United States Department of the Interior

FISH AND WILDLIFE SERVICE

Washington Fish and Wildlife Office
510 Desmond Dr. SE, Suite 102
Lacey, Washington 98503

In Reply Refer To:
13410-2011-F-0141
13410-2010-F-0175

AUG 16 2011

Daniel M. Mathis, Division Administrator
Federal Highway Administration
ATTN: Jeff Horton
Evergreen Plaza Building
711 Capitol Way South, Suite 501
Olympia, Washington 98501-1284

Michelle Walker, Chief, Regulatory Branch
Seattle District, Corps of Engineers
ATTN: Rebecca McAndrew
P.O. Box 3755
Seattle, Washington 98124-3755

Dear Mr. Mathis and Ms. Walker:

This document transmits the U.S. Fish and Wildlife Service's Biological Opinion (Opinion) based on our review of the proposed State Route 20, Skagit River Emergency Bank Stabilization and Chronic Environmental Deficiency Project in Skagit County, Washington, and its effects on the bull trout (*Salvelinus confluentus*), marbled murrelet (*Brachyramphus marmoratus*), northern spotted owl (*Strix occidentalis caurina*), and designated bull trout critical habitat, in accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*) (Act).

Your requests for initiation of formal consultation were received on February 3, 2011, and January 19, 2010. The Federal Highway Administration (FHWA) and U.S. Army Corps of Engineers – Seattle District (Corps) provided information in support of "may affect, likely to adversely affect" determinations for the bull trout and designated bull trout critical habitat. On April 13 and 14, 2011, the FHWA and Corps gave their consent for addressing potential adverse effects to the bull trout and bull trout critical habitat with a single Opinion.

TAKE PRIDE® IN AMERICA

The enclosed Opinion addresses the proposed action's adverse effects on the bull trout and designated bull trout critical habitat, and includes mandatory terms and conditions intended to minimize certain adverse effects. The Opinion also finds that the action's foreseeable effects on the marbled murrelet, northern spotted owl, their habitat, and prey base are insignificant and that no measurable effects to the marbled murrelet and northern spotted owl are anticipated.

If you have any questions regarding the Opinion or your responsibilities under the Act, please contact Ryan McReynolds at (360) 753-6047 or Emily Teachout at (360) 753-9583 of this office.

Sincerely,

Ken S. Berg, Manager
Washington Fish and Wildlife Office

cc:
WSDOT, Seattle, WA (B. Bigler)
WSDOT, Olympia, WA (P. Wagner)

Endangered Species Act - Section 7 Consultation

BIOLOGICAL OPINION

U.S. Fish and Wildlife Service Reference:
13410-2011-F-0141 & 13410-2010-F-0175

State Route 20, Skagit River Emergency Bank Stabilization & CED (MP Vic. 100)

Skagit County, Washington

Agency:

Federal Highway Administration, Washington Division
U.S. Army Corps of Engineers, Seattle District
Olympia & Seattle, Washington

Consultation Conducted By:

U.S. Fish and Wildlife Service
Washington Fish and Wildlife Office
Lacey, Washington

Ken S. Berg, Manager
Washington Fish and Wildlife Office

8-16-11
Date

TABLE OF CONTENTS

CONSULTATION HISTORY 1
CONCURRENCE FOR MARBLED MURRELET 3
CONCURRENCE FOR NORTHERN SPOTTED OWL 4
DESCRIPTION OF THE PROPOSED ACTION 7
Emergency Actions 7
Permanent Stabilization – Design 8
Permanent Stabilization – Construction 11
Conservation Measures 14
ANALYTICAL FRAMEWORK FOR THE JEOPARDY AND ADVERSE MODIFICATION DETERMINATIONS 15
STATUS OF THE SPECIES (BULL TROUT) 17
STATUS OF CRITICAL HABITAT (BULL TROUT) 17
ENVIRONMENTAL BASELINE 17
Description of the Action Area 17
Environmental Baseline in the Action Area 20
Status of the Species in the Action Area (Bull Trout) 22
Status of Critical Habitat in the Action Area (Bull Trout) 23
EFFECTS OF THE ACTION 25
Insignificant and Discountable Effects 27
Adverse Effects of the Action (Bull Trout) 29
Emergency Replacement of Failed Bank Armor 30
Effects Resulting from Fish Capture and Handling 32
Exposure to Elevated Turbidity and Sedimentation During Construction 35
Summary of Effects (Matrix of Pathways and Indicators) 40
Effects of the Action (Designated Bull Trout Critical Habitat) 41
Effects of Interrelated and Interdependent Actions 46
CUMULATIVE EFFECTS 47
CONCLUSION 48
INCIDENTAL TAKE STATEMENT 51
AMOUNT OR EXTENT OF TAKE 52
EFFECT OF THE TAKE 53
REASONABLE AND PRUDENT MEASURES 54
TERMS AND CONDITIONS 54
CONSERVATION RECOMMENDATIONS 58
REINITIATION NOTICE 58
LITERATURE CITED 59
APPENDIX A: WSDOT Fish Exclusion Protocols and Standards (2009) 64
APPENDIX B: Status of the Species (Bull Trout; Coterminous Range) 65
APPENDIX C: Status of Designated Critical Habitat (Bull Trout; Coterminous Range) 66
APPENDIX D: Lower Skagit River Core Area (Bull Trout) 67
APPENDIX E: Sediment Analysis Framework (2010) 68

LIST of FIGURES and TABLES

Figure 1. Vicinity map. 7
Figure 2. Aerial photo of project reach. 9
Figure 3. ELJs and revetment in plan view. 10
Figure 4. Typical ELJ, embankment, and roadway cross-section; dolotimber and log detail. 10
Figure 5. Traffic control detail. 12
Figure 6. Action area. 18
Figure 7. Graphic model output depicting post-project 10-year bed shear stress differentials. .. 20

Table 1. Emergency bank armor installations (WSDOT 2009, p. 6). 8
Table 2. ELJ and revetment quantities (Acosta, pers. comm. 2011b). 11
Table 3. Effects of the action ("Matrix of Pathways & Indicators"). 40

LIST OF ABBREVIATIONS AND ACRONYMS

BA	Biological Assessment
BMP	Best Management Practice
CED	Chronic Environmental Deficiency
Corps	U.S. Army Corps of Engineers
cy	cubic yard
ELJ	engineered log jam
ESA	Endangered Species Act of 1973, as amended (16 U.S.C. l53I *et seq.*)
FHWA	Federal Highway Administration
FMO	Foraging, Migration and Overwintering
HCP	Habitat Conservation Plan
ISPG	Integrated Streambank Protection Guidelines
NMFS	National Marine Fisheries Service
NTU	nephelometric turbidity units
OHWM	Ordinary High Water Mark
Opinion	Biological Opinion
PCE	Primary Constituent Element
RPM	Reasonable and Prudent Measures
Service	U.S. Fish and Wildlife Service
SPCC	Spill Prevention, Control, and Countermeasures
SR	State Route
TNC	The Nature Conservancy
WDFW	Washington State Department of Fish and Wildlife
WSDOT	Washington State Department of Transportation

CONSULTATION HISTORY

The Federal Highway Administration (FHWA) and Washington State Department of Transportation (WSDOT) propose to construct a series of bank-anchored engineered log jams (ELJs) and large wood and dolotimber revetments along approximately 1,300 linear ft of State Route (SR) 20 and the Skagit River, in Skagit County, Washington. The proposed action will stabilize the roadway embankment and provide instream roughness and habitat complexity at a location where right-bank erosion has frequently required road closures, placement of bank armor under emergency conditions, and other related maintenance activities. The site, located along SR 20 (milepost vicinity 100) approximately 4.5 miles upstream of the Sauk and Skagit River confluence, is identified by the WSDOT as a Chronic Environmental Deficiency (CED).

Emergency actions taken by the WSDOT during 2004, 2006, and 2007 replaced failed bank armor along approximately 300 linear ft of the Skagit River, and required issuance of a Clean Water Act section 404 permit (NWS-2007-1111-SOD). On January 19, 2010, the U.S. Army Corps of Engineers (Corps), Seattle District, requested after-the-fact consultation to address related potential adverse effects to listed species and critical habitat. During March 2010, the WSDOT provided notice that a request to consult on permanent stabilization of the same site should be forthcoming in a matter of months. In response, the U.S. Fish and Wildlife Service (Service) decided to address both actions, the interim, emergency repairs and permanent stabilization of the site, under one consultation.

Federal funding and issuance of Clean Water Act section 404 permits create a nexus requiring consultation. On April 13 and 14, 2011, the FHWA and Corps both gave their consent for combining the two actions for the purpose of consultation. This formal consultation has been completed in accordance with section 7(a)(2) of the Endangered Species Act of 1973, as amended (16 U.S.C. l53I *et seq.*) (ESA).

The Service based this Biological Opinion (Opinion) on the following sources of information: the Biological Assessment (BA) and Memorandum received from the Corps on January 19, 2010; the BA received from the FHWA on February 3, 2011; WSDOT responses to our questions and comments, received electronically on May 6, 2011; engineering design plans obtained electronically from the WSDOT on May 11, 2011; a field review of the project site on June 23, 2011; plans for landscape replanting and permanent stabilization, received electronically on June 23, 2011; and various scientific literature and personal communications cited herein. A complete record of this consultation is on file at the Washington Fish and Wildlife Office in Lacey, Washington.

