement Plan (A-LA 12);
- Diversion Dam Volitional Passage (A-LA 13);
- Reservoir Operations (A-LA 14);
- Adaptive Management Plan (A-LA 15);
- Steelhead Planting Program (A-LA 16);
- Fisheries and Habitat Monitoring Plan (A-LA 17);
- Water Supply (A-LA 18); Historic Proprieties Management Plan (C-LC 1);
- Recreation Resource Management Plan (R-LA 1);
- Terrestrial Resource Management Plan (T-LA 1);
- Water Quality Monitoring (W-LA 1); and
- USFS 4(e) Condition 3 - Implementation of Activities on NFS Lands.

We discuss  the effects of each of these License articles , as well as the effects of the Jackson Off-License Supplementation Program Agreement and Lake Chaplain Tract Land Management Off-License Agreement.  Other License articles approved in the Settlement Agreement, but not mentioned above, were determined to have "no effect" on or were "not likely to adversely affect" bull trout or bull trout critical habitat.

A-LA 2:  Marsh Creek Slide Modification and Monitoring Plan

On December 11, 2004, the Marsh Creek landslide blocked or reduced the upstream passage of adult anadromous salmonids beyond RM 7.6 in Reach 2 of the Sultan River.  The Marsh Creek slide deposited a significant volume of large rock and debris in the river, temporarily blocked flows, and created a high-gradient, constricted channel that had blocked or severely limited upstream fish passage.  Two high-flow events of up to 3,560 cfs subsequently occurred in the river in November 2006 and March 2007.  The high flows from these events cleared some of the rocks, most of the sediment, and all of the exposed woody debris from the slide area.  After these two events, limited fish passage through the original slide area was restored for some species.

As a component of the Settlement Agreement, the District filed a Marsh Creek Slide Modification and Monitoring Plan (A-LA 2).  This plan was developed in consultation with the Settlement Parties and includes: provisions for establishing a permanent survey control point or benchmark within the Marsh Creek slide area of the Sultan River; a schedule and methods for conducting a detailed baseline physical survey at low flow; and provisions for establishing a schedule and methods for modifications of the size and location of specific rocks in the slide area.  If the committee determines modifications are necessary to enhance fish passage, the plan also includes: provisions for continuation of annual spawner escapement monitoring upstream of the slide area to evaluate fish passage following implementation of any modifications within the slide area; provisions for conducting visual inspections of the slide area following flow events exceeding 4,000 cfs; provisions for conducting post-modification physical surveys; a schedule and provisions for conducting future modifications after the initial modification is completed and evaluated; and provisions to file a post-modification report with the FERC that documents methods used to modify the slide.

Under A-LA 2, the District's monetary obligations would be limited to a one-time effort to improve fish passage past a natural, partial barrier caused by slope failure.  If this effort is not effective (as defined by the License Article), the ARC would have the ability to approve funding for additional corrective measures through the Fish Habitat Enhancement Plan's Habitat Enhancement Account (A-LA 12).

Under existing conditions, Project operations limit high flows that could flush the remaining large rocks from the slide area and eventually fully restore fish passage.  The primary impediment to upstream fish migration within the slide area is a turbulent, 16-foot-long, two-step chute/small pool/falls with a 46-percent gradient and a channel width of 10 to 20 feet. Modification of the slide is anticipated to provide safe, timely, and effective access to 2.1 miles of salmon and steelhead spawning and rearing habitat up to the Diversion Dam, and an additional 6.8 miles of historically available habitat upstream of the Diversion Dam, after passage is provided at the Diversion Dam (A-LA 13). If successful restoration of fish passage is achieved, it is anticipated that this measure would increase Chinook and coho salmon and steelhead production in the Sultan River by allowing these species to fully utilize historically available, productive spawning habitat upstream of the Marsh Creek slide. Bull trout would also benefit from access to additional foraging and overwintering habitat and an increase in the prey base.

Improving fish passage at the Marsh Creek Slide may require some channel modifications and slope stabilization work. Disturbance or modification of the channel could result in short-term turbidity and sedimentation, at a minimum, and depending on the method chosen for channel modification (i.e., explosives), may result in disturbance, injury, or mortality to bull trout. Regardless of the method selected to restore fish passage at the slide, only limited amounts of sediment or turbidity will be generated. Most of the sediment and all the woody debris trapped behind the slide have been flushed out by repeated high flows since 2004. In addition, only selected large rocks will be moved or broken into small pieces then removed to restore fish passage generating little, if any, sediment. If it is necessary to use explosives to break some of the rock, some adverse effects are anticipated. Using work windows to limit exposure of bull trout to potential concussive blasts would reduce, but may not completely eliminate the likelihood of adverse effects from such actions. In the event explosives are not used, we would not anticipate to adverse effects to bull trout from the project. The particular method to improve fish passage at the March Creek Slide will be reviewed and approved by FWS prior to implementation.

<u>A-LA 3: Temperature Conditioning in Reach 3</u>

Under existing conditions, the water released to Reach 3 of the Sultan River from the valve at the base of Culmback Dam ranges from 3 to 6ºC year round. As a result, water temperatures in the upper end of Reach 3 are 5 to 8ºC colder than optimal for salmonids and other aquatic resources. The low densities of rainbow trout in this reach are likely the result of these low temperatures.

Under the Settlement Agreement, the District proposes to develop and implement a Water Temperature Conditioning Plan to provide more seasonally appropriate water temperatures for spawning and rearing salmonids and other aquatic biota in Reach 3. The plan would include temperature conditioning regime targets for the water release points and the downstream end of Reach 3 (i.e., near the Diversion Dam) from April through October. These targets would be set at the suitable temperature ranges to benefit salmonids and other aquatic resources. The District would also monitor the biological response of salmonids and other aquatic resources (including other fishes and macro-invertebrates) to the temperature conditioning for the term of the license.

The water temperature-conditioning program would be implemented in two phases.

Phase I would begin immediately upon License issuance and would consist of modifying some of the existing flow release structures at the base of Culmback Dam to release up to 70 cfs through the 10-inch cone valve (45 cfs), hydro unit (5 cfs), and new 12-inch cone valve on the existing auxiliary water line (20 cfs). Due to constraints on the intake elevation of the existing auxiliary water line, Phase I conditioning could only occur when reservoir elevations are greater than 1,410 feet msl, and during periods of reservoir stratification, typically April through October.

Phase II would consist of installation of a floating inlet collector combined with a flexible conveyance system that allows the withdrawal water from the top of the Spada Lake Reservoir to provide greater flow release and temperature conditioning opportunities than would be possible under Phase I. The Phase II improvements would allow for temperature conditioning when the reservoir is stratified and at an elevation greater than 1,380 feet msl. The Phase II improvements would be designed to accommodate a minimum 165-cfs release of temperature-conditioned water when the reservoir elevation is at 1,430 feet msl. Phase II is intended to condition the higher minimum instream flows that would be provided in Reach 3 following the construction of any volitional fish passage facilities at the Sultan River Diversion Dam. Accordingly, Phase II would be implemented by the earlier of: (1) 2 years after the date that volitional fish passage modifications are completed at the Sultan River Diversion Dam; or (2) January 1, 2020.

The District used temperature modeling to evaluate the potential effects of the proposed conditioning measure on water temperatures in Reach 3. The model results indicate that conditioned releases from Culmback Dam would raise the daily mean water temperatures during the summer under existing conditions from 5.5ºC to about 14ºC below Culmback Dam, and from about 11.8ºC to as much as 13.3ºC at RM 9.8 just upstream of the Sultan River Diversion Dam. The results of the modeling indicate that the summer 7-DADMax (the highest 7-Day Average of Daily Maximum) water temperatures throughout Reach 3 would be less than the State criterion for Core Salmonid Habitat of 16°C during typical summer conditions.

Under current conditions, the year-round water temperatures downstream of Culmback Dam range between 3 and 6°C. These low water temperatures may prolong egg incubation, delay larval development, and retard rainbow trout growth throughout most of Reach 3. Improved water temperatures under Phase I, would likely increase macro-invertebrate production and improve fish growth, condition, and survival for resident rainbow trout. When fish passage facilities are constructed at the Diversion Dam (see A-LA 13), the improved water temperatures realized under Phase II would also improve habitat conditions for ESA-listed steelhead and Chinook salmon, and may also benefit bull trout through an increase in the forage base. Adverse effects to bull trout from the implementation of this measure are not anticipated. Temperatures achieved by this license article are within those considered suitable for foraging and overwintering of bull trout. The effectiveness of water temperature conditioning in Reach 3 would be determined by the monitoring of both water temperatures and any changes to aquatic community in Reach 3.

<u>A-LA 4: Whitewater Boating Flows</u>

Under A-LA4, the District would develop and implement a plan to provide flows for 12 viable whitewater boating events every 3 years for the duration of a new License with sufficient advance notice to whitewater boaters. Proposed whitewater flows would range from 600 to 2,000 cfs for at least 3 hours. During each 3-year period, the District would provide a firm total water budget of 2,100 acre-feet of water to ensure that 12 viable whitewater events occur. If the 2,100 acre-feet of water budget in combination with controlled and uncontrolled flow releases (i.e., spill) and accretion flows is not sufficient to achieve 12 viable whitewater boating events during each 3-year period, the District would provide a reserve budget of 1,200 acre-feet to ensure that such events occur.

The ARC would annually coordinate scheduling of the April, May, and September whitewater flow releases and the proposed process flows discussed in A-LA 8. Any combination of the proposed whitewater recreation flows could be used to satisfy the requirements of the proposed process and migration flows, as long as the timing, duration, and magnitude are greater than or equal to the proposed process and migration flows, and vice versa. Any potential adverse effects to forage fish (stranding) from the whitewater flow releases would be minimized through the implementation of timing restrictions developed in consultation with the Aquatic Resource Committee. Instances of juvenile salmonid mortalities due to stranding in combination with other actions that injure or kill juvenile salmonids may adverse effect prey abundance in the Sultan River.

A-LA 5 Downramping Rate Conditions

Rapid reductions in river flow associated with Project operations have the potential to strand fish and other aquatic organisms in pools, off-channel habitats, and low-gradient gravel bars (often resulting in immediate or delayed mortality) (Hunter 1992, page 5). Fry and juvenile fish less than 2 inches in length are particularly vulnerable to stranding due to their weak swimming ability; preference for shallow, low-velocity habitat and side channels; and their tendency to burrow into the substrate. In addition to stranding, Project-related flow changes can also dewater redds, alter habitat use, and adversely affect the production of macroinvertebrates. Limits governing the rate, timing, and number of Project-induced flow changes are often established at hydroelectric projects to protect aquatic organisms, including ESA-listed fish species. Different ramping rate requirements are appropriate for different times of the year depending on the species and life history stages present and the prevailing flows.

Releases from the Jackson Powerhouse (i.e. discharge through the Pelton turbines) largely control flow levels in the Sultan River downstream of RM 4.5. Historically, any emergency shutdown of the Pelton units at the Powerhouse has had the potential for stranding fry and juvenile salmonids that may be present in the lower Sultan River – particularly during March through August. Pelton unit shutdown can decrease flow by as much as 650 cfs per Pelton wheel unit over a short period in Reach 1 downstream of the Powerhouse. Over the last 10 years, there have been nine occurrences of shutdown of the Pelton units; only one of these instances involved both Pelton wheels.

To address this source of rapid downramping in Reach 1, the District recently installed and is currently testing a new Pelton unit flow continuation system. This new system is designed to minimize the risk of excessive downramping events during an emergency shutdown. The newly installed Pelton unit continuation system should allow the District to bypass water when the Pelton units are required to shut down operation. The system would also allow the other Pelton unit, if operating or in standby mode, to be operated to reduce rapid flow decreases from a single unit outage (8 of the 9 Pelton unit outages in the last decade were single unit outages). These efforts would help prevent dewatering of redds or stranding of fry during power outages.