The following timeline summarizes the history of this consultation:

November 2004, November 2006, and July 2007 – On three separate occasions the WSDOT replaced failed bank armor along approximately 300 linear ft of SR 20 and the Skagit River. These actions were taken under declared emergency conditions with prior notification given to the Service and other permitting agencies.

January 19, 2010 – The Corps submitted a BA, Memorandum, and letter requesting after-the-fact

consultation to address potential adverse effects to listed species and critical habitat. The Corps' BA provided information in support of "may affect, likely to adversely affect" determinations for the bull trout (*Salvelinus confluentus*) and designated bull trout critical habitat.

March 30, 2010 – The Service met with the FHWA, WSDOT, and National Marine Fisheries Service (NMFS) to discuss tentative plans for constructing more permanent bank stabilization and habitat enhancement features at the site. The Service provided notice of its intent to combine the actions (i.e., emergencies and follow-up permanent stabilization) for the purpose of section 7 consultation.

November 10, 2010 – The Service met with the FHWA, WSDOT, and other stakeholders to discuss design, permitting, and construction issues for a CED project that would include bank-anchored ELJs and large wood and dolotimber revetments.

February 3, 2011 – The FHWA submitted a BA and letter requesting Service concurrence with "may affect, likely to adversely affect" determinations for the bull trout and designated bull trout critical habitat, and "may affect, not likely to adversely affect" determinations for the marbled murrelet (*Brachyramphus marmoratus*) and northern spotted owl (*Strix occidentalis caurina*).

April 11, 2011 – The Service requested additional information from the WSDOT relevant to the effect determinations for the bull trout and designated bull trout critical habitat.

May 6, 2011 – The WSDOT provided responses to the Service's questions and comments.

May 11, 2011 – The Service obtained engineering design plans from the WSDOT.

June 23, 2011 – The Service visited the project site.

June 23, 2011 – The WSDOT provided preliminary plans for landscape replanting and permanent stabilization.

July 20, 2011 – The Service provided a complete draft of the Opinion to the FHWA and Corps for review and comment.

August 3 and 11, 2011 – The FHWA, Corps, and WSDOT provided comments on the draft Opinion, including revised construction quantities.

CONCURRENCE FOR MARBLED MURRELET

The FHWA has provided information in support of a "may affect, not likely to adversely affect" determination for the marbled murrelet. Forested stands located within the action area may provide suitable marbled murrelet nesting habitat, and the Skagit River valley serves as a flight corridor for marbled murrelets transiting between nesting and foraging habitats. Much of this habitat has not been surveyed to protocol in years and the nearest documented below-canopy murrelet observations are located at distance of more than four miles. Very little suitable nesting habitat is present in close proximity and the FHWA has concluded that foreseeable direct and indirect effects to marbled murrelet behaviors will be insignificant. The project will not physically remove or alter trees or stands providing suitable marbled murrelet habitat.

The FHWA proposes to construct the project between January and December 2013. Construction would begin during mid-winter in order to take advantage of low stream flows and light, off-season, traffic conditions. From May through July, coinciding with high spring and summer flows, the project would complete little or no in-water work. A second phase of in-water work would be completed during the established in-water work window for this portion of the Skagit River (August 1 to September 1). Because of these constraints, construction activities would be completed during both the early and late marbled murrelet nesting seasons (i.e., April 1 - August 5 and August 6 - September 15, respectively).

The FHWA proposes daylight-only operations when conducting any and all helicopter flights in support of the project. All helicopter flights in support of the project will be conducted between two hours after sunrise and two hours before sunset (local). Helicopter flights between the on-site staging locations and project area will follow a flight path along the Skagit River channel/valley bottom. The FHWA and its chosen contractor will avoid excursions over adjacent forested stands.

The submitted BA assesses in-air sound generation and attenuation associated with helicopter flights conducted during the period of construction. The FHWA has concluded that the 92 dB injury effects threshold previously identified by the Service (USFWS 2003) will not be exceeded to a distance of more than 600 ft from the planned helicopter flight path (WSDOT 2011, pp. 51-53).

The Service used information provided by the BA, supplemental information describing marbled murrelet habitat suitability and site/stand occupancy, and field observations to evaluate whether and where suitable and potentially occupied habitats may be present within the action area. Datasets maintained by the Washington State Department of Fish and Wildlife (WDFW) do not identify documented below-canopy flights, or any known or presumed occupied stands, to a distance of more than four miles (WDFW 2008). The Washington State Department of Natural Resources has reported to the WSDOT that the nearest suitable and potentially occupied habitat is located at a distance of approximately one mile (WSDOT 2011, pp. 29, 52).

We use two models to predict landscape-scale patterns of marbled murrelet habitat suitability and distribution, the Expert Judgment Model and the Ecological Niche Factor Analysis Model (Raphael et al. 2006). Outputs from these models identify moderately to highly suitable marbled murrelet habitat within the action area, occurring as both small and discontinuous patches and as larger, contiguous stands. The nearest stands greater than five acres in size are located at a distance of approximately 0.4 mile (Raphael et al. 2006). The action area includes large swaths of unsuitable or low-suitability habitat, reflecting land use patterns that include intensive silvicultural management, agricultural operations, and utility/power rights-of-way.

Observations made in the field indicate, while there may be a few scattered, large-diameter trees of sufficient size to provide suitable nest platforms, these trees are not surrounded by trees or stands of a similar character. The valley bottoms exhibit a large deciduous component, and there are no intact stands of large-diameter conifers. Field observations made from SR 20 and the Sutter Creek Roadside Park suggest stand characteristics throughout the valley bottoms, including forest community composition, canopy closure, and vertical diversity, are not indicative of suitable marbled murrelet nesting habitat. There appears to be no suitable marbled murrelet nesting habitat located within 1,000 ft of the project.

The Service conducted an independent analysis of in-air sound generation and attenuation using conservative assumptions; for fuller details see a section that follows (Environmental Baseline, Description of the Action Area). The Service has concluded that temporary increased sound levels associated with construction (helicopter flights in particular) are likely to exceed ambient, background sound levels to a distance of approximately 1.8 miles (Figure 6, Page 19). Consistent with conclusions from the submitted BA, the Service also finds that the 92 dB sound-only injury effects threshold (associated with missed feedings and/or a flushing response) should not be exceeded to a distance of more than 600 ft from the planned helicopter flight path.

Construction of the proposed project will result in temporary increases in sound and human activity. Marbled murrelets that nest in the vicinity of the project, or that transit through the Skagit River flight corridor, may experience temporary elevated levels of disturbance. However, increases in sound and human activity will be of short duration and helicopter flights will occur only during daylight hours, when marbled murrelets are less vulnerable to disturbance. The sound only injury effects threshold should not be exceeded to a distance of more than 600 ft, and therefore disturbance sufficient to cause missed feedings or a flushing response will not extend to any suitable and potentially occupied nesting habitats. Therefore, potential adverse effects to nesting marbled murrelets are discountable.

Given the nature, timing, and duration of the proposed project, and with implementation of the proposed conservation measures, effects to normal marbled murrelet behaviors (including crepuscular movements, transiting along the Skagit River flight corridor, and nesting) will be insignificant. No measurable adverse effects are anticipated. The project will not physically remove or alter trees or stands providing suitable marbled murrelet habitat, and will have no effect on the marbled murrelet prey base or availability of food resources. The project will not result in changes in the use or function of the highway infrastructure and there are no foreseeable indirect effects to marbled murrelets or marbled murrelet habitat that might occur later in time.

CONCURRENCE FOR NORTHERN SPOTTED OWL

The FHWA has provided information in support of a “may affect, not likely to adversely affect” determination for the northern spotted owl. Forested stands located within the action area do provide suitable northern spotted owl dispersal, foraging, and nesting habitats. However, the FHWA has concluded that foreseeable direct and indirect effects to northern spotted owl behaviors will be insignificant. The project will not physically remove or alter trees or stands providing suitable northern spotted owl habitat.

The FHWA proposes to construct the project between January and December 2013. Construction would begin during mid-winter in order to take advantage of low stream flows and light, off-season, traffic conditions. From May through July, coinciding with high spring and summer flows, the project would complete little or no in-water work. A second phase of in-water work would be completed during the established in-water work window for this portion of the Skagit River (August 1 to September 1). Because of these constraints, construction activities would be completed during both the early and late northern spotted owl nesting seasons (i.e., March 1 to July 15 and July 16 to September 30, respectively).

The FHWA proposes daylight-only operations when conducting any and all helicopter flights in support of the project. All helicopter flights in support of the project will be conducted between two hours after sunrise and two hours before sunset (local). Helicopter flights between the on-site staging locations and project area will follow a flight path along the Skagit River channel/valley bottom. The FHWA and its chosen contractor will avoid excursions over adjacent forested stands.

The submitted BA assesses in-air sound generation and attenuation associated with helicopter flights conducted during the period of construction. The FHWA has concluded that the 92 dB injury effects threshold previously identified by the Service (USFWS 2003) will not be exceeded to a distance of more than 600 ft from the planned helicopter flight path (WSDOT 2011, pp. 51-51).

The Service used information provided by the BA, supplemental information describing northern spotted owl habitat suitability and site/stand occupancy, and field observations to evaluate whether and where suitable and potentially occupied habitats may be present within the action area. Datasets maintained by the WDFW do not identify any known active or historic site centers or territories within a distance of approximately 3.5 miles (WDFW 2008); the edge of the nearest known active or historic territory is located approximately 3.5 miles from the project, and outside the action area. The Washington State Department of Natural Resources has reported to the WSDOT that the nearest suitable and potentially occupied habitat is located at a distance of approximately one mile (WSDOT 2011, pp. 29, 52).

Observations made in the field indicate, while there may be inclusions of suitable nesting and foraging habitat within the action area, the valley bottoms exhibit a large deciduous component, lack intact stands of large-diameter conifers, and have few remnant, large diameter trees. Field observations made from SR 20 and the Sutter Creek Roadside Park suggest that stand characteristics throughout the valley bottoms, including forest community composition, canopy closure and vertical diversity, and the availability of snags, cavity trees, and dead and down

wood, are not indicative of suitable spotted owl nesting or foraging habitats. There appears to be no suitable northern spotted owl nesting or foraging habitats located within 1,000 ft of the project.

The Service conducted an independent analysis of in-air sound generation and attenuation using conservative assumptions; for fuller details see a section that follows (Environmental Baseline, Description of the Action Area). The Service has concluded that temporary increased sound levels associated with construction (helicopter flights in particular) are likely to exceed ambient, background sound levels to a distance of approximately 1.8 miles (Figure 6, Page 19). Consistent with conclusions from the submitted BA, the Service also finds that the 92 dB sound-only injury effects threshold (associated with missed feedings and/or a flushing response) should not be exceeded to a distance of more than 600 ft from the planned helicopter flight path.

Construction of the proposed project will result in temporary increases in sound and human activity. Northern spotted owls that forage or nest in the vicinity of the project may experience temporary elevated levels of disturbance. However, increases in sound and human activity will be of short duration and helicopter flights will occur only during daylight hours, when northern spotted owls are less vulnerable to disturbance. The sound only injury effects threshold should not be exceeded to a distance of more than 600 ft, and therefore disturbance sufficient to cause missed feedings or a flushing response will not extend to any suitable and potentially occupied nesting habitats. Therefore, potential adverse effects to nesting northern spotted owls are discountable.

Given the nature, timing, and duration of the proposed project, and with implementation of the proposed conservation measures, effects to normal northern spotted owl behaviors (including crepuscular movements, nesting, foraging, and dispersal) will be insignificant. No measurable adverse effects are anticipated. The project will not physically remove or alter trees or stands providing suitable northern spotted owl habitat, and will have no effect on the prey base or availability of food resources. The project will not result in changes in the use or function of the highway infrastructure and there are no foreseeable indirect effects to northern spotted owl or their habitat that might occur later in time.

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

The FHWA and WSDOT propose to construct a series of bank-anchored ELJs and large wood and dolotimber revetments along approximately 1,300 linear ft of SR 20 and the Skagit River, in Skagit County, Washington. The proposed action will permanently stabilize the roadway embankment and provide instream roughness and habitat complexity at a site identified by the WSDOT as a CED (SR 20 milepost vicinity 100; right-bank approximately 4.5 miles upstream of the Sauk and Skagit River confluence).

The site is located between Rockport and Marblemount, Washington, in Sections 20, 21, and 29 of Township 35 North, Range 10 East (Figure 1). Water Resources Inventory Area (WRIA) 4 – Upper Skagit; hydraulic unit code 17110005 (Upper Skagit).

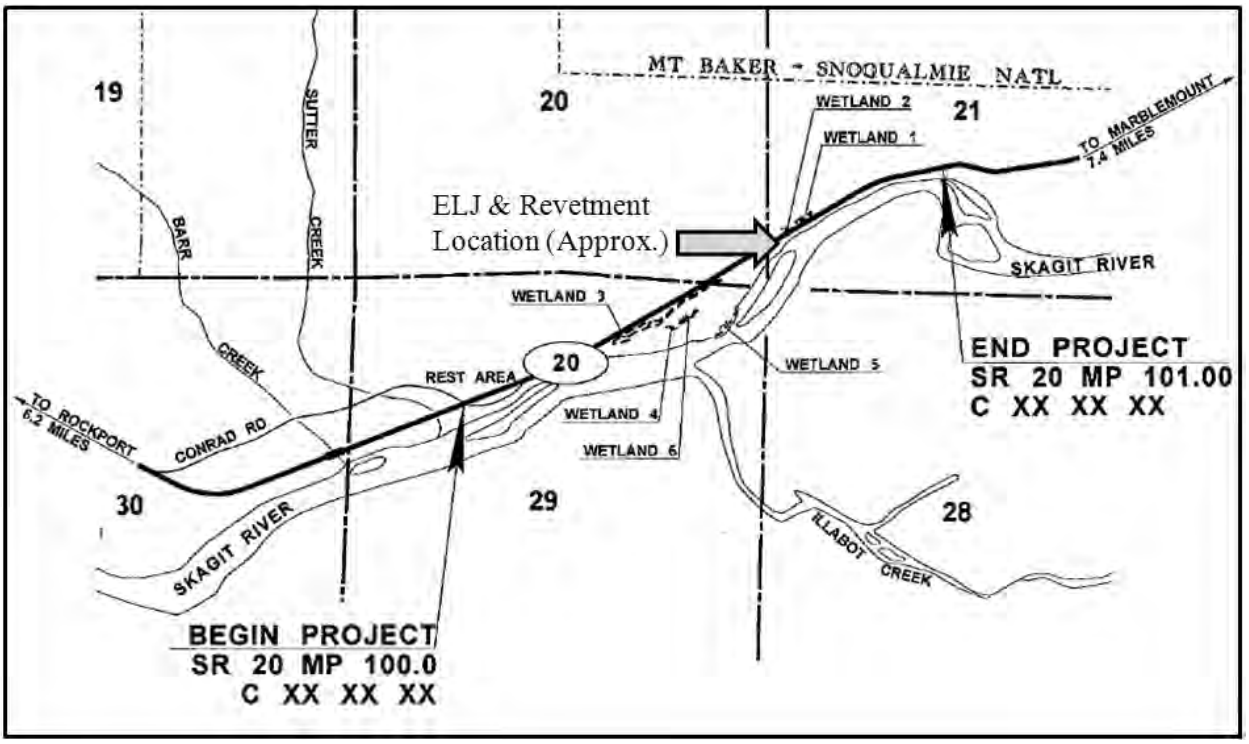


Figure 1. Vicinity map.

Emergency Actions

On three separate occasions, during November 2004, November 2006, and July 2007, the WSDOT replaced failed bank armor at the site under declared emergency conditions. The WSDOT used an excavator to place approximately 700 cubic yards (cy) of riprap in a controlled manner above and below the Skagit River's ordinary high-water mark (OHWM) (Table 1).

Table 1. Emergency bank armor installations (WSDOT 2009, p. 6).

Event / Date	Linear Feet of Affected Bank	Riprap Quantity Total (cy)	Riprap Quantity Below OHWM (cy)
November 2004	40	414	92
November 2006	150	1,000	360
July 2007	100	400	230
Total	**290**	**1,814**	**682**

These actions, affecting approximately 300 linear ft of the Skagit River, were taken under declared emergency conditions with prior notification given to the Service and other permitting agencies. Subsequent to the actions, the Corps issued a Clean Water Act section 404 permit (NWS-2007-1111-SOD) and requested after-the-fact consultation to address potential adverse effects to listed species and critical habitat.

Permanent Stabilization – Design

The proposed action will permanently stabilize the roadway embankment and provide instream roughness and habitat complexity at a location where right-bank erosion has frequently required road closures, placement of bank armor under emergency conditions, and other related maintenance activities. The project area is part of a continuous, smooth riprap revetment extending more than 2,000 ft upstream of a right-bank, forested floodplain wetland that lies between SR 20 and the Skagit River's active channel (The Nature Conservancy's Kahn Preserve) (Figure 2). Portions of the existing revetment date from the 1980s or earlier, but maintenance repairs have occurred frequently during the 1990s and 2000s.

The WSDOT has described the site- and reach-scale causes for bank failure at this location (WSDOT 2011, pp. 5, 6):

- (Site-Scale) Lack of channel bed and bank roughness, leading to hydraulic erosion of the embankment toe;
- Lateral bar formation, resulting in entrainment of the thalweg against the existing revetment and increased constriction scour;
- Localized scour resulting from back-eddy formation under flood flows; and,
- (Reach-Scale) Lateral and downstream migration of the active channel meander bend, and locally heavy sediment deposition.

Figure 2. Aerial photo of project reach.

The WSDOT has evaluated a variety of design alternatives for permanent stabilization of the site. These included augmented riprap bank armor protection, large wood and rock groins, and relocation of a portion of the highway further landward within the 100-year floodplain. Unavoidable impacts to cultural/historical, tribal, and private property interests make relocation of the highway infeasible. The FHWA and WSDOT have selected the preferred alternative as the design option with the best long term prospects for success, and the fewest, or least severe, environmental impacts. The FHWA and WSDOT expect that the preferred option will be found acceptable under the U.S. Forest Service's Wild and Scenic River Requirements. The FHWA and WSDOT expect that the preferred option will avoid significant construction impacts associated with some of the other design alternatives, including impact pile driving below the OHWM and extensive work area isolation, dewatering, and fish capture operations (WSDOT 2011, pp. 9, 22).