Under A-LA5, the District is required to operate the Project within specified downramping rate limitations, established in the Settlement Agreement, to reduce the potential for harmful effects on aquatic resources. These downramping rates would not apply to power-generation equipment failures, forced outages, or modification to flow releases when downstream flood conditions are occurring. However, until the new Pelton unit flow continuation system proves to be effective, the District will maintain staff at the Powerhouse during electrical storms or similar events likely to trigger an emergency Powerhouse shutdown to provide flow continuation minimizing the effects of a power outage.

With implementation of A-LA 5, the District would also formally adopt its existing voluntary downramping rates for Reach 2. The Reach 2 downramping rates would not apply to flushing flows, which would require manual operation of the sluice gate at the Sultan River Diversion Dam. For flow releases from Culmback Dam (into Reach 3), the District would attempt, within the constraints of the Project's existing equipment, to limit the downramping rate to no more than 0.5 feet per hour when the proposed process, special purpose, and whitewater recreation flows cause the flow range at the Sultan River Diversion Dam gage to be greater than 300 cfs but less than 1,000 cfs.

In addition to the above measures, the District will institute a ceiling flow of 550 cfs (mean daily discharge measured at the Powerhouse gage) during the September 15 to October 15 period of peak spawning for Chinook salmon, unless natural accretion flows or Spada Lake Reservoir inflow supersedes the District's hydraulic control of the Project. This spawning flow should ensure that redds remain wetted should Project flows be reduced to a minimum of 300 cfs before the end of the egg incubation and fry emergence period. The District would use spawner survey information on an annual basis to determine the highest elevation and the corresponding flow at which spawning has occurred during the Chinook salmon and steelhead spawning seasons. Based on this information, the District would attempt to keep redds covered with water until fry emergence has occurred. The spawning flow ceiling and corresponding minimum flow could be adjusted based upon approval by the Aquatic Resource Committee.

The District's proposed mean daily discharge ceiling of 550 cfs during the peak Chinook salmon spawning period (September 15 to October 15) should protect Chinook salmon redds from being dewatered if Project flows are reduced to 300 cfs. The District would use the annual Chinook salmon and steelhead spawning survey and flow data to attempt to keep redds covered with water until fry emergence has occurred. The District's proposed annual downramping report would quantify how successful the District has been in its attempts to keep redds submerged, so that the need for additional protective measures can be identified and incorporated into future downramping decisions, if appropriate. The Aquatic Resource Committee would use the annual downramping report to determine whether additional ramping rate restrictions are necessary to protect fish from stranding in the side channels, once the proposed access to those side channels is restored.

The implementation of ramping rates below Culmback Dam, as approved in the Settlement Agreement, would provide greater protection for bull trout and their prey resources than under existing conditions. We would not anticipate bull trout to become stranded from the implementation of ramping rates and minimal instream flows approved under the Settlement Agreement because sub-adult and adult bull trout are more mobile and less vulnerable to stranding than juvenile fishes. Although the ramping rates in A-LA 5 represent an improvement over existing conditions in the Sultan River, some limited stranding of juvenile salmonids would still occur. Instances of juvenile salmonid mortalities due to downramping in combination with other actions that injure or kill juvenile salmonids may adverse effect prey abundance in the

Sultan River potentially adversely affecting bull trout's ability to forage. Overall, implementation of this license article would benefit salmonid spawning and rearing in the Sultan River by creating improved spawning, incubation, and rearing flow conditions in the lower Sultan River.

A-LA 6 Large Woody Debris

Large woody debris (LWD) is an important component of a healthy river ecosystem. Large trees that fall into rivers perform an important role in forming pools, regulating storage and routing of sediment, and trapping spawning gravel. LWD also provides complex fish habitat that increases carrying capacity, high-flow refugia for fish, and substrate for macroinvertebrates. LWD of sufficient size is either not being recruited from the older second-growth stands found in the bypass reach or it is recruited but not being delivered from stands upstream of Culmback. As a result, the wood loading rate in the lower 3 miles of the Sultan River is substantially less than that observed in unregulated rivers in Washington, and much of the LWD is small- to medium-sized and positioned along the channel margins (Stillwater Sciences and Meridian Environmental Inc. 2008b). Under existing conditions, there is limited wood of suitable size to provide the needed structural complexity to create pools. While this is likely the consequence of long-term logging dating back to the late 1800s (Stillwater Sciences and Meridian Environmental, Inc. 2008a, page vi), operation of the Project continues to block the downstream recruitment of LWD.

A lack of in-channel LWD has also been identified as a major salmonid habitat-limiting factor in the mainstem Skykomish and Snohomish rivers. According to the Snohomish River Basin Salmon Conservation Plan (Snohomish Basin Salmon Recovery Forum 2005), mainstem channels in the watershed have low levels of LWD and debris jams, contributing to a lack of pools and side channels. The Conservation Plan also notes that it would take at least 50 years for existing riparian forests to contribute LWD. As a result, structural remedies (engineered logjams and other features designed to increase habitat complexity) are recommended in some locations.

In A-LA 6, the District proposes to develop and implement a LWD Plan that would result in the placement of LWD in the Sultan River, both in the form of engineered structures and by placement of LWD collected at Culmback Dam at appropriate downstream locations. The plan would describe: (1) the design and location of each LWD structure; (2) the LWD installation schedule; (3) the restrictions necessary to minimize adverse effects to public safety and property; (4) the method and schedule for monitoring the effectiveness of the LWD structures; and (5) the method and schedule for moving LWD accumulated in Spada Lake Reservoir between Culmback Dam and the log boom to areas targeted for restoration.

Within 5 years of licensing, and after gaining regulatory approval and legal access, the District would install five to eight LWD structures in the lower Sultan River (RM 0 to 16). Up to five of the initial eight LWD structures would be designed to improve main channel habitat complexity, re-direct flow, carve and create habitat, add diversity, retain and sort sediment, provide salmonid-rearing habitat, and provide a medium for use by macroinvertebrates. Up to three of the eight structures would be associated with side channels and would be designed to improve mainstem/side channel connectivity by directing flow into side channels. The District would install up to four additional LWD structures in the Sultan River beginning 10 years after license issuance.

The specific locations and designs of the LWD structures would be based on the probability of retention and possible risk to property, and would be developed in consultation with the Aquatic Resource Committee. Each LWD structure would include 5 to 30 structural pieces of Douglas fir, hemlock, or cedar of approximately 24 to 36 inches in diameter (at breast height) and 35 to 40 feet in length (with intact rootwads); larger structural pieces would be used within the transport capabilities of trucks or a helicopter. The structures would be designed to rack wood and eventually develop into logjams. LWD from Spada Lake Reservoir would be used to build the structures and to provide material for the proposed side-channel enhancement projects.

Whereas the function of LWD upstream of RM 3.0 is unlikely to change in the foreseeable future (due to the channel's high stream power, confinement, and the small size of available trees), an increase in the quantity of wood downstream of RM 3.0 would likely increase overall physical heterogeneity in that reach, benefiting resident and anadromous salmonids. The LWD structures are expected to increase Chinook, coho, and steelhead productivity in the lower Sultan River, which would provide additional forage for bull trout.

Most of the construction of LWD structure would be accomplished outside the active channel or in dewatered side channels. However, some streambank and in-water work could be needed to construct and/or secure the structures. In-water work would likely cause short-term turbidity plumes and sedimentation, and may result in some injury or mortality to fish, particularly young-of-the-year salmonids. Best management practices including in-water work windows employed during any construction and maintenance activities are anticipated to minimize potential adverse effects from LWD placement, but are not anticipated to fully avoid their occurrence. Adult and subadult bull trout are less susceptible to short-term increases in turbidity and sediment because of their size and mobility. Impacts to prey resources (juvenile salmonids) are more likely to occur. Such occurrences in combination with other actions that adversely affect bull trout prey abundance may adversely affect bull trout's ability to forage. Overall, LWD placement is likely to improve habitat conditions in the Sultan River for adult and subadult bull trout and their prey resources over the term of the License.

A-LA 7 Side Channel Projects

Side channels in the alluvial lower reach of the Sultan River provide important spawning and rearing habitat for several species of resident and anadromous salmonids. Juvenile coho in particular are known to make widespread use of off-channel habitats, often gaining access to small streams and backwater environments that are either inaccessible to adult coho or unsuitable for spawning. Side channels are also recognized for their value as summer and winter rearing habitat for juvenile fishes and, when regularly available, provide high quality protected spawning habitat, especially for coho, chum, and pink salmon. Juvenile fish of these species are often prey for bull trout in the riverine environment.

Implementation of A-LA 7 requires a Side-Channel Enhancement Plan to address the loss of this type of habitat. Under this measure, the District would enhance a minimum of 10,000 linear feet of side channel area to provide a minimum of 3 acres of salmonid rearing habitat. This habitat would be located within the wetted area defined by a Sultan River flow of 4,100 cfs, as measured at the USGS gage downstream of the Powerhouse. The Settlement Agreement targets five specific side channels in Reach 1. The enhancement projects would be designed to improve flow connectivity and include other habitat modifications such as the placement of LWD. The proposed plan would outline the methods and schedules for monitoring, reporting, and maintaining side channel enhancements throughout the term of the License.

Installation of the structures, channel excavation, and other instream work related to the proposed side-channel enhancement projects would likely cause short-term turbidity plumes and sedimentation that could cause mortality of eggs, fry, and juveniles of bull trout prey species. Adult and subadult bull trout are less susceptible to short-term increases in turbidity and sediment because of their size and mobility. Best management practices including in-water work windows, employed during any construction and maintenance activities and timed to avoid periods when the majority of bull trout and bull trout prey are present, are anticipated minimize affects to bull trout prey species. Some mortality of juvenile salmonids from side channel projects is anticipated to occur. These impacts to prey resources (juvenile salmonids) in combination with other actions that adversely affect bull trout prey abundance may adversely affect bull trout's ability to forage.

<u>A-LA 8 Process Flow Regime</u>

The frequency, magnitude, and duration of high flow events (peak flood flows) in the Sultan River below Culmback Dam have been reduced under Stage II operations. While this flow regulation has allowed the establishment, persistence, and in some cases increase of salmon populations below the Diversion Dam, it has also reduced the active channel area and affected the creation and maintenance of side channels in the 3-mile alluvial reach of the Sultan River (Reach 1). Specifically, the Physical Processes Study (Stillwater Sciences and Meridian Environmental Inc. 2008b, pages 48 and 49) concluded:

> "Vegetation encroachment in the lower alluvial reach has been an unforeseen consequence of flow alteration. Riparian vegetation has reduced the active channel area in the alluvial reach by 32 percent since Stage II operations began.
>
> Side channels in the Sultan River are relict features, a consequence of vegetation encroachment into formerly active channels of the river."

During Project relicensing, several stakeholders expressed an interest in the release of additional high flows (process flows) to improve channel and aquatic habitat conditions in the lower Sultan River. Under the Settlement Agreement, the District would develop and implement a Process Flow Plan to provide flushing, maintenance, channel forming, and fish migration flows throughout the Project reaches (Settlement Agreement proposed measure A-LA 8). The plan would document how the District would implement a program for periodic, controlled flow releases from the Powerhouse, the outlet pipe located adjacent to the Sultan River Diversion Dam, and Culmback Dam.

Specifically, the plan would describe: (1) the frequency, magnitude, duration, and timing of process flow components; (2) the on-going involvement of the Aquatic Resource Committee in implementing this program; (3) the mechanism for timing controlled flow releases including whitewater boating releases (discussed later in this section) to coincide with natural rainfall events or uncontrolled flow releases to achieve the flow frequency, magnitude, and duration for each of the process flow components; (4) the timing and other restrictions necessary to minimize effects on aquatic resources and not exacerbate downstream flood damage in the City of Sultan; (5) the method, locations, and schedule for monitoring and measuring process flow components; (6) the method and schedule for studying the necessity of flushing flow for supporting the geomorphic process goals; (7) the method and schedule for studying the necessity of upstream migration flow and out-migration flow for providing timely and effective upstream and downstream migration of anadromous fishes; and (8) the method and schedule for monitoring the effects of process flows on aquatic resources.

If necessary, the District would develop a process flow release schedule for periods of drought in consultation with the Aquatic Resource Committee when: (1) a drought event resulting in voluntary reductions in domestic water consumption (defined as a stage 2 response to a drought event) is occurring; (2) the process flows require interim modification including changes in timing or reductions in flow magnitude to manage water supply during periods of drought; and (3) such a schedule would not undermine the purposes of this License Article. The District would notify the FERC and would implement the drought-release flow schedule within 7 days of providing such notice, unless otherwise directed by the FERC.

In year 10 of the new License and every 10 years thereafter, the District, in consultation with the Aquatic Resource Committee, would file with the FERC, a process flow effectiveness report based on the proposed fisheries and habitat monitoring program and the best available information.

The proposed process flows would consist of the components specified in Table 6. Unless otherwise provided, the magnitude, duration, timing, and frequency of the process flows may be achieved through any combination of uncontrolled spills, controlled flow releases such as whitewater boating releases, and accretion flows. Such flow releases could indirectly affect bull trout through redd scouring and juvenile stranding of other salmonid species (bull trout prey resources).

**Table 6. Proposed process flow components.**

| Process Flow | Magnitude and Duration | Frequency |
|---|---|---|
| **Channel Maintenance and Channel Forming Flows** | | |
| Reach 1 channel maintenance flow measured at USGS gage 12138160 just downstream of the Powerhouse at RM 4.5 | Channel maintenance flow would be achieved when:<br><br>(a) a target flow of at least 4,100 cfs is maintained for 24 hours; or<br><br>(b) a target flow of at least 4,100 cfs is achieved and the District provides a maximum release flow at the time when flow drops below 4,100 cfs for a total duration (including the target flow and maximum release) of 24 consecutive hours. | Four times every 10 years but not less than once every 4 years. |
| Reach 1 channel forming flow measured at USGS gage 12138160 | Channel forming flow would be achieved when:<br><br>(a) a target flow of at least 6,500 cfs is maintained for 24 consecutive hours; or<br><br>(b) a target flow of 6,500 cfs is achieved and the District provides a maximum release flow at the time when flow drops below 6,500 cfs for a total duration (including the target flow and maximum release) of 24 consecutive hours, or<br><br>(c) the District provides a maximum release flow for 24 consecutive hours that is timed to achieve, to the extent feasible, a target flow of 6,500 cfs. | Once every 10 years. |
| **Flushing Flows** | | |
| Reach 1 flushing flows measured at USGS gage 12138160 | Reach 1 flushing flow would be achieved when 1,500 cfs is maintained for 6 consecutive hours.<br><br>If Spada Lake is below elevation 1,420 feet msl, Reach 1 flushing flow would be achieved when a 1,200-cfs instantaneous minimum flow is maintained for 6 consecutive hours. | Twice a year; once in September and once between April 1 and May 31. |
| Reach 2 flushing flow measured immediately upstream of the Powerhouse at RM 4.7 | Reach 2 flushing flow would be achieved when:<br><br>(a) a 500-cfs instantaneous minimum flow is maintained for 6 consecutive hours; or<br><br>(b) a 700-cfs instantaneous minimum flow is maintained for 3 consecutive hours. | Twice a year; once in September and once between April 1 and May 31. |

| Process Flow | Magnitude and Duration | Frequency |
|---|---|---|
| Reach 3 flushing flow measured immediately upstream of the Sultan River Diversion Dam at RM 9.8 | Reach 3 flushing flow would be achieved when:<br><br>(a) a 400-cfs instantaneous minimum flow is maintained for 6 consecutive hours; or<br><br>(b) a 600-cfs instantaneous minimum flow is maintained for 3 consecutive hours. | Twice a year; once in September and once between April 1 and May 31. |
| **Upstream Migration Flows** | | |
| Reach 1 upstream migration flow measured at USGS Gage 12138160 | Reach 1 upstream migration flow would be achieved when a minimum flow between 800 and 1,200 cfs is maintained or exceeded for 6 consecutive hours.[a] | Once per year in September |
| Reach 2 upstream migration flow measured immediately upstream of the Powerhouse at RM 4.7 | Reach 2 upstream migration flow would be achieved when a flow between 400 and 600 cfs instantaneous minimum flow is maintained for 6 consecutive hours.[a] | Once per year in September. |
| Reach 3 upstream migration flow measured immediately upstream of the Sultan River Diversion Dam at RM 9.8 | Reach 3 upstream migration flow would be achieved when a minimum flow between 300 and 500 cfs is maintained or exceeded for 6 consecutive hours.[a] | Once per year in September after completion of Sultan River Diversion Dam volitional fish passage modification. |
| **Out-migration Flows** | | |
| Reach 1 out-migration flow measured at USGS gage 12138160 | Reach 1 out-migration flow would be achieved when a minimum flow of between 800 and 1,200 cfs is maintained or exceeded for 6 consecutive hours.[a] | Twice a year; once in April and once in May. |
| Reach 2 out-migration flow measured immediately upstream of the Powerhouse at RM 4.7 | Reach 2 out-migration flow would be achieved when a minimum flow of between 400 and 600 cfs is maintained or exceeded for 6 consecutive hours.[a] | Twice a year; once in April and once in May. |
| Reach 3 out-migration flow measured immediately upstream of the Sultan River Diversion Dam at RM 9.8 | Reach 3 out-migration flow would be achieved when a minimum flow of between 200 and 400 cfs is maintained or exceeded for 6 consecutive hours.[a] | Twice a year; once in April and once in May after volitional fish passage and the Aquatic Resource Committee determines the need. |

[a] Actual upstream and out-migration flows would be determined by the Aquatic Resource Committee.

Flushing flows are high-flow pulses that provide sufficient flow depth and velocity for fish migration, flushing organic matter and fine sediment from the channel, renewing spawning habitat, and maintaining juvenile rearing habitat. The mean annual or average discharge on unregulated streams in Washington typically has sufficient depth and velocity to provide both fish passage functions and the force necessary for flushing organic matter and fine-grained sediment from the channel.

Channel maintenance flows are small floods that provide geomorphic and ecological functions, such as sediment transport and maintenance of streamside vegetation. They scour the channel bed to reshape alluvial features, provide lateral migration and periodic inundation of the floodplain, and protect and sustain channel banks and the floodplain by maintaining healthy streamside vegetation. Channel maintenance flows mobilize sand and larger sediments, scour streambeds, undercut banks, relocate LWD, prevent riparian encroachment, maintain floodplain connectivity, and provide access to side channels and other important rearing habitat for juvenile salmon.

Channel forming flows are large floods that create and sustain channel patterns and floodplain morphology, form and maintain side channels, scour floodplain surfaces, refill off-channel wetlands, and recharge groundwater storage near the river. Large floods transport significant amounts of sediment, recruit and transport LWD from the floodplain, and maintain riparian habitat. The District developed the proposed Reach 1 channel forming flows to mimic the channel forming flows on unregulated streams that have a recurrence interval of 10 to 25 years.

The characteristics and geomorphic processes that form channel features are based on complex interactions between channel gradient, confinement, discharge, sediment load, LWD, and riparian vegetation. Project operations have altered the timing and decreased the frequency of channel flushing, channel forming, and channel maintaining flows compared to unregulated conditions in the Sultan River. Combined, these flows would likely maintain more normative channel processes in the Sultan River benefiting bull trout and its prey resources.

Although the flow regimes proposed under the Settlement Agreement are a significant departure from current operations, the FWS believes occasional releases of higher flows are needed to maintain the natural processes of the river including the recruitment and transportation of spawning gravels and large woody debris, the formation of side channels and off-channel habitats, and the restoration and maintenance of channel diversity throughout the lower Sultan River. Although it is anticipated that a return to more normative flows in the lower Sultan River could cause limited red scour and juvenile stranding over the term of the new license, the FWS does not expected this to significantly impact bull trout or their prey resources, because no bull trout spawning occurs in the Sultan River; and flow magnitudes and timing will be coordinated with the ARC to minimize impacts to spawning salmonids, redd incubation, and rearing juvenile fish. In additions, process flow releases will be timed to occur during or following natural high flow events and the more significant process flow releases will only occur periodically (i.e., once every 10 years). The Project would continue to reduce peak flows and increase minimum flows compared to the natural, unregulated hydrograph. However, the new FERC-license will provide additional releases in the form of channel flushing, channel maintenance, channel-forming flows (process flows) to more closely mimic natural pre-Project flows and improve habitat conditions in the lower river. Overall, the FWS believes the proposed process flow regimes in the Settlement Agreement will benefit bull trout and its prey resources by improving and maintaining habitat in the lower Sultan River.

A-LA 9 Minimum Flows

Minimum instream flow levels can affect water temperature, the availability of spawning and rearing habitat, main channel and side channel connectivity, and fish migration. Project operations directly affect Sultan River instream flows throughout the entire 16.5-mile reach downstream of Culmback Dam. Under the Settlement Agreement, the District proposes the following seasonally shaped minimum instream flow schedule for all three reaches of the Sultan River downstream of Culmback Dam:

Reach 1 - The District would release water from the Powerhouse to maintain instantaneous minimum flows of 300 cfs.

Reach 2 - The District would release water from the outlet pipe located adjacent to the Sultan River Diversion Dam to maintain instantaneous minimum flows according to the schedule shown in Table 7.

**Table 7**. Proposed Reach 2 instantaneous minimum flows.

| Instantaneous Minimum Instream Flow (cfs) | Spada Lake Reservoir Level (feet msl) | Date |
|---|---|---|
| 100 | --- | November 1 through March 15 |
| 140 | --- | March 16 through June 15 |
| 100 | --- | June 16 through September 14 |
| 200 | Above 1,415 | September 15 through October 31 |
| 175 | 1,415 to 1,405 | September 15 through October 31 |
| 150 | Below 1,405 | September 15 through October 31 |

Reach 3 - The District would provide an annual water budget of 20,362 acre-feet for release from Culmback Dam until 2020. The District would provide an additional 3,469 acre-feet to the water budget for a total annual water budget of 23,831 acre-feet beginning during the July 2020 to June 2021 water year, and for the remaining term of a License, unless the ARC decides to delay or postpone this increase.

The District would release the annual water budget as instantaneous minimum flows with a release schedule developed prior to each water budget year (July 1 to June 30) in consultation with the ARC. In the event that the ARC is unable to reach consensus regarding the release of the water budget 15 days prior to the beginning of the water budget year, the default Reach 3 flow regimes shown in Table 8 would be implemented beginning the first day of the water budget year.

**Table 8**. Default Reach 3 instantaneous minimum monthly flow releases.

| Month | Minimum Flow Releases | | |
|---|---|---|---|
| | Prior to the 3,469-acre-foot water budget increase and the date the District completes the Diversion Dam's volitional fish passage modifications (cfs) | Prior to the 3,469-acre-foot water budget increase, but after the date the District completes the Diversion Dam's volitional fish passage modifications (cfs) | After the 3,469-acre-foot water budget increase beginning July 2020 (cfs) |
| July | 20 | 30 | 40 |
| August | 20 | 35 | 45 |
| September 1-15 | 20 | 45 | 55 |
| September 16-30 | 20 | 55 | 65 |
| October 1-15 | 20 | 65 | 70 |
| October 16-31 | 20 | 50 | 60 |
| November | 20 | 20 | 20 |
| December | 20 | 20 | 20 |
| January | 20 | 20 | 20 |
| February | 25 | 20 | 20 |
| March | 30 | 20 | 20 |
| April 1-15 | 45 | 20 | 20 |
| April 16-30 | 55 | 20 | 20 |
| May 1-15 | 65 | 20 | 30 |
| May 16-31 | 50 | 20 | 30 |
| June | 35 | 25 | 35 |

The objectives of this instream flow PME are to protect, mitigate, and enhance fish and wildlife resources, riparian vegetation, and water quality in the Sultan River. The proposed seasonal allocation of minimum instream flows in the Sultan River were developed in collaboration with the resource agencies and the Tribe, are based on the habitat flow relationships determined during the District's Instream Flow Study (R2 Resource Consultants 2008a). The Settlement Agreement's proposed minimum instream flow schedule would, in most cases, substantially increase existing minimum flows in the Sultan River.