The preferred alternative consists of a series of four bank-anchored ELJs, contiguous with large wood and dolotimber revetments, and a single mid-channel island ELJ, constructed along approximately 1,300 linear ft of SR 20 and the Skagit River's right-bank (Figures 3 and 4). The proposed ELJs and revetments will incorporate approximately 1,700 eight-ton, pre-cast concrete dolotimbers (6,200 cy), stacked and complexed with a similar volume of large wood (Table 2).

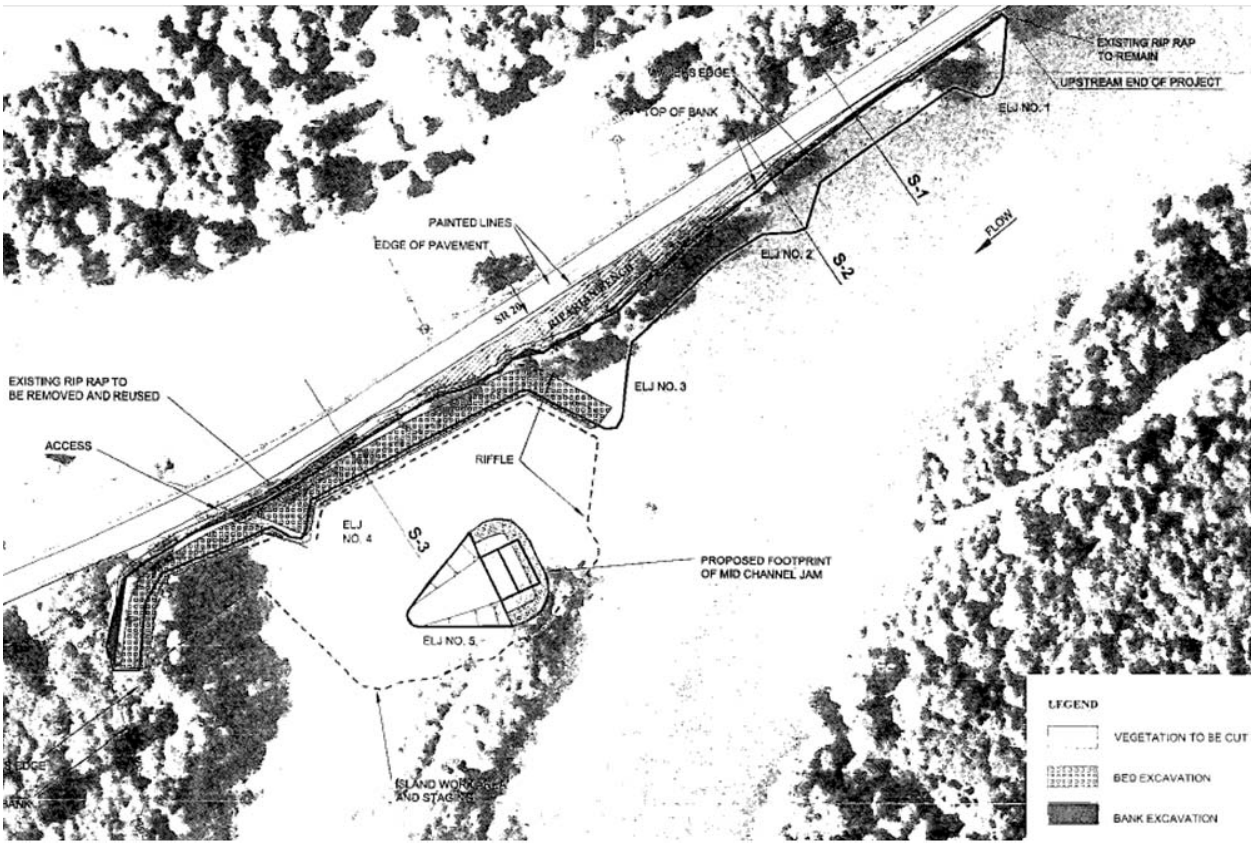


Figure 3. ELJs and revetment in plan view.

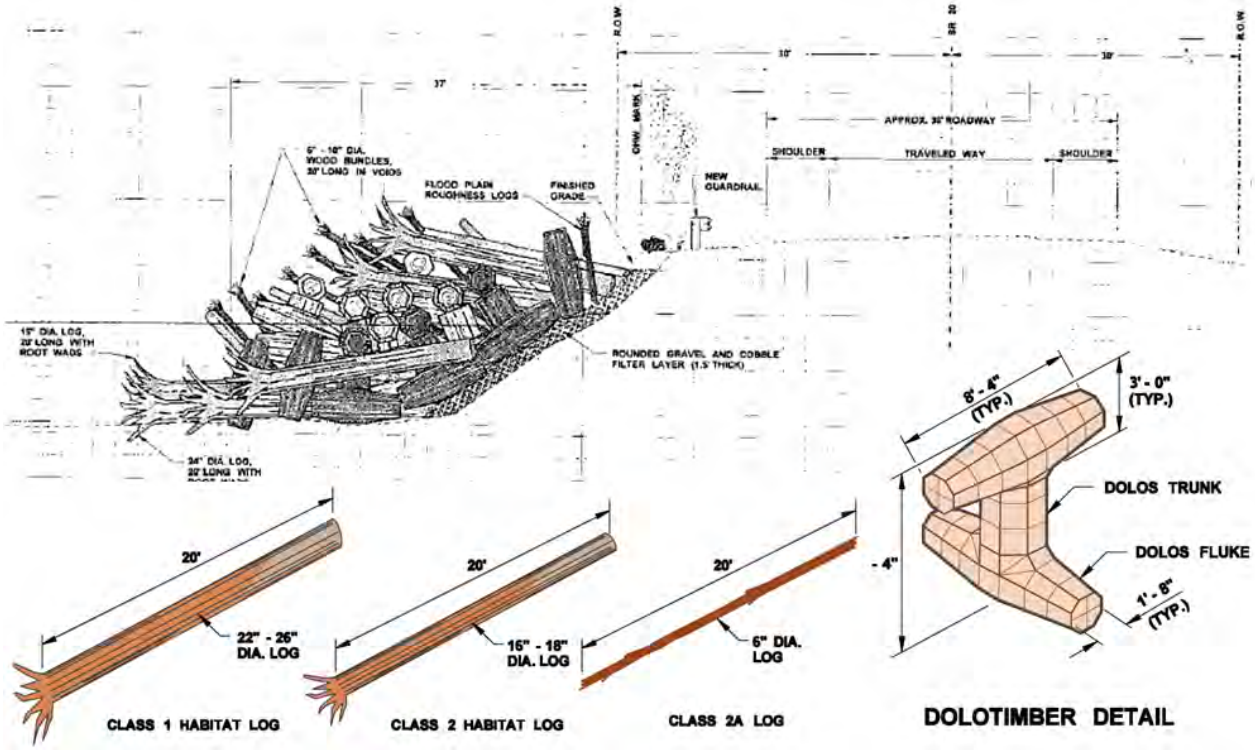


Figure 4. Typical ELJ, embankment, and roadway cross-section; dolotimber and log detail.

Table 2. ELJ and revetment quantities (Acosta, pers. comm. 2011b).

Location	Structural Element	Material	Volume (cy)
Below OHWM	Revetments and ELJs	Dolotimbers	4,300
		Large Wood	6,200
		Rounded Cobble	1,500
		Sub-Total	*12,000*
	Mid-Channel ELJ	Dolotimbers	390
		Large Wood	410
		Streambed Gravel	1,400
		Sub-Total	*2,200*
	Below OHWM Sub-Total		**14,200**
Above OHWM	Revetments and ELJs	Dolotimbers	1,400
		Large Wood	2,000
		Rounded Cobble	500
		Sub-Total 1	*3,900*
	Mid-Channel ELJ	Dolotimbers	120
		Large Wood	130
		Streambed Gravel	400
		Sub-Total 2	*650*
	Above OHWM Sub-Total		**4,550**
		Project Total	**18,750**

What we refer to here as "dolotimbers" are dolosse (or dolos) fabricated with a surface texture and coloration designed to mimic natural, large wood. Dolosse are more commonly used in coastal settings, but the FHWA and WSDOT expect that they will provide a number of important benefits at this high-energy location along the middle Skagit River (WSDOT 2011, pp. 8-10).

Each dolotimber is massive and has a complex, interlocking shape that resists rolling. Dolotimbers can be complexed with, and will act as the ballast for attached large wood (typical stem length 20 ft; 6-26 inches diameter). Dolotimber and large wood "bundles" can be deployed with little or no excavation below the OHWM. Dolotimber and large wood bundles can be stacked vertically, and interlocked linearly, to form continuous bank protection that resists erosion and maintains structural integrity even with some amount of settling and deformation. The FHWA and WSDOT expect that ELJs and revetments composed of dolotimbers, large wood, and fill (gravel or cobble) will provide channel bed and bank roughness, redirect flows and energies away from the roadway embankment, and create complex channel margin habitat and refugia across a range of surface water elevations (Acosta, pers. comm. 2011; WSDOT 2011, pp. 24, 44-48, 60-62, 65-66).

Permanent Stabilization – Construction

The proposed project will require approximately 1,700 eight-ton, pre-cast concrete dolotimbers. The FHWA and WSDOT expect that the project will contract with an established, off-site, concrete structural manufacturing supplier located in Bellingham, or elsewhere within acceptable hauling distance (WSDOT 2011, pp. 14, 24).

Construction of the ELJs and large wood and dolotimber revetments will require approximately 16 weeks of in-water work. In order to take advantage of low stream flows and light, off-season, traffic conditions, the FHWA and WSDOT propose to begin construction during mid-winter (January 2013) (WSDOT 2011, pp. 11-14). The first phase of construction will include mobilization, site preparation and staging, establishment of a temporary traffic bypass, and as much in-water work as weather and flow conditions permit. From May through July, coinciding with high spring and summer flows, the project will complete little or no in-water work. A second phase of in-water work will be completed during the established in-water work window for this portion of the Skagit River (August 1 to September 1) and is likely to include construction of the mid-channel island ELJ (WSDOT 2011, pp. 11-14). Removal of the temporary traffic bypass, replanting of cleared areas, and other upland activities associated with final cleanup will extend into fall and early winter, with completion of the project expected during December 2013.

On-site staging and temporary traffic control will utilize existing, suitable locations, including portions of the Sutter Creek Roadside Park and fields and fallow pasture surrounding Cascadia Farm (WSDOT 2011, pp. 15-17). Figure 5 depicts the current, preliminary plans for traffic control.

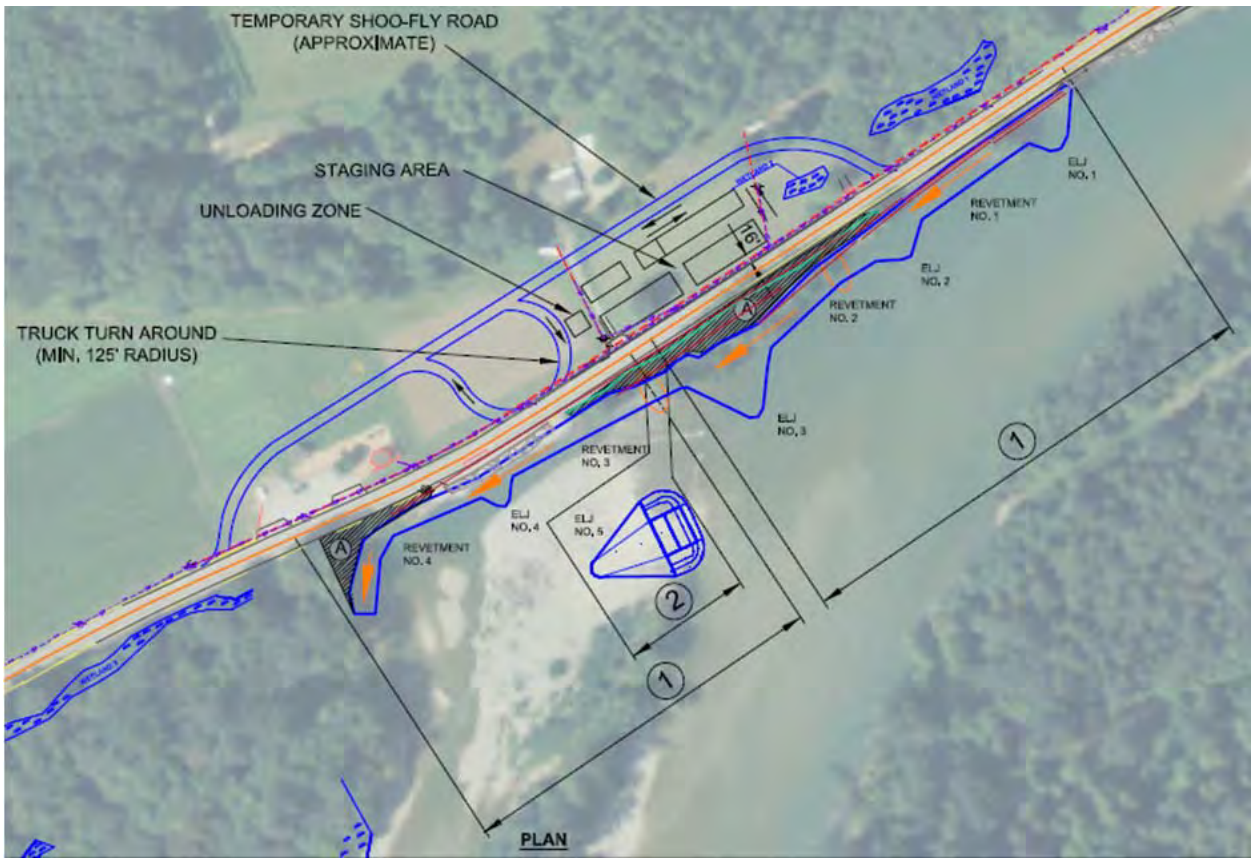


Figure 5. Traffic control detail.

The project will clear approximately 40,000 square ft (0.9 acre) of woody and herbaceous

vegetation, including approximately 130 deciduous trees (10 to 42 inches diameter-at-breast-height). Clearing for the purpose of temporary access will be from two areas, the upstream corner of The Nature Conservancy's (TNC) Kahn Preserve, and a narrow riparian bench between SR 20 and the approximate location of ELJ #3 (Acosta, pers. comm. 2011 and June 23, 2011, Replanting Plan Details; WSDOT 2011, pp. 17, 21, 24, 42, 54, Appendix B – Plan Sheet).

The project will excavate and remove existing riprap from the construction footprint, extending from the waterline at the time of construction to the top of the embankment and approximately 8 ft landward. Much of this material will be hauled off-site for proper disposal or suitable reuse (WSDOT 2011, pp. 19, 23).

Gaining access to the waterward apex of the constructed ELJs may require temporary fills, timber platforms, or use of a barge. The project will use these same means to gain access to the mid-channel island. Dolotimber and large wood bundles will be assembled on land and deployed to their final positions with the use of a crane, front loader, and/or log loader. The chosen contractor may elect to use a helicopter for some placements, including the mid-channel island ELJ. The project will span, or otherwise seek to minimize impacts to shallow-water spawning habitats and refugia. The project will use the best, most recent spawner survey information to adaptively manage plans for access during construction (WSDOT 2011, pp. 17-23).

Excavation and placement of materials for the mid-channel island ELJ will require a temporary water crossing and operation of heavy equipment on the exposed channel bed. In conjunction with work performed on the exposed channel bed, the project may temporarily divert stream flow with the use of gravel-filled bags, a constructed bypass flume, or culvert. Flow diversion, and other appropriately selected in-water construction best management practices (BMPs), will minimize turbidity, prevent sedimentation or dewatering of adjacent shallow-water spawning habitats and refugia, and avoid entrainment or stranding of fish (WSDOT 2011, pp. 17-23). The FHWA and WSDOT do not expect that it will be necessary to capture and handle fish. However, in the event that fish become stranded, or if construction results in temporary conditions (i.e., turbidity) with a potential for fish injury or mortality, the FHWA and WSDOT will implement the WSDOT's *Fish Exclusion Protocols and Standards* (included as Appendix A) (WSDOT 2011, p. 54).

The project will restore areas cleared for temporary access and staging. Wherever feasible given site and safety constraints, the project will reestablish native, woody vegetation along the reconstructed embankment (Acosta, pers. comm. 2011; WSDOT 2011, p. 21). The WSDOT's preliminary plans for landscape replanting and permanent stabilization include standard roadside seed mix for field and pasture, a mix of native woody shrubs for locations closest to the roadway, a mix of woody shrubs and native deciduous and coniferous trees for locations further removed from the roadway, and a design for "pocket plantings" placed on top of the constructed ELJs (June 23, 2011, Replanting Plan Details).

Conservation Measures

The proposed project will implement conservation measures, including but not limited to the following, to avoid and minimize impacts resulting from construction:

- The project will use suitable, engineer-approved locations for on-site staging of equipment and materials during construction.

- All helicopter flights in support of the project will be conducted between two hours after sunrise and two hours before sunset (local). Helicopter flights between the on-site staging locations and project area will follow a flight path along the Skagit River channel/valley bottom. The project will avoid excursions over adjacent forested stands.

- The FHWA and WSDOT will gather current spawner information from Seattle City Light and tribal representatives prior to construction. If current information is not available or is incomplete, WSDOT and/or tribal biologists will conduct weekly spawner surveys prior to and during construction (February through August). The project will document salmon redd locations from 100 ft upstream, to 500 ft downstream, of the proposed work.

- The project will use the best, most recent spawner survey information to adaptively manage plans for access during construction so as to avoid direct disturbance to redds, eggs, or alevins to the fullest extent practicable.

- Temporary fills, timber platforms, or other structures placed within the channel (e.g., a barge) shall prevent sedimentation or dewatering of adjacent redds, and avoid entrainment or stranding of fish. Except for the purposes of gaining access to and constructing the mid-channel island ELJ, heavy equipment shall operate from positions above and/or landward of the wetted channel.

- A qualified biologist shall be present on-site when placing or using the temporary water crossing, diverting stream flow, or operating heavy equipment on the exposed channel bed. In the event that fish become stranded or are seen in distress, the biologist shall use a seine or net to safely capture and promptly release the fish to flowing waters.

- The project will remove riprap bank armor placed during previous emergency actions, extending from the waterline at the time of construction to the top of the embankment and approximately 8 ft landward.

- Gravel and cobble imported for use as fill within the constructed ELJs and revetments shall be clean and free of excess fines.