Reach 1 - Reach 1 contains the most productive Chinook, steelhead, coho, chum, and pink salmon, rainbow trout, and cutthroat trout habitat in the Sultan River downstream of Culmback Dam. Spawning flows in this reach are generally not limiting, with the potential exception of pink and chum salmon. The proposed 300-cfs minimum flow would increase the amount of spawning habitat for Chinook (by 25 percent) and steelhead (by 30 percent). Although not listed under the ESA, the proposed minimum flow would also increase the amount of spawning habitat for coho (by 7 percent), chum (by 6 percent), and rainbow trout (by 25 percent), compared to current conditions. Pink salmon and cutthroat trout spawning habitat would decrease by 15 and 17 to 27 percent, respectively, compared to current conditions.

The proposed 300-cfs minimum flow would also increase the amount of juvenile rearing habitat for Chinook salmon (by 8 to 11 percent) and steelhead (by 16 to 24 percent), and rainbow (by 8 to 15 percent) in Reach 1 compared to current conditions. The amount of cutthroat trout rearing habitat would remain essentially unchanged. The amount of mainstem coho salmon juvenile rearing habitat would decrease by 12 to 15 percent, compared to current conditions. However, the proposed minimum flows are expected to increase the amount of side channel habitat in Reach 1, which is highly productive coho salmon rearing habitat.

Reach 2 - Reach 2 receives moderate use by spawning steelhead, Chinook, and coho salmon, and the confined nature of the channel makes the availability of fish habitat less sensitive to flow changes. Spawning flows in this reach are generally not limiting. The District, in consultation with the resource agencies and other stakeholders, used steelhead-spawning criteria to determine preferred winter and spring minimum flows, and coho rearing criteria to determine summer minimum flows. The proposed seasonal range of minimum flows would increase the amount of spawning habitat for fall spawning Chinook salmon by 3 to 18 percent compared to current conditions. The amount of habitat for pink salmon and spring spawning steelhead would decrease by 12-14 and 17-43 percent, respectively. Significant accretion during steelhead spawning season will mitigate reductions in spawning habitat associated with the minimum flow regime. Chum salmon, rainbow and cutthroat trout spawning habitat would remain essentially the same. Juvenile rearing habitat for all modeled species would remain essentially the same.

Reach 3 – Under existing conditions, Reach 3 has a small population of resident rainbow trout and is inaccessible to anadromous fish. The proposed initial default minimum flows would increase spawning habitat for resident rainbow and cutthroat trout, depending on the month. After completion of volitional fish passage at the Diversion Dam and again in 2020, the default minimum flows would either retain the existing amount of spawning habitat for rainbow and cutthroat trout or increase it from 2 to 36 percent, depending on the month. Rearing habitat for rainbow and cutthroat trout under the initial default minimum flows would either remain the same or increase by up to 28 and 46 percent. After completion of volitional fishways, rearing habitat for rainbow and cutthroat trout would either remain the same or increase by up to 21 and 37 percent, respectively, depending on the month. After 2020, rearing habitat for rainbow and cutthroat trout would increase by up to 6 to 28 and 9 to 46 percent, respectively, depending on the month. Although not modeled during relicensing studies, the increased minimum flows in Reach 3 would also likely benefit ESA-listed Chinook and steelhead that may spawn and rear in this reach. Providing passage alone would increase habitat availability for anadromous fish, compared to existing conditions.

During drought conditions, releases from the Project facilities account for the vast majority of flows within the Sultan River. Under the Settlement Agreement, the District would implement a contingency minimum flow-release protocol for drought conditions. These contingency flow releases would generally allow for interim modifications to the proposed release schedule to manage water supply during periods of drought.

Implementation of a drought-controlled minimum flow release schedule, in consultation with the ARC, would allow for interim modifications to the minimum flow regime in all three reaches during periods of weather-related shortages. This flexible approach would allow the District and stakeholders the opportunity to provide as much flow as possible to protect aquatic resources while accounting for the severity of the drought coupled with anticipated voluntary and involuntary municipal water use reductions.

The proposed minimum flow in all three reaches of the Sultan River under the Settlement Agreement represent an increase in minimum instream flows over current operations. Increasing minimum instream flows will allow for better distribution of spawning adult salmonids over the available habitat and increase the amount of juvenile rearing habitat. Although such increases in would represent an increase in minimum flows compared to the natural, unregulated hydrograph, the FWS believes minimum instream flow in the Settlement Agreement will mainly benefit bull trout by improving and maintaining spawning and rearing habitat in the lower Sultan River for its prey resources

<u>A-LA 12 Fish Habitat Enhancement Plan</u>

Under A-LA 12, the District proposes to develop a comprehensive Fish Habitat Enhancement Plan to guide the implementation of similar aquatic habitat enhancement projects in addition to those specified in other proposed environmental measures. The plan would be funded by a habitat enhancement account with a $2.5 million initial deposit, with subsequent deposits of $200,000 starting the tenth year following License issuance and then annually for the term of the License. Potential projects that would be funded by the District through the plan could include: instream structure enhancements; side channel habitat development; LWD projects; fish passage barrier removal; gravel augmentation; land purchases for aquatic habitat enhancement; up to $3,000 in annual funding for the National Resources Conservation Service's hydrological monitoring equipment; and other unspecified projects throughout the Sultan River and Snohomish River basins.

If available funds remain within this account, the District would implement other appropriate aquatic habitat enhancement and restoration projects developed by the ARC within the Snohomish River Basin; however, any measures identified in the plan for implementation in a location that is both (1) outside the Sultan River Basin, and (2) outside of the existing Project boundary, would be limited to actions that do not result in an expansion of the Project boundary. In the event that a future landslide causes a barrier to upstream migration, and the District and the ARC determine that there is a relationship between the Project and the barrier, the District would prioritize the use of funds to study and, if necessary, modify such landslide to remove the barrier to upstream migration.

Overall, it is anticipated that the funds associated with this measure would likely benefit bull trout and prey resources in the Sultan River and other rivers in the Snohomish River Basin through the implementation of projects designed to enhance or increase the amount of habitat for these species. In-water work would likely cause short-term turbidity plumes and sedimentation, and may result in some injury or mortality to fish, particularly young-of-the-year salmon. Best management practices including in-water work windows, employed during any construction and maintenance activities and timed to avoid periods when the majority of fish are present, are anticipated to minimize potential adverse effects from projects. Adult and subadult bull trout are less susceptible to short-term increases in turbidity and sediments because of their size and mobility. Impacts to prey resources (juvenile salmonids) are more likely to occur. Such occurrences in combination with other actions that adversely affect bull trout prey abundance may adversely affect bull trout's ability to forage. FWS is a member of the ARC and will be involved in the development of these projects. Project will also have to get FWS approval before being funded and implemented

A-LA 13 Diversion Dam Volitional Passage

The Sultan River Diversion Dam at RM 9.7 prevents fish from accessing approximately 6.68 miles of historical spawning and rearing habitat above the Diversion Dam. The only species currently known to persist in Reach 3 (Diversion Dam to Culmback Dam) are resident rainbow trout, mountain whitefish, and unidentified sculpin.

Under A-LA 13, the District would provide volitional fish passage at the Sultan River Diversion Dam; the timing of this would be based on future index area spawning surveys. The District would make structural modifications to the Diversion Dam to provide for the construction, maintenance, and operation of safe, timely, and effective upstream and downstream volitional fish passage to reintroduce anadromous fish to the river above the dam. The District's design for any upstream fishway at the Diversion Dam or installation of a fish screen would conform to criteria in the Anadromous Salmonid Passage Facility Design Manual (NMFS 2008b).

The District would file a Volitional Passage Plan with the FERC within 1 year of License issuance. This plan would include: (1) the conceptual design drawings and cost estimates of the proposed upstream and downstream fishways; (2) the method and schedule for implementing the fishways in the event that the passage triggers occur; (3) the method and the schedule for monitoring annual spawning escapement within the Sultan River index areas and above the Diversion Dam; (4) the method and schedule for testing and verifying fish passage effectiveness at the Diversion Dam; and (5) annual monitoring, reporting, and ARC consultation requirements.

The District, in consultation with the ARC, would file the final design for the Diversion Dam modifications with the FERC and apply for all necessary permits within 6 months after the fish passage trigger occurs. The District would not begin construction of the fishways until the ARC, FWS, NMFS, and FERC approve the final design and plan, and all the necessary permits have been obtained. The District would complete the fishways no later than two full construction seasons after FERC approval of the final design and plan and obtaining all necessary permits.

After upstream fishways have been implemented, the District would not divert water directly from the river to Lake Chaplain from the Diversion Dam in any year in which more than six anadromous salmonid redds occur above the Diversion Dam, unless no other means are available to meet the City of Everett's water supply requirements. If this water supply requirement is triggered, the District would respond appropriately to prevent entrainment of federally listed fish in consultation with the ARC. In the event that the District installs and operates a fish screen at the entrance to the tunnel from the Diversion Dam to Lake Chaplain, the District may resume the direct diversion of Sultan River water to Lake Chaplain at any time.

The Sultan River Diversion Dam at RM 9.7 has been a complete barrier to upstream fish migration since its construction in 1916. The lower 6 miles of Reach 3 have suitable habitat for resident and anadromous salmonids. The average channel gradient is moderate (1.6 percent), and the dominant habitat types are pools and glides (65 percent) separated by cascades. Providing access to this historical spawning and rearing habitat between the Diversion Dam and Culmback Dam and implementing the proposed interrelated environmental measures (i.e., water temperature improvements, instream and process flows, and downramping rate control) would likely increase the production of Chinook salmon and steelhead juveniles. Although conditions would be suitable for bull trout spawning (i.e. suitable temperatures and substrate) above the Diversion Dam, it remains to be seen if bull trout will colonize Reach 3 to spawn. There is no documented use of the lower river by bull trout for spawning. It is expected that any bull trout using the Sultan River for foraging and overwintering has the potential to use the volitional fish passage facility. The potential increase in Chinook and steelhead production would benefit bull trout in the terms of an increased forage base. Since this license article is not expected to be implemented immediately following license issuance, all anadromous species including bull trout will continue to be prevented from using habitat in Reach 3 until the fish passage facility is constructed.

### Effects to Bull Trout Critical Habitat PCEs

Under the ESA, critical habitat is defined has having several PCEs. PCEs are physical and biological requirements that are essential to the conservation of a given species. The proposed action will cause periodic short-term adverse effects to some PCEs, but all PCEs are expected to improve over the term of the License. The focus of this analysis is to determine if critical habitat rangewide would remain functional (or would retain the current ability for the PCEs to be functionally established in areas of currently unsuitable but capable habitat) to serve its intended recovery role for the species.