- The project will use coniferous large wood, with typical stem lengths of 20 ft and ranging in stem diameter from 6 to 26 inches. Smaller pieces of large wood may be placed as racking material. The project will stagger protruding rootwads along the face of the ELJs and revetments, and across a vertical range of surface water elevations.

- The project will obtain large wood from an approved, properly permitted source.

- The project will use biodegradable fixtures when fixing large wood to the dolotimbers (e.g., manila rope), and/or will remove any non-biodegradable fixtures (steel cables or chains).

- The project will monitor turbidity resulting from construction activities in accordance with the Clean Water Act section 401 Water Quality Certification issued for the project by the Washington State Department of Ecology. The project will monitor for exceedances of the State of Washington aquatic life turbidity criteria, five nephelometric turbidity units (NTUs) over background when less than 50 NTU (10 percent increase over background when more than 50 NTU). Trained staff will collect background (upstream) and downstream measures of turbidity during the course of in-water work and shall have the authority to take all measures necessary, including temporary cessation of work, to ensure compliance with criteria at the downstream extent of the allowed mixing zone.

- The project will implement an engineer-approved Spill Prevention, Control, and Countermeasures (SPCC) plan. A current copy of the SPCC plan will be maintained onsite for the duration of the project and no work or staging in advance of work will commence prior to implementing the plan. The approved SPCC plan will provide site- and project-specific details identifying potential sources of pollutants, exposure pathways, spill response protocols, protocols for routine inspection fueling and maintenance of equipment, preventative and protective equipment and materials, and emergency notification and reporting protocols.

- Any pumps used to temporarily bypass water or to dewater residual pools will be screened at the intake. Fish screens or guards will comply with Washington State law (RCW 77.57.010 and 77.57.070), with guidelines prescribed by the NMFS (NMFS 1997), and any more stringent requirements contained in permits issued for the project by the WDFW. Pumps will not be operated without a screened intake unless the project has confirmed that there is no risk of entraining fish, and there are adequate plans in place to address contingencies (including a routine schedule for inspection).

- All equipment operating below the OHWM will use vegetable-based hydraulic fluid, and no oils, fuels, cleaning agents or solvents, concrete or equipment wash water, slurry, waste, or construction debris will be discharged to surface waters or onto land with a potential to reenter surface waters.

- The project will identify and document any obvious signs of channel instability resulting from the work, any additional actions taken to correct channel instability, and the final condition of the work area.

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' range-wide 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 impacts 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, non-Federal 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 places an emphasis on consideration of the range-wide survival and recovery needs of the species and the role of the action area in the survival and recovery of the species as the context for evaluating 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 impacts 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, non-Federal 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 critical habitat are evaluated in the context of the range-wide condition of the critical

habitat, taking into account any cumulative effects, to determine if the critical habitat range-wide 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 range-wide recovery function of 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 Federal action, taken together with cumulative effects, for purposes of making the adverse modification determination.

STATUS OF THE SPECIES (BULL TROUT)

The rangewide status of the bull trout is provided in Appendix B.

STATUS OF CRITICAL HABITAT (BULL TROUT)

The rangewide status of bull trout critical habitat is provided in Appendix C.

ENVIRONMENTAL BASELINE

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.

Description of the Action Area

The action area is defined as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). As such, the action area includes the extent of the physical, biotic, and chemical effects of the action on the environment.

The terrestrial boundaries of the action area were defined based on the extent of temporary sound and visual disturbance that will result during construction. Temporary increases in sound associated with helicopter operations would have the farthest reaching effects in the terrestrial environment. Our assessment of in-air sound generation and attenuation finds that increased sound levels are likely to exceed ambient in-air sound levels to a distance of approximately 1.8 miles (Figure 6).

The aquatic boundaries of the action area were defined with consideration for the following:

- Where, and how far, are suspended sediments expected to extend upstream and downstream of work activities during construction?

- Where, and how far, are bedload movements, large wood transport and accumulation, and channel formation processes likely to be influenced (directly or indirectly) by construction of the project?

We expect that sediment resulting from in-water work will have the farthest reaching effects in the aquatic environment during the period of construction. We also expect the project will have indirect effects associated with channel response to the constructed ELJs and revetments. The proposed project is expected to influence bedload movements, large wood transport and accumulation, and channel formation on a localized scale.

The data needed to determine the actual distance that suspended sediments will travel downstream were not provided, nor are they readily available. To predict the extent of downstream effects, we made the following assumptions:

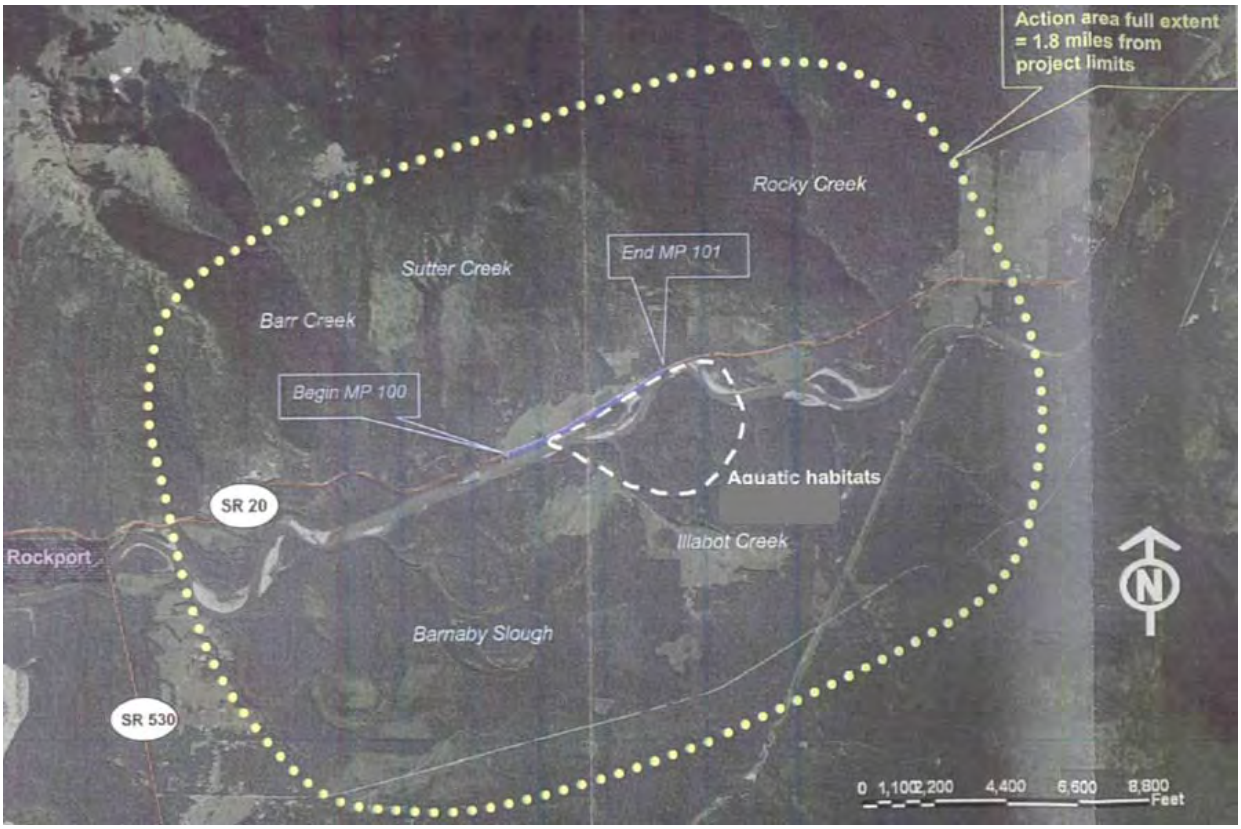


Figure 6. Action area.

- Concentrations of suspended sediment resulting from construction activities will be diluted by flow in the Skagit River.

- As suspended sediments and bedload move downstream, heavier components will fall out of suspension sooner, while lighter components (e.g., silt and clay particles) will be carried farther downstream.

- Sediments and bedload will fall out of suspension sooner in a slow moving, low gradient, reach, and later in a high gradient, fast moving, reach.

- Morphological features such as meanders and bends generally slow flows. The inside bends of such features are characteristically depositional, while the outside of the bends are erosive.

Based upon the nature of the proposed work, the size, volume, and morphology of the Skagit River within the action area, and the conditions likely to prevail during construction of the project, we expect that turbidity and sedimentation resulting from construction activities will travel as far as 600 ft downstream before concentrations are diminished by dilution and deposition to levels that are difficult to distinguish from background/ambient concentrations. However, bedload movements, large wood transport and accumulation, and channel formation processes are likely to be influenced on a larger scale.

The FHWA and WSDOT have modeled channel response to post-project conditions under projected 10-year and 100-year flood flows (WSDOT 2011, pp. 24-27, 45-49, 61, 62). This hydraulic modeling predicts modest changes to backwater elevations, velocities, and bed shear stress throughout an approximately 250 acre portion of the Skagit River's channel and floodplain. This area includes much or all of the TNC's Kahn Preserve, the low floodplain forest and remnant meanders or oxbows on a left-bank property managed by the WDFW, and the mouth of Illabot Creek (Figure 7). A later section discusses in greater detail the anticipated direct and indirect effects to large wood and bedload transport, channel formation processes, and instream habitat quantity and quality.

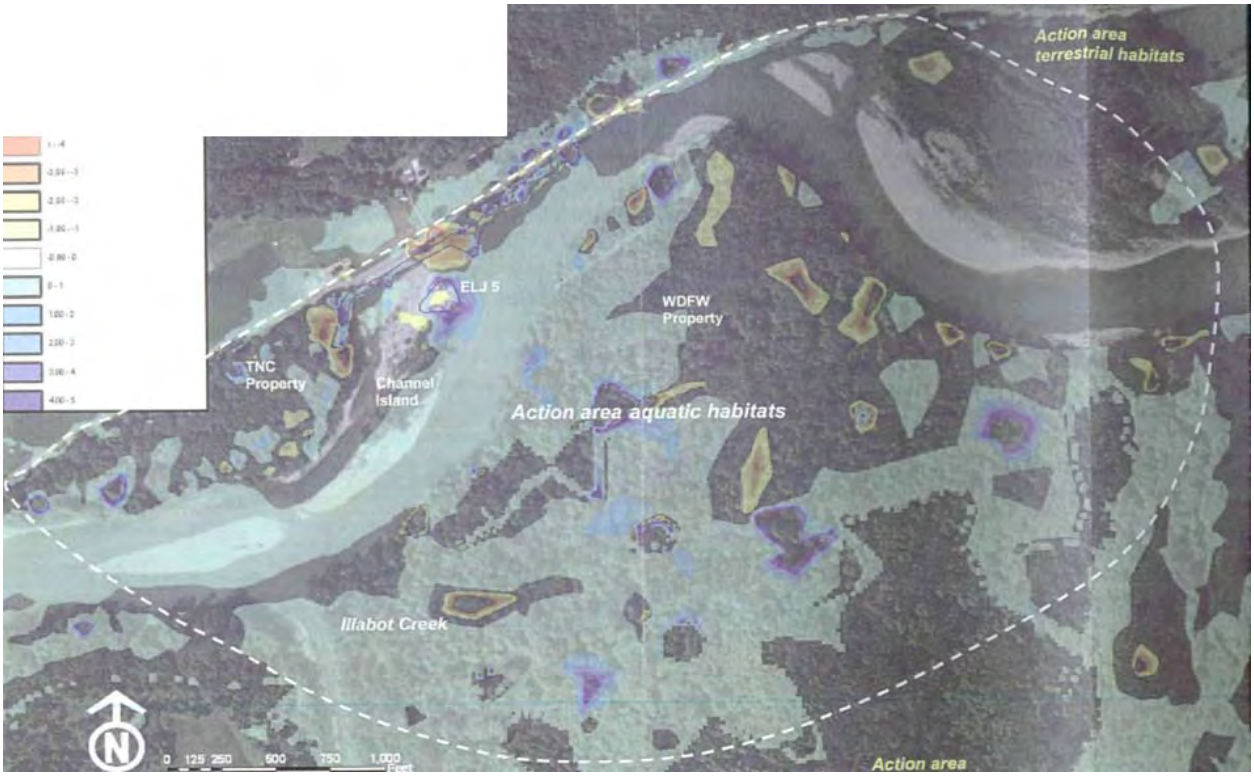


Figure 7. Graphic model output depicting post-project 10-year bed shear stress differentials.

The aquatic boundaries of the action area include the active channel migration zone, side-channels, and floodplain of the Skagit River, including the mouth of Illabot Creek located approximately 0.25 mile downstream. In total, the aquatic boundaries of the action area extend over approximately 1.4 linear miles of channel and floodplain.

Environmental Baseline in the Action Area

The project is located along SR 20 (milepost vicinity 100) approximately 4.5 miles upstream of the Sauk and Skagit River confluence. Land use throughout the action area consists of mixed-use Federal and State forestland, private commercial timberland, agriculture, and small rural

residential development. The terrestrial component of the action area includes floodplains converted for agricultural purposes and a mosaic of second-and third-growth forests.

The Skagit River is the largest of the Puget Sound tributaries and supports some of its healthiest and most robust salmonid populations (WSCC (Washington State Conservation Commission) 2003, p. 3). Habitat conditions and limiting factors for natural salmonid production are variable throughout the basin. Along much of the lower mainstem river, including tidally influenced estuaries, baseline conditions reflect a history of diking and leveeing for flood control, navigational, and agricultural purposes. Residential, commercial, and industrial land uses are also focused throughout lower portions of the watershed, resulting in conditions that further limit and degrade habitat functions. Upstream of the Sauk and Skagit River confluence, most of the watershed lies within the boundaries of the Mt. Baker – Snoqualmie National Forest, North Cascades National Park, a national recreation area, or designated wilderness areas. Here habitat conditions are regarded as good to excellent. Three dams and a large impounded lake (Ross Lake) managed for hydroelectric and flood storage functions are prominent features in the upper watershed. These facilities have pronounced effects on seasonal discharge volumes and sediment and large wood transport dynamics (WSCC (Washington State Conservation Commission) 2003, pp. 4-6).

Between Newhalem and Marblemount, the Skagit River flows through a narrow, confined valley.
Downstream of Marblemount, the middle mainstem Skagit River flows through a wider valley as a relatively unconfined, low gradient, meandering channel. Major tributaries to these portions of the river include the Cascade River and Goodell, Bacon, Diobsud, and Illabot Creeks, each of which may be characterized as steeper and more confined than the mainstem (WSCC (Washington State Conservation Commission) 2003, pp. 44, 45). Illabot Creek, the named tributary in closest proximity to the proposed action, provides approximately 9.8 linear miles of mainstem anadromous habitat for coho and steelhead salmon (*Oncorhynchus kisutch*, *O. mykiss*), cutthroat trout (*O. clarkii*), and native char; its lower reaches provide habitat for Chinook and pink salmon (*O. tshawytscha*, *O. gorbuscha*) (WSCC (Washington State Conservation Commission) 2003, pp. 44, 45).

Along the middle mainstem Skagit River, floodplain road densities are high (2.9 miles/square mile) and there are frequent and extensive hydromodifications in the form of dikes and other bank hardening (WSCC (Washington State Conservation Commission) 2003, pp. 75, 76). Conditions are comparatively better than along the lower river, but these hydromodifications do reduce the amount of available side- and off-channel habitat and refugia. Floodplain conditions are rated here as “fair” (WSCC (Washington State Conservation Commission) 2003, pp. 75, 76).

Long stretches of State Routes 20 and 530 lie in close proximity to the active channel (Skagit and Sauk Rivers, respectively). Along these and other county, local, and forest roads there are many locations where transportation infrastructure impinges upon channel migration zones. This infrastructure degrades floodplain, riparian, and instream habitat functions, and maintaining these roadways requires frequent flood response actions.

Baseline instream habitat and watershed conditions may be assessed with the *Matrix of Diagnostics / Pathways and Indicators* (USFWS 1998). The matrix provides a framework for considering the effects of individual or grouped actions on habitat elements and processes important to the complete life cycle of bull trout. The FHWA's BA applies the matrix to describe baseline environmental conditions at the scale of the action area (WSDOT 2011, pp. 38-51). Those descriptions are incorporated here by reference, and what follows is only a very brief summary: within the action area, the Skagit River is rated as *properly functioning* for nine indicators, including temperature, sediment, chemical contaminants/ nutrients, substrate, pool frequency and quality, off-channel habitat, refugia, width-depth ratio, and riparian reserves; within the action area, the Skagit River is rated as *functioning at risk* for all remaining indicators, including physical barriers, large woody debris, stream bank condition, floodplain connectivity, peak/base flows, drainage network, road density and location, and disturbance regime.

Status of the Species in the Action Area (Bull Trout)

The action area contains foraging, migration, and overwintering (FMO) habitat for fluvial and anadromous bull trout of the Lower Skagit River core area, and lies in close proximity to productive bull trout spawning and rearing habitats. A complete description of the Lower Skagit River core area is included as an appendix to this Opinion (Appendix D).

In total, the aquatic boundaries of the action area extend over approximately 1.4 linear miles of the mainstem Skagit River's active channel migration zone, side-channels, and floodplain, including the mouth of Illabot Creek located approximately 0.25 mile downstream (Figure 7, p. 20). The action area provides core FMO habitat and, based on its location, is presumed to support adult and subadult bull trout originating from 7 of the core area's 21 documented, local bull trout populations (Illabot Creek, Cascade River and South Fork Cascade River, Bacon Creek, Goodell Creek, Newhalem Creek, and Stetattle Creek) (USFWS 2004). The nearest known bull trout spawning and early rearing habitats are located in Illabot Creek. Adult and subadult bull trout may occur within the action area at any time of year and, based on proximity to suitable spawning and rearing habitats, there is some potential for rearing juvenile bull trout to occur in the action area.

Researchers from the University of Washington have provided an estimate for the approximate number of adult bull trout that reside in the 26-mile section of the mainstem Skagit River between the Sauk River and the town of Newhalem. Most of these adults are fluvial fish and are presumed to spawn in the above-mentioned tributaries. Snorkel strip-count surveys indicate that between 1,600 and 5,000 adult bull trout reside in these portions of the mainstem Skagit River (Lowery, UW, pers. comm. 2008 in USFWS 2008, pp. 1638, 1643). Genetic analyses completed in conjunction with these surveys found that bull trout were genetically diverse, with statistically significant differences in genetics observed on a longitudinal basis along this section of the river (Smith, UW, unpublished data 2008 in USFWS 2008, pp. 1638, 1643). This finding, in conjunction with migration data from acoustic tag studies, suggests that the local bull trout populations situated along the mainstem Skagit are genetically distinct even though adult fish freely migrate among these areas (E. Connor, Seattle City Light, unpublished data 2008 in USFWS 2008, pp. 1638, 1643).