For the Sultan River, critical habitat is designated from the confluence of the Sultan River with the Skykomish River upstream to the Diversion Dam. The proposed action would have the following effects on bull trout critical habitat PCEs:

PCE (1): *Springs, seeps, groundwater sources, and subsurface water connectivity (hyporheic flows) to contribute to water quality and quantity and provide thermal refugia.*

Under the proposed action, the Project would continue to provide beneficial water temperature control in Reach 1 and Reach 2. As the City's water demand increases, the likelihood that Spada Lake Reservoir would drop below elevation 1,380 feet msl would increase, resulting in cold water releases from Culmback Dam (to meet water withdrawal and minimum flow requirements). While it is likely that these cold water releases would be minimized through implementation of the AMP, these events would likely occur in the mid- to late-summer. Cooler water temperatures in the Sultan River during this time period are likely to benefit bull trout by providing short-term, cold water refugia, which may be used by upstream migrant fluvial and anadromous bull trout as they migrate from Puget Sound and the lower Snohomish River to upstream spawning grounds in the Snohomish/Skykomish basin.

PCE (2): *Migratory habitats with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers.*

The Marsh Creek slide currently restricts access to upstream spawning and rearing habitat of some salmon species and foraging and overwintering habitat for bull trout. Under existing conditions, Project operations limit high flows that could flush the remaining large rocks from the slide area and eventually fully restore fish passage. The primary impediment to upstream fish migration within the slide area is a turbulent, 16-foot-long, two-step chute/small pool/falls with a 46-percent gradient and a channel width of 10 to 20 feet. In addition, the Diversion Dam at RM 9.7 prevents all anadromous species including bull trout from entering Reach 3. Therefore, under existing conditions and until fish passage at the Marsh Creek Slide is addressed under License article A-LA 2, the Migration Corridor PCE is properly not functioning.

Under the proposed action, the Migration Corridor PCE would be improved by correcting the fish blockage at the Marsh Creek Slide, providing fish passage at Diversion Dam, increasing the minimum instream flow requirements, providing beneficial water temperatures in Reach 1 and Reach 2, and improving side channel connectivity in Reach 1.

PCE (3): *An abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.*

The Sultan River supports a robust population of pink salmon (odd-year run). Bull trout are known to prey heavily on pink salmon eggs, flesh, and fry (Lowery 2009, page 29). In addition, Chinook, coho and steelhead also spawn in large numbers in the Sultan River. Conservation measures to improve instream flows in the lower Sultan, to improve habitat conditions especially in Reach 1, and to improve or restore fish passage at the Marsh Creek and the Diversion Dam should provide increased spawning and rearing capacity in the Sultan River Basin for all salmon species. It is expected that the proposed action would continue to support an increasing trend in salmon abundance in the Sultan River. If properly implemented, these actions are anticipated to increase the forage base for bull trout over the License term. Actions that increase sediment (in-water habitat projects) or scour redds (process flows) could result in temporary reductions in bull trout prey in some years.

PCE (4): *Complex river, stream, lake, reservoir, and marine shoreline aquatic environments and processes with features such as large wood, side channels, pools, undercut banks and substrates, to provide a variety of depths, gradients, velocities, and structure.*

The increased minimum flows under the Proposed Action will maintain sufficient stream flow in the Lower Sultan River to ensure a variety of depths and velocities. Flushing flows that will also be implemented under Settlement Agreement are expected to result in increased stream channel complexity (through scour and redistribution of wood and sediment) and contribute to the formation of undercut banks and side-channel habitat. Under the Settlement Agreement, funds will be available to implement a wide range of aquatic habitat enhancement projects. These projects will incorporate additional large woody debris and improve side-channel habitat in the lower river. These projects, although important to the long-term maintenance of habitat in the lower Sultan River, will result in short-term sediment pulses that could render some habitat unsuitable for short-periods of time following installation. As previously discussed, these measures are expected to promote successful bull trout foraging and overwintering habitat throughout the action area. The lower Sultan River will continue to not experience the full range of pre-Project flows because of the existence of Culmback Dam.

PCE (5): *Water temperatures ranging from 2 to 15 °C (36 to 59 °F), with adequate thermal refugia available for temperatures at the upper elevation end of this range. Specific temperatures within this range would vary depending on bull trout life history stage and form; geography; elevation; diurnal and seasonal variation; shade, such as that provided by riparian habitat; and local groundwater influence.*

Under existing conditions, water temperatures in the lower Sultan River are within temperature tolerances for foraging and overwintering bull trout. Beneficial water temperature control would continue to be provided under the proposed action and increases in instream flows would also occur. Therefore, it is expected that properly functioning water temperature conditions for foraging, migration, and overwintering habitat would be maintained and improved over the new license term.

PCE (7): *A natural hydrograph, including peak, high, low, and base flows within historic and seasonal ranges or, if flows are controlled, they minimize departures from a natural hydrograph.*

Flows in the lower Sultan River have been regulated by the Project since its installation. In general, the regulated hydrograph has negatively affected the quality and quantity of aquatic habitat in the lower Sultan River. Vegetation encroachment in the lower alluvial reach is a direct result of flow alteration. Riparian vegetation has reduced the active channel area in the alluvial reach and side channels in the Sultan River are relict features, a consequence of vegetation encroachment into formerly active channels of the river. The Project would continue to reduce peak flows and increase minimum flows compared to the natural unregulated hydrograph under the proposed action perpetuating similar habitat degradation in the near term. However, the new FERC-license will provide additional releases in the form of channel flushing, channel maintenance, channel forming flows (process flows) to more closely mimic the natural hydrograph and improve habitat conditions in the lower river and begin to reverse the adverse effects of a man-altered hydrograph.

PCE (8): *Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.*

The flow schedules in the Settlement Agreement attempt to mimic the natural seasonal variation in the lower Sultan River. In addition, the Project's minimum flow schedule improves on the existing License schedule in timing and volume. The flow schedules in the Settlement Agreement will substantially improve bull trout habitat by improving foraging and overwintering habitat in the lower Sultan River. However, because of the existence of Culmback Dam, the lower Sultan River will not experience the full range of pre-dam flows.

PCE (9): *Few or no non-native predatory (e.g., lake trout, walleye, northern pike, smallmouth bass); inbreeding (e.g., brook trout); or competitive (e.g., brown trout) species present.*

Species that may interbreed or directly compete with bull trout, such as brook trout, are not known to occur in the lower Sultan River and there are no proposals in the new FERC-license to introduce these species or affect their abundance or distribution in the lower Sultan River in any way.

The proposed action is anticipated to improve all proposed bull trout critical habitat PCEs in the Sultan River over the term of the proposed FERC License. Habitat enhancements (i.e., side channels and LWD) and the implementation of process flows are expected to improve bull trout foraging, migration, and overwintering habitat uses over the term of the proposed FERC-license. In the near term, fish blockage at the Marsh Creek Slide and the Diversion Dam will continue impede bull trout distribution in the lower Sultan River, Culmback Dam will continue to negatively affect the recruitment of large woody debris and alter the natural hydrograph by increasing minimum flows and reducing most peak flows.

**Effects to Marbled Murrelets**

Most of the environmental measures included under the proposed action address aquatic resources, and/or would occur in areas that do not overlap with suitable habitat for murrelets. The following actions have the potential to adversely affect murrelets or their suitable habitat. These actions include the Marsh Creek Slide Modification and Monitoring Plan (A-LA 2); Recreation Resource Management Plan (R-LA 1), Terrestrial Resource Management Plan (T-LA 1), Noxious Weed Management Plan (T-LA 2), Marbled Murrelet Habitat Protection Plan (T-LA 3); and development of site-specific plans for habitat or ground-disturbing activities on NFS lands. The following sections discuss the effects of each of these measures on murrelet and suitable habitat, as well as the Lake Chaplain Tract Land Management Off-License Agreement and hazard tree removal along trails and roads. Although measures are included to minimize and mitigate potential adverse effects from license implementation on murrelets, they are not anticipated to fully avoid adverse effects from occurring.

Adverse effects to murrelets can occur when known or potential nest trees are felled, or when the forest surrounding nest trees is materially altered by the felling of other trees. Noise disturbance during the nesting season can also adversely affect murrelets when murrelets are active at their nests. Human activity can indirectly affect murrelets by attracting murrelet predators, such as ravens, crows, and jays to occupied habitats. The District has developed a Marbled Murrelet Habitat Protection Plan (MMHPP)(SnoPUD 2009) that describes measures the District would implement to avoid or minimize habitat or disturbance impacts on murrelets that could result from any Project-related operations or activities.

<u>A-LA 2 Marsh Creek Slide Modification and Monitoring Plan</u>

The District proposes to identify methods and a schedule for modifying the slide to facilitate fish passage. Methods under consideration include using helicopters, a high-lead cable system, crawler tractor and winch line, hand-operated equipment (i.e. jackhammer), and blasting, or some combination of these methods. Potentially suitable habitat for the murrelet is located within 1 mile of the Marsh Creek slide. The District surveyed an 8.3-acre stand of suitable habitat on City-owned land within the Lake Chaplain Tract of the WHMP in 2007 and 2008 and no murrelets were detected. Another approximately 6.5-acre stand of potentially suitable habitat within 1 mile of the Marsh Creek slide was not surveyed due to ownership concerns and it was not known that modifications would be made to the Marsh Creek Slide at that time. This potentially suitable habitat is directly across from the slide and runs upstream and downstream the adjacent bank. Both tracts provide similar habitat. The potential habitat adjacent to the slide is a narrow strip less than 300 feet-wide, with the exception of a small portion of the southern end that is adjacent to suitable habitat on Washington Department of Natural Resources' (DNR) land, which was surveyed in 2006 and 2007 and no marble murrelets were detected (Figure 9).

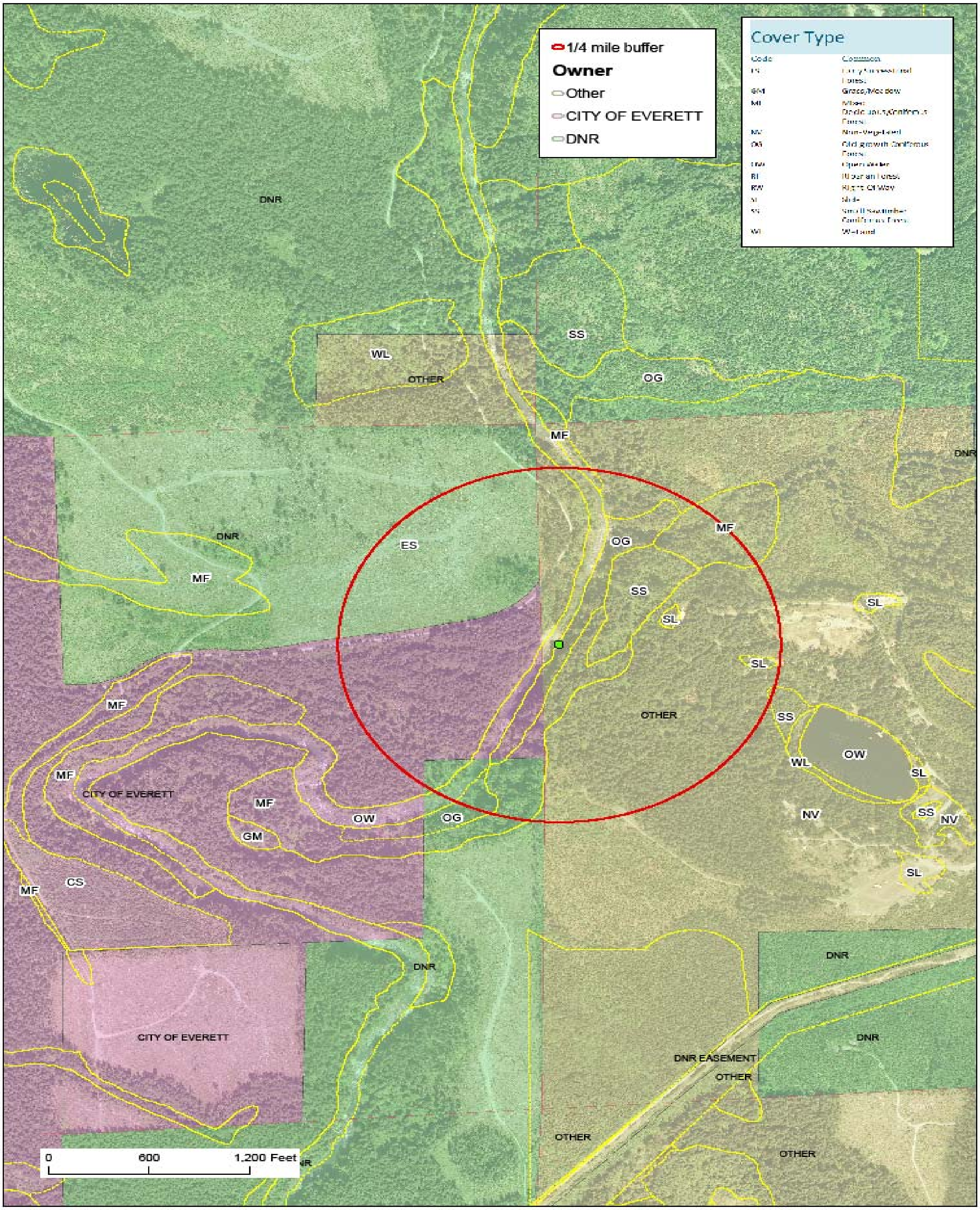


Figure 9. Marsh Creek slide area cover type map.

According to the MMHPP, suitable habitat would be considered occupied unless surveyed and shown to be unoccupied. Surveys must be to PSG protocol and procedures and layout approved by WDFW or the FWS or both. The 8.3 acres of suitable habitat was surveyed to PGS protocol and found to be unoccupied. The additional potentially suitable habitat has not been surveyed nor has it been determined to be suitable. Therefore, prior to commencing work on Marsh Creek Slide the District would assess this habitat to determine if it is suitable. If it is considered suitable it would also be considered occupied until surveys were conducted and occupancy was determined. If occupied, work will be scheduled outside the nesting season (April 1 through September 22), at distance thresholds adequate to protect murrelets from noise disturbance (table 9) and/or 3) with timing restrictions (construction-noise from 2 hours after sunrise to 2 hours before sunset) during the nesting season.

Threshold distances for disturbance to murrelets from several activity types are shown in Table 9. The District will adhere to these threshold distances during the nesting season. In addition, no suitable habitat will be removed during the restoration of fish passage at the Marsh Creek Site. The plan to improve fish passage at the March Creek Slide and any proposed deviation from the MMHPP will be reviewed and approved by FWS prior to implementation to ensure the likelihood of murrelets being disturbed during construction activities at Marsh Creek slide is discountable.

Table 9 Threshold distances to protect the marbled murrelet from noise disturbance associated with construction activities.

| **Activity** | **Threshold Distance[1]** |
|---|---|
| Blast > 2 pounds | 1.0 mile |
| Blast ≤ 2 pounds | 120 yards |
| Impact pile driver, jackhammer, rock drill | 60 yards |
| Helicopter, single-engine airplane | 120 yards |
| Chainsaw | 45 yards |
| Heavy equipment | 35 yards |

[1] Threshold distances are based on USFWS 2003.

R-LA 1 Recreation Resources Management Plan

Under the RRMP, the District would improve several existing recreational facilities and construct two new facilities. Measures contained in the RRMP are summarized below:

1. Improve Trout Farm Road River Access Site: The District would better define the existing parking spaces at this access point, remove noxious weeds, revegetate degraded areas with native trees, shrubs and grasses, and remove boulders that interfere with boat launching. The District would also improve informational signage and increase management presence to deter vandalism and dumping that have occurred in the past.

2. <u>Improve South Fork Recreation Site:</u> The District would improve the existing boat ramp to accommodate trailered boat access and expand the turn-around area. This measure would require the removal of less than 1 acre of mixed deciduous/coniferous forest. This site is expected to become the primary boat launch site on Spada Lake Reservoir. Improvements of this boat ramp are not expected to significantly increase recreation use of Spada Lake by boaters in the project area.

3. <u>Improve Nighthawk and Bear Creek recreation sites</u>: The Washington State DNR is proposing to abandon the South Shore Road at the South Shore Recreation Site, and to develop a trail that would provide pedestrian access to the Nighthawk and Bear Creek recreation sites, and eastward to the Greider and Boulder Lake trailheads. As a result, vehicles could no longer be driven to the Nighthawk or Bear Creek Recreation sites. The District proposes to replace existing toilets at both sites with a different type of sanitation facility, remove the concrete boat ramp at Nighthawk, and install new guardrails at Bear Creek. Disturbed areas would be revegetated with native tree and shrub species and grasses suitable to the site. Changing the existing road to a trail and removing the existing concrete boat ramp is expected to reduce recreation use of these sites and the associated noise.

4. <u>Improve North Shore Recreation Site and access across Culmback Dam</u>: The District proposes to restore hiking and biking recreation access to the North Shore Recreation Site by improving access across Culmback Dam. The District would upgrade signage and railings at the North Shore site, and continue to monitor and maintain the picnic areas and vault toilets.

5. <u>Construct a new trail for whitewater boater access to the Sultan River Canyon</u>: The District would construct a trail following the existing auxiliary release flow line down the face of Culmback Dam to the canyon entrance.

6. <u>Construct new recreation site:</u> A new recreation site near the intersection of the Culmback Dam Road and Forest Road (FR) 6122 would accommodate parking for six vehicles, two to four picnic sites, wildlife-proof trash receptacles, and interpretive signs. Some trees and shrubs would be removed on approximately 2 acres of closed canopy sapling/pole-sized conifer forest in order to develop the site.

7. <u>Construct a new trail for hiker and angler access to the Sultan River Canyon</u>: The District proposes to maintain both the District-owned 0.5-mile portion and the Forest Service-owned 0.4 mile portion of FR 6122 that crosses wildlife lands near Culmback Dam for use as a trail. The District will gate the trail for public use as a trail for hiking and mountain biking. The trail will occasionally be accessed by vehicles for administrative use by the District, USFS, DNR, and for non-Project mineral claimants.

Of the seven recreation measures listed above, two would have the potential to affect murrelets, because they are located in or near suitable habitat. These measures include: (1) the new recreation site near Culmback Dam(#6); and (2) the new access for hikers and anglers into the Sultan River Canyon via Forest Road 6122 (#7).

*New Recreation Site*

The new recreation site is approximately 300 feet from suitable murrelet habitat, so construction of the new facility would have no direct effects on suitable habitat. Construction would require the use of chain saws and heavy equipment for clearing and grading. The MMHPP specifies that timing restrictions and specific distances will be implemented for various construction activity involving chainsaws and heavy equipment during the murrelet nesting season (April 1 and September 22). Any deviations from protection measures in the MMHPP during the planning and construction of this site will be reviewed and approved by FWS to ensure the likelihood of murrelets being disturbed during the construction of this site is discountable.

The use of this recreation site has the potential to increase recreational use in the vicinity of suitable habitat. An increase in recreational use can lead to an increase in nest predators near suitable habitat. Studies with artificial nests have documented nest predation rates are highest within 50 meters of forest edges (including roads or clearcuts), and that predation rates along edges increased in areas that were close to human settlements, recreations sites, and in areas with complex old-growth forest habitat (Raphael et al 2002, p. 230). Suitable habitat is approximately 100 meters from the site. The potential for attracting nest predators (e.g., ravens, crows, and jays) will be reduced by enforcing tight controls on food waste and other trash that attracts the predators. To accomplish this, the District will install wildlife-resistant garbage containers and post informational signs at the site to alert visitors to the importance of managing waste and litter at this location to minimize the risk of attracting murrelet predators to the area. The District will regularly maintain the site to ensure the containers are functioning properly. Based on the proximity of suitable habitat to the recreation site, the small size of the recreation site (parking for up to six vehicles), and District's efforts to control nest predator access to food waste and trash, the FWS does not anticipate a measurable increase in predation in and round the site.

*New Trail for Hiker and Angler Access to the Sultan River Canyon*

The District-owned 0.5-mile portion and the Forest Service-owned 0.4- mile portion of FR 6122 traverses suitable murrelet habitat. Most work needed to maintain the road to appropriate standards would occur within the existing road prism. The total area needed to be cleared for maintenance of the road is not expected to exceed 0.3 acre over the 1-mile distance, since most of the area is already an existing road prism.

The new trail leading from FR 6122 down to the Sultan River would also traverse suitable habitat. The District is currently consulting with the USFS regarding trail layout and design to avoid the removal of overstory trees and avoid platform trees. Although the final route has not yet been determined, no more than 0.36 (assuming a total length of 1 mile and a width of 3 feet) forested acres would be converted to trail by removing small understory trees.

The MMHPP (SnoPUD 2009) calls for minimizing the total area of trail within 100 feet of potential nest trees, and not felling trees with nesting platforms or live dominant or co-dominant trees directly adjacent to trees with platforms, unless necessary for safety, slope stability, and water quality protection. On June 10, 2010, a USFS biologist surveyed the flag line for the proposed trails. The survey indicated that it is not possible to keep the trail more than 100 feet from all nest platforms at locations along the slope into the canyon, due to the large number of trees with suitable platforms. The District will continue to work with the USFS to refine the trail alignment to minimize the number of conifer trees to be removed, and to minimize the footprint of the trail, which should result in only minimal effects on the quality of habitat in the stand.

The District would implement timing restrictions to prevent disturbance to nesting murrelets during road conversion and trail construction. Chain saws and heavy equipment would not be used for construction activities within previously specified distances of suitable habitat during the murrelet nesting season between April 1 and September 22. Implementation of these timing restrictions would avoid the likelihood of noise disturbance to nesting murrelets.

The site described above would serve as the trailhead for visitors using the converted FR 6122 and new Sultan River Canyon trail for fishing and whitewater boater access. The use of this site has the potential to increase recreational use near suitable habitat, which, in turn, can lead to an increase in nest predators near suitable habitat. Studies with artificial nests have documented nest predation rates are highest within 50 m of forest edges (including roads or clearcuts), and that predation rates along edges increased in areas that were close to human settlements, recreations sites, and in areas with complex old-growth forest habitat (Raphael et al 2002, p. 230). The potential for attracting nest predators (e.g., ravens, crows, and jays) will be reduced by enforcing tight controls on food waste and other trash that attracts the predators. To accomplish this, the District will install wildlife-resistant garbage containers and post informational signs at the site to alert visitors to the importance of managing waste and litter at this location to minimize the risk of attracting murrelet predators to the area. The District will regularly maintain the site to ensure the containers are functioning properly. Based on the proximity of suitable habitat to the recreation site and District's efforts to control nest predator access to food waste and trash, the FWS would not anticipate this potential effect to extend more than 50 meters from the trailhead.

The level of recreational activity within suitable murrelet habitat is expected to increase once the trail is completed. Increased activity in occupied habitat could disturb nesting murrelets. Long and Ralph (1998, pages 18-19) discussed two comparable situations where hikers were a potential disturbance: Big Basin Redwoods State Park, California (Singer et al. 1995; Singer, pers. comm.) and the northern Cascade Mountains, Washington (Hamer, pers. comm.). "At neither area did hikers or park personnel appear to greatly influence murrelet behavior." At the Big Basin site, "incubating birds only rarely showed behavior suggesting agitation from human presence or noise," and "no visible reaction to loud talking (or) yelling...near the nest tree." The trail to the Sultan River is expected to be within 100 feet of some trees containing suitable nesting platforms in a few locations, but generally, it will be aligned to stay at least 100 feet from most platform trees. Trail use will consist mainly of day hikers, fisherpersons, and whitewater boating enthusiasts transiting the area during daylight hours to access the Sultan River. FWS believes that the level and type activities expected to occur on the Sultan River trail is within the range of those discussed in Long and Ralph (1998, pages 18-19), for example, activities that are foot-based, transitory in nature, and potentially within close proximity of suitable nest trees. Therefore, the FWS believes it is reasonable to assume that the increase in recreational activities as a result of trail use is not likely to adversely affect murrelets nesting.