The Lower Skagit River core area supports anadromous, fluvial, adfluvial, and resident life history forms. The core area is believed to support the Puget Sound Management Unit's largest and most robust bull trout populations (USFWS 2004). Long term viability of the Lower Skagit River bull trout population is critically important to maintaining the overall distribution of migratory life history forms throughout the management unit.

The Lower Skagit River core area is believed to support a spawning population of migratory bull trout that numbers in the thousands. Illabot Creek, the Cascade River and South Fork Cascade River, Bacon Creek, Goodell Creek, and Newhalem Creek are all believed to support stable, or increasing, resident and migratory bull trout populations (USFWS 2004). Connectivity among most of the local populations and foraging areas is good to excellent. Large pools along the mainstem Skagit River are important foraging and overwintering habitat for the core area's fluvial bull trout populations. Most local bull trout populations contain a significant anadromous component.

Status of Critical Habitat in the Action Area (Bull Trout)

The Service's recent final rulemaking revises the previous (2005) bull trout critical habitat designation (50 FR 63898 [October 18, 2010]). This final rule took effect on November 17, 2010. The action area includes freshwater environments providing eight of the nine Primary Constituent Elements (PCEs) of designated bull trout critical habitat.

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

The Skagit River's hydrological and temperature regimes are strongly influenced by seasonal glacial melt, snow-on-snow, and rain-on-snow precipitation events. Presumably, within the action area, springs, seeps, groundwater sources, and subsurface water connectivity (hyporheic flows) all contribute to water quality and quantity, and provide thermal refugia. These portions of the Skagit River currently meet the State of Washington's surface water quality criteria for temperature (WDOE 2008). Water temperature is not a limiting factor within the action area.

(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.*

There are no significant barriers or impediments to migration within the action area. Connectivity among most of the Lower Skagit River local populations and foraging areas is good to excellent (USFWS 2004).

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

These portions of the Skagit River provide an abundant food base for adult, subadult, and juvenile bull trout. The Skagit River supports populations of Chinook, steelhead, pink, and coho salmon, cutthroat trout, and other native fishes, which together provide a sizable prey base for

adult bull trout. There are no indications that either terrestrial organisms or aquatic macroinvertebrates are lacking. The food base is not a limiting factor within the action area.

(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 action area extends over approximately 1.4 linear miles of the mainstem Skagit River's active channel migration zone, side-channels, and floodplain, including the mouth of Illabot Creek located approximately 0.25 mile downstream (Figure 7, p. 20). While past and present land use practices, including bank hardening and the systematic removal of large woody material, have caused simplification or loss of habitat features within the action area, the action area does still provide a diversity of habitat types. Some portions of the action area exhibit an excess of aggraded bedload, and reduced pool frequency and quality. All portions of the action area lack sufficient large woody material and channel roughness (i.e., diversity of instream structure and velocities).

(5) *Water temperatures ranging from 2 to 15 °C (36 to 59 °F), with adequate thermal refugia available for temperatures at the upper end of this range. Specific temperatures within this range will 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.*

The Skagit River's hydrological and temperature regimes are strongly influenced by seasonal glacial melt, snow-on-snow, and rain-on-snow precipitation events. These portions of the Skagit River currently meet the State of Washington's surface water quality criteria for temperature (WDOE 2008). Water temperature is not a limiting factor within the action area.

(6) *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. A minimal amount (e.g., less than 12 percent) of fine substrate less than 0.85 mm (0.03 in.) in diameter and minimal embeddedness of these fines in larger substrates are characteristic of these conditions.*

The action area does not provide suitable bull trout spawning habitat. The nearest documented bull trout spawning and early rearing habitats are located in Illabot Creek, outside of the action area and at higher elevations. Within the action area, the Skagit River transports large quantities of coarse and fine sediment, and is prone to frequent scouring flows and channel bed and bank instability. Channel instability may limit salmonid spawning success and productivity within the action area, although annual redd surveys consistently document successful Chinook and steelhead salmon spawning within the action area.

(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.*

The Skagit River's hydrological regime is strongly influenced by seasonal glacial melt, snow-on-snow, and rain-on-snow precipitation events. The Skagit River is also a managed system; three dams and a large impounded lake (Ross Lake) provide hydroelectric and flood storage functions and are prominent features in the upper watershed. Within the action area, peak, high, low, and base flows are all regulated, and do depart significantly, on a seasonal basis, from the natural hydrograph. Channel confinement, bank armoring, and lack of channel/floodplain roughness all contribute to heightened velocities and shear forces within the action area.

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

Water quality and quantity conditions are properly functioning. These portions of the Skagit River currently meet the State of Washington's surface water quality criteria for temperature (WDOE 2008). There are no apparent sources of chemical contamination or excess nutrient loading. The Skagit River does transport large quantities of coarse and fine sediment, resulting in high baseline turbidities. Within the action area, water quality and quantity conditions do not limit normal bull trout reproduction, growth, and survival.

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

The lower Skagit River supports relatively few nonnative species of concern for bull trout. Inbreeding species (e.g., brook trout) are known to occur in the upper Skagit River basin (especially Ross Lake and its tributaries), but are not known to occur in action area (Chan, pers. comm. 2011). Nonnative predatory or competitive species do not limit normal bull trout reproduction, growth, and survival within the action area, or within the lower Skagit River sub-basin as a whole.

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 "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" (50 CFR 402.02).

On three separate occasions, during November 2004, November 2006, and July 2007, the WSDOT replaced failed bank armor along the Skagit River's right-bank. These actions, which included placement of approximately 700 cubic yards (cy) of riprap below the OHWM and direct impacts to 300 linear ft of streambank in total, were taken under declared emergency conditions. Subsequent to the actions, the Corps identified adverse, direct and indirect effects resulting from the actions (WSDOT 2009), and requested formal consultation.

The FHWA and WSDOT now propose a series of bank-anchored ELJs and large wood and dolotimber revetments at this same location, designed to permanently stabilize the roadway

embankment and provide instream roughness and habitat complexity. The preferred alternative would be constructed along approximately 1,300 linear ft of SR 20 and the Skagit River's right-bank (Figures 3 and 4, p. 10). The proposed project will remove riprap bank armor placed during previous emergency actions, extending from the waterline at the time of construction to the top of the embankment and approximately 8 ft landward. The proposed ELJs and revetments will provide channel bed and bank roughness, redirect flows and energies away from the roadway embankment, and create complex channel margin habitat and refugia across a range of surface water elevations.

The actions taken under the declared emergencies of 2004, 2006, and 2007, resulted in direct impacts to habitats that support bull trout and their prey. These actions resulted in adverse, direct and indirect effects to the bull trout and designated bull trout critical habitat. A sub-section that follows discusses those effects. Our analysis of the emergency actions is focused on the measurable direct effects to instream habitat conditions and functions, and indirect effects to the channel bed and banks in close proximity, including subsequent bank instability and loss of functioning riparian vegetation. Some of the adverse effects have persisted for years, and will continue to persist until the proposed ELJs and revetments are constructed.

We expect that permanent stabilization of the site will result in both direct and indirect effects to the bull trout and designated bull trout critical habitat. Some of these effects will be temporary, construction-related and limited in both physical extent and duration. Others will be long term, lasting for the functional life of the constructed ELJs and revetments. Our analysis specifically addresses the following potential adverse exposures and effects, as well as any effects associated with interrelated and interdependent actions:

- Stress and/or injury resulting from fish capture and handling operations.

- Exposure to construction activities and resulting direct effects. Construction activities will directly affect instream habitat that supports bull trout. Adult, subadult, and juvenile bull trout will be temporarily exposed to elevated levels of turbidity and sedimentation. The effects of construction, including those resulting from flow diversion, will create a temporary barrier to free movement and migration.

- Permanent and temporary effects to instream habitat structure, function, and diversity. The proposed project will reinforce an existing artificial constraint on the channel migration zone and floodplain, but would also improve instream habitat function over the long term compared to the existing smooth riprap revetment. Temporary effects to instream habitat resulting from channel response, during the months immediately following construction, will include significant bedload movements and resulting turbidity and sedimentation.

Construction activities have the potential to injure or kill a limited number of adult, subadult, and juvenile bull trout. Temporary exposures and effects to instream habitat may also significantly disrupt normal bull trout behaviors (i.e., ability to successfully feed, move, and/or shelter). These exposures and effects may temporarily cause bull trout to avoid the action area, may impede or discourage free movement through the action area, prevent individuals from

exploiting preferred habitats, and/or expose individuals to less favorable conditions. Suitable bull trout spawning habitats are not present in the action area, and therefore the proposed action will have no effect on bull trout spawning habitat or essential spawning behaviors.

Insignificant and Discountable Effects

The proposed action includes some items of work, including off-site activities, which we expect will have no measurable effect on the bull trout or designated bull trout critical habitat. These include:

- Off-site fabrication (forming and pouring) of concrete dolotimbers;
- On-site staging and temporary traffic control.

Some of the proposed action's potential effects to the bull trout and designated bull trout critical habitat will be insignificant or discountable. With implementation of the proposed conservation measures and permanent design elements, we have concluded that the following potential effects are extremely unlikely