T-LA 1 Terrestrial Resource Management Plan

With implementation of the TRMP, the District proposes to bring lands under its ownership (Lost Lake, Project Facility Lands, Spada Lake and Williamson Creek tracts) into the Project boundary for the Project. These tracts are collectively referred to as the "TRMP Lands". The District would manage the TRMP Lands in accordance with the objectives established under the WHMP, except that Project lands would be managed with an emphasis on promoting late-successional and old growth forest habitat conditions. Forest management activities under the TRMP include creating canopy gaps, thinning dense stands, creating snags, decaying live trees and coarse woody debris, and protecting wetland and stream buffers.

The TRMP sets a goal of creating three snags and decaying live trees per acre every 8 to 12 years in second-growth stands. It also prescribes the felling of live trees to create logs. Gaps would be created at the discretion of District biologists, and thinning would be conducted on a limited basis, where it is economically and operationally feasible and where it is likely to accelerate late-seral forest development. Once second-growth stands reach 100 years of age, the TRMP emphasizes stand protection, rather than active management.

Under current conditions, all of the areas that are considered occupied murrelet habitat are located in stands more than 100 years old. As described above, the District does not propose to implement forest management activities within stands over 100 years old. For this reason, none of the proposed TRMP activities would occur within suitable habitat. However, second-growth stands that are not currently classified as murrelet habitat may develop conditions within the new License period that would trigger a reclassification. The MMHPP specifies that the District would update murrelet habitat maps every 10 years, to ensure that protective measures are implemented where they are needed.

Implementing the TRMP would continue to preserve 502 acres of existing old-growth conifer forest known to be occupied by murrelets and promote the development of old-growth characteristics in an additional 1,119 acres of second-growth conifer forest. Over the license term the proposed management regime in the TRMP would add 1,119 acres of suitable nesting habitat with similar characteristics to the existing 502 acres of old-growth forest in the Williamson Creek and Spada Lake tracts of the TRMP. Expanding the amount of available nesting habitat on Project lands will result in large blocks of nesting habitat and would reduce fragmentation, which we anticipate would contribute to improved nesting success.

Creating snags, decaying live trees, and logs; thinning; and creating forest canopy gaps by felling or topping live trees in second-growth stands could reduce the potential for murrelet nesting if these activities were conducted adjacent to suitable habitat, because they could affect the buffering capabilities of the habitat, by making nest trees more vulnerable to windthrow or by making nests more vulnerable to predation. The MMHPP specifies the size, species, and density of trees that should be retained in managed stands to ensure adequate habitat buffering for suitable habitat and to provide for habitat recruitment over time.

The MMHPP also includes timing restrictions that would be applied to TRMP activities in second-growth stands. Within 300 feet of suitable habitat, no activities would be conducted during the murrelet nesting season (April 1 through September 22). Beyond 300 feet but within 0.25 miles of suitable habitat, no activities would be conducted during the daily peak activity periods (2 hour before official sunrise to 2 hours after official sunrise, and 2 hour before official sunset to 2 hour after official sunset) during the murrelet nesting season between April 1 and September 22. Any deviations from protection measures in the MMHPP will be reviewed and approved by FWS to ensure the likelihood of murrelets being disturbed during the implementation of the TRMP is discountable.

T-LA 2 Noxious Weed Management Plan

The District proposes to implement a Noxious Weed Management Plan that would build on the existing Vegetation Management Plan and would include measures to monitor and control existing weed populations and prevent the introduction and spread of weeds in the action area. Typically, mowing, hand-pulling, herbicide application, or clipping of weeds is used to manage the spread of weeds. Given that the primary purpose of the Spada Reservoir is municipal drinking water supply, the use of herbicides for weed management on Project lands has been, and will continue to be, extremely restricted. However, the District acknowledges the challenge of managing noxious weeds over such a large area exclusively by manual and mechanical methods, and reserves the option to investigate the use of chemical herbicides when no other method of weed management is effective at achieving control as required by State and/or County regulations. The District's current Vegetation Management Plan includes specifications for the application of pesticides (herbicides) on District lands, including herbicide toxicity ratings, applicator credentials, sensitive area restrictions, and materials storage, handling, and record keeping (District 2003, as cited in Smayda Environmental Associates et al. 2008a).

Implementation of the Noxious Weed Management Plan is not anticipated to adversely affect murrelets or suitable murrelet habitat. Most weed populations are associated with Project facilities, recreation sites, and roads, where ground disturbance provides suitable soil conditions and traffic may serve as a vector for spread. During field surveys in 2007, few weeds were observed in forested areas (Smayda Environmental Associates et al. 2008b) that could potentially serve as habitat for murrelets. In these areas only hand-pulling, pack-back spraying of herbicide, or clipping of weeds would be permitted year-round. Mowing in suitable habitat would occur outside of the murrelet nesting season (April 1 to September 22) or at threshold distances from suitable habitat to protect the murrelet from noise disturbance (Table 9) will be implemented.

Lake Chaplain Tract Land Management Off-License Agreement

The Lake Chaplain Tract (Figure 8) includes a 441-acre reservoir and 2,198 acres of land in and adjacent to the City of Everett's Lake Chaplain Watershed. The tract is located outside the Project boundary. Under the current License, the Lake Chaplain Tract is managed pursuant to the Wildlife Habitat Management Plan (WHMP) for the Project. The WHMP addresses the mitigation of wildlife effects resulting from the construction and operation of the Project and was prepared by the City of Everett and the District in cooperation with FWS, WDFW, USFS, and Tulalip Tribes.

Pursuant to the Lake Chaplain Tract Land Management Off-License Agreement between the District, the City of Everett, and WDFW, the City will manage the Lake Chaplain Tract towards achieving the management objectives and habitat priorities of the WHMP that are applicable to the Lake Chaplain Tract, but within 6 months of the effective date of the agreement, will develop a site-specific plan. The objectives of this plan (the Lake Chaplain Tract Plan, or LCT Plan) include (1) managing for a diversity of species; (2) managing for a higher percent of trees older than 60 years of age; (3) retaining legacy trees and creating snags; (4) limiting clearcut size to less than 26 acres; (5) increasing the number of stands with multiple canopy layers by increasing the number of uneven-aged harvest units; (6) continuing to provide understory habitat for deer and other species; (7) applying adaptive management principles; and (8) implementing habitat treatments based upon due consideration of the needs of wildlife habitat, water quality, and economics. The City would use the District's wildlife biologist staff or other qualified wildlife biologist(s) under the supervision of the District, for the oversight of the biological aspects of implementation and monitoring of the LCT Plan. The LCT Plan includes provisions for monitoring, annual reports, and consultation with the Parties to the agreement.

The Lake Chaplain Tract is not located within designated critical habitat for the murrelet. The Lake Chaplain Tract includes less than 100 acres of suitable nesting habitat for murrelets, which are located along the eastern shoreline of Lake Chaplain and at Horseshoe Bend. Both areas are within existing set-asides that would remain in place under the proposed LCT Plan in order to maintain its consistency with the goals and objectives of the WHMP; no timber harvest would occur in these areas. Surveys conducted in both areas in 2007 and 2008 indicated that these areas are not currently occupied.

Hazard Tree Removal

An estimated 3 miles of Project roads and 1 mile of trail pass through suitable habitat, or through forests that are within 300 feet of suitable habitat. This number of affected road miles could increase during the term of the new license as forests in and near the Project boundary mature and additional acres become suitable for murrelet nesting, or if the District assumes management responsibility for additional miles of existing Washington State Department of Natural Resources (WDNR) roads along the south shore of Spada Lake. Suitable habitat along the three miles of road was surveyed in 2007 and 2008 and no detections were observed. Suitable habitat along the trail route was also surveyed during the same period. Murrelet occupancy was detected in 2007, but this site is not within or adjacent to the trail alignment.

Among the routine maintenance activities conducted by the District are the pruning, topping and felling of danger trees (trees capable of falling onto and blocking the road or trail and/or striking passing vehicles or hikers). To date, these activities have occurred outside the murrelet nesting season and have resulted in the removal of 580 trees, mostly consisting of alder with a diameter at breast height of 10 inches or less. None of the 580 trees contained platforms. Conducting these activities in forests that are occupied or could be occupied by murrelets has the potential to directly or indirectly affect nesting success. The pruning, topping, or felling of an occupied tree during the nesting period could lead to injury or death of murrelet chicks or eggs and the significant disruption of adult nesting behavior. Felling a tree within close proximity (45 yards) of an occupied tree could also disturb nesting murrelets and chicks. Similar activities outside the nesting season could reduce the availability of suitable nest sites in successive seasons. The pruning, topping, or felling of other dominant or co-dominant overstory trees in forests surrounding suitable nesting habitat could also damage nesting trees or expose nest trees to increased wind damage and make individual nests more vulnerable to disturbance and predation.

Prior to the scheduled pruning, topping, or felling of danger trees in suitable murrelet habitat, District biologists will evaluate each potential danger tree proposed for such activity for nesting platforms. A danger tree will be considered an imminent threat if it is leaning toward a road at an angle of greater than 20 degrees from vertical, is upslope from a road or trail and being undercut by erosion, or is otherwise in a condition that would lead a professional forester or other similarly qualified person to conclude it has a reasonable potential to fall on or across the road or trail without warning.

The District will not prune, top, or fell roadside danger trees in or within 300 feet of suitable habitat during the murrelet nesting season (April 1 through September 22), unless the roadside danger tree poses an imminent threat to the operation of the Project or safe use of a Project road. Any tree-felling in or within 300 feet of suitable habitat that must take place within the nesting season will be performed between two hours after official sunrise and two hours before official sunset. Outside the murrelet nesting season, the District may prune, top, or fell roadside danger trees within suitable habitat. The District will avoid felling trees that contain murrelet nesting platforms unless such danger tree poses a threat to the operation of the Project or safe use of a Project road or trial. Although the FWS expects most roadside danger trees in suitable habitat to be pruned, topped, or felled outside the murrelet nesting season, there may be rare occasions when a hazard tree located in or adjacent to suitable habitat is an imminent threat of falling on the road or trail and must be removed during the murrelet nesting season. The District estimates that approximately 20 dominate or co-dominate danger trees in suitable habitat may need to be removed during the murrelet nesting season over the 45 year license term. Although we do not anticipate that every tree would contain suitable nesting structures, for the purpose of our analysis we assume these 20 trees would be suitable nest trees. We believe felling one or more of these trees could result in a significant disruption of breeding behavior of adults and the death of chicks or eggs. The pruning, topping, or felling of these dominant or co-dominant overstory trees in forests surrounding suitable nesting habitat could also damage adjacent nesting trees or expose nest trees to increased wind damage and make individual nests more vulnerable to disturbance and predation. However, according to surveys conducted in 2007 and 2008, only a small proportion of the presence detections and none of the occupancy detections were along the road. In addition, based on declining population trends the likelihood of these trees being occupied over the license term is reduced. Therefore, we assume only a small portion of these twenty trees would be occupied over the term of the license.

Helicopters to Install LWD Projects and Restore Marsh Creek Slide

Helicopters may be used to transport material and/or equipment to install large woody debris as part of A-LA (Large Woody Debris Projects), A-LA 7 (Side Channel Projects), A-LA (Fish Habitat Enhancement Plan and/or to restore fish passage under A-LA 2 (Marsh Creek Slide Modification and Monitoring Plan). Helicopters, especially those used to lift and transport heavy loads are a significant source of sound in the environment. In addition to being loud, helicopters are generally rare in the action area. Adult murrelets will flush in response to certain activities

(Long and Ralph 1998, p. 19), where chicks show little or no reaction to aircraft flying overhead ((Long and Ralph 1998, p. 19). Flushing exposes the adult and eggs or chicks to any predator in the vicinity when they would otherwise be motionless and cryptic on the nest. This is presumed to be the most important consequence of flushing (Aubrey and Bowles 1990, p. 32). Flushing during feeding activities can also result in aborted feeding attempts. The adult must then return to foraging habitat, capture another prey item and return to the nest for prey delivery. Since adults average 2.2 round-trip feeding attempts per day during the breeding season, a single unsuccessful trip can constitute about a 50 percent reduction in that day's feeding effort, depending on whether the adult returns to foraging habitat for another feeding attempt. These scenarios can be considered a significant disruption of normal behavior as they cost the adult both energy and time that may have been spent on other life-sustaining activities such as foraging and result in a reduction in feeding for the chick. Additional flights also increase exposure of the adult to predation.

Since neither of the plans will be fully developed prior to the issuance of the license, whether or not helicopters are utilized, the type of helicopters selected, the flight paths chosen to approach and leave the various sites, are all decisions that will be made post-license issuance and in coordination with the FWS. All applicable measures in the MMHPP will be incorporated into any final plans for these projects including; scheduling work outside murrelet nesting season (April 1 through September 22), avoid disturbance of suitable murrelet habitat during in the murrelet nesting season, and by applying the threshold distances in Table 9 to protect the murrelet from noise disturbance. Any deviations from protection measures in the MMHPP will be reviewed and approved by FWS. Therefore, the FWS assumes the likelihood of murrelets being disturbed or habitat being damaged from helicopters is discountable.

## CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this Opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the ESA.

The City of Everett water supply system is the only other water resource development located on the Sultan River. Under existing and proposed conditions, the storage and diversion of water associated with the Project alters the natural hydrology, geomorphology, and water quality in the Sultan River downstream of Culmback Dam, which in turn affects the quality and quantity of aquatic habitat for resident and anadromous fish, including ESA-listed Chinook, steelhead, and bull trout. In addition to these Project effects, municipal water withdrawals, the Sultan River Diversion Dam, agriculture, timber harvest, rural development, flood control, and commercial and recreational fish harvest have and would continue to affect aquatic habitat and fish community structure.

The primary factor affecting old-growth in the Sultan River Basin was timber harvest. Timber harvest began in the late 1800s and resulted in the loss of large areas of old-growth conifer forest prior to construction of Phase I of Culmback Dam in 1965. Timber harvest in Washington since 1965 has varied in response to economic pressures and environmental restrictions, but has generally dropped from year to year since the late 1980s. Most remaining old-growth forest in the Sultan River Basin is on NFS lands managed by the USFS and state lands managed by the Washington State DNR. The remaining old-growth forest is generally protected from harvest under the current management policies of both agencies.

## CONCLUSION

After reviewing the current status of bull trout, the environmental baseline for the action area, the effects of the Proposed Action and the cumulative effects, it is the FWS's Opinion that the action, as proposed, is not likely to jeopardize the continued existence of bull trout. This determination is based on the following rationale:

- The measures required by the Settlement Agreement will reduce the effects to bull trout associated with the operation and presence of the Project and represent a significant improvement over measures in the existing FERC license.

- The adverse effects of the Project to instream flows and overall habitat diversity in the lower Sultan River will be reduced through the implementation of higher minimum instream flows, process flows, and the implementation of instream habitat features such as large woody debris structures and side channels enhancements.

- We anticipate the installation of an upstream fish-passage facility will restore volitional fish passage to Reach 3.

- We anticipate bull trout will benefit from the increases in the abundance of prey resources resulting from the instream flow measures, restoration of fish passage, and habitat enhancements implemented to improve anadromous salmon spawning and rearing in the lower Sultan River.

- The adverse effects resulting from the construction of the required measures in the Settlement Agreement are expected to persist for less than one year and mainly affect bull trout foraging opportunities in the lower Sultan River due to disturbance and elevated levels of sediment.

After reviewing the current status of murrelet, the environmental baseline for the action area, the effects of the Proposed Action and the cumulative effects, it is the FWS's Opinion that the action, as proposed, is not likely to jeopardize the continued existence of murrelet. This determination is based on the following rationale:

- Implementing the Terrestrial Resources Management Plan in the Settlement Agreement would continue to preserve 502 acres of existing old-growth conifer forest known to be occupied and promote the development of similar old-growth characteristics in an additional 1,119 acres of second-growth conifer forest. Expanding the amount of available nesting habitat on Project lands will result in large blocks of nesting habitat and reduce fragmentation, which we anticipate would contribute to recovery by improving murrelet nesting success in the action area over the license term.

- Noise disturbance will be of short duration and will occur only during daylight hours, when murrelets are generally less active. We expect that these exposures could temporarily disturb adult and chicks within 45 yards of hazard tree removal activities. However, based on the intensity and limited duration of these potential exposures of murrelets to noise, we do not expect these exposures to have measurable, short- or long-term effect on juvenile recruitment, murrelet numbers, or productivity at the scale of the action area, larger landscape, or Conservation Zone 1.

- The proposed action would remove up to 20 dominate or co-dominate hazard trees in suitable habitat along project infrastructure during the murrelet nesting season over the 45-year license term. Although we do not anticipate that every tree would contain suitable nesting structures, we believe felling one or more of these trees could result in a significant disruption of breeding behavior of adults and the death of chicks or eggs. The pruning, topping, or felling of these dominant or co-dominant trees in forests surrounding suitable nesting habitat could also damage adjacent nesting trees or expose nest trees to increased wind damage and make individual nests more vulnerable to disturbance and predation. However, according to surveys conducted in 2007 and 2008, only a small proportion of the presence detections and none of the occupancy detections were in areas where hazard tree removal is being considered. In addition, based on declining population trends the likelihood of these trees being occupied over the license term is reduced. Therefore, we assume only a small portion of these twenty trees would be occupied over the term of the license. This action will not preclude murrelets from nesting in the action area. We do not expect the removal of up to 20 hazard trees during the nesting season over the 45 year license term to have measurable, short- or long-term effect on juvenile recruitment, murrelet numbers, or productivity at the scale of the action area, larger landscape, or Conservation Zone 1.

- In conclusion, we anticipate that the direct and indirect (including beneficial) effects of the action, combined with the effects of interrelated and interdependent actions, and the cumulative effects associated with future State, tribal, local, and private actions will not appreciably reduce the likelihood of survival and recovery of the species. The anticipated direct and indirect effects of the action (permanent and temporary) will not measurably reduce murrelet reproduction, numbers, or distribution at the scale of the surrounding landscape (i.e., Sultan River basin) or in Conservation Zone 1. The anticipated direct and indirect effects of the action will not alter the status or distribution of the murrelet in Conservation Zone 1 or at the scale of the coterminous range.

After reviewing the current status of bull trout critical habitat, the environmental baseline for the action area, the effects of the Proposed Action and the cumulative effects, it is the FWS's

Opinion that the action, as proposed, will not destroy or adversely modify designated bull trout critical habitat. This determination is based on the following:

- Water temperatures, complex stream channels, spawning substrate, and the hydrograph will all benefit from the various flow regimes provided for by the Proposed Action. For examples: a substantial increase in the minimum daily flows will benefit foraging, overwintering, and migrating bull trout. Provisions for providing higher flows are intended to benefit fish migration and spawning, to periodically flush organic matter from spawning substrate, to maintain channel geometry via sediment transport, to form new channel meanders, and to initiate side-channel activation.
- The Proposed Action will restore bull trout connectivity to Reach 3 of the lower Sultan River below Culmback Dam opening up approximately 6.8 miles of habitat for foraging and overwintering bull trout and spawning and rearing habitat for several species of salmon potentially increasing the prey base for bull trout.

## INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. *Harm* is defined by the FWS as an act, which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavior patterns, including breeding, feeding, or sheltering (50 CFR 17.3). *Harass* is defined by the FWS as an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering (50 CFR 17.3). Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of Section 7(b)(4) and Section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

### AMOUNT OR EXTENT OF TAKE (Bull Trout)

The FWS expects that adult and subadult bull trout within 600 feet downstream of the instream habitat enhancement projects during construction and up to one year following completion would be taken as a result of construction activities associated with the following projects; LWD placement and side-channel enhancement. Take is anticipated to be in the form of harassment.

The FWS expects that adult and subadult bull trout within 300 feet of Marsh Creek Slide during one-time construction activities involving explosives would be taken. Take is anticipated to be in the form of harm.

**AMOUNT OR EXTENT OF TAKE (Marbled Murrelet)**

The FWS expects the harm of murrelet chicks or eggs associated with the 20 hazard trees to be removed during the nesting season. This take will occur over the 45-year license term.

The FWS expects the harassment of adult marbled murrelets within 45 yards of the 20 hazard trees to be removed during the nesting season. This take will occur over the 45-year license term.

**EFFECT OF THE TAKE**

In the accompanying Opinion, the FWS determined that this level of anticipated take is not likely to result in jeopardy to the bull trout and murrelet, or destruction or adverse modification of bull trout critical habitat.

**REASONABLE AND PRUDENT MEASURES**

Reasonable and prudent measures (RPM) are non-discretionary measures designed to minimize impacts on specific individuals or habitats affected by the proposed action, and involve only minor changes to the Project. Pursuant to 50 CFR §402.14 (I) (ii), RPMs are those measures the FWS considers necessary to minimize incidental take. The FWS believes the following RPMs are necessary and appropriate to minimize the incidental take of murrelets.

**RPM 1.** Minimize the likelihood of bull trout injury and mortality from Marsh Creek Slide modification.

**RPM 2**. Minimize the extent and likelihood of effects to murrelets from noise disturbance.

**RPM 3**. Minimize the extent and likelihood of effects to murrelets from habitat modification.

**TERMS AND CONDITIONS**

In order to be exempt from the prohibitions of section 9 of the ESA, the District and the FERC must comply with the following terms and conditions (T&C), in addition to the conservation measures, all of which implement the reasonable and prudent measures described above. T&Cs are nondiscretionary.

Implement the following T&C to fulfill RPM 1:

> **T&C 1.** Seine and block net the pool below the Marsh Creek slide to remove fish that are present and then prevent fish from entering the pool during any blasting that is deemed harmful to fish.

Implement the following T&C to fulfill RPM 2:

> **T&C 1**. Prohibit helicopters within .5 miles of suitable murrelet habitat during the murrelet nesting season.

Implement the following T&C to fulfill RPM 3:

> **T&C 1**. Use the USFS manual (2008), "Field Guide for Danger Tree Removal Identification and Response" as additional guidance to the MMHPP when identify and removing danger trees in and adjacent to murrelet habitat.
>
> **T&C 2.** If suitable nesting trees are to be felled during nesting season, they should be removed as early or as late in the nesting season as possible.
>
> **T&C 3**. Contact the FWS to discuss potential options to reduce effects to murrelets prior to the removal of potential nest trees in suitable habitat during the nesting season.
>
> **T&C 4**. Update MMHPP to reflect new information in this Opinion.

## CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

The FWS offers the District and the FERC the following conservation recommendations:

1. The District and the FERC should work closely with the FWS during the development and implementation of all plans to further minimize adverse effects to bull trout and murrelets in the action area.

2. Update the MMHPP every 10 years in coordination with the FWS to reflect new information.

3. Conduct no activities generating noise above ambient levels within 0.25 miles (1 miles for blasting and 0.5 miles for helicopters) of suitable murrelet nesting habitat from April 1 to September 22.

4. Survey for murrelets in all suitable habitat in the action area.

5. The survey results and field notes of monitoring efforts for listed species should be documented and sent to the FWS on an annual basis, in order to maintain and update baseline information, and to facilitate future consultations.

## REINITIATION NOTICE

This concludes formal consultation on the action(s) outlined in the (request/reinitiation request). As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

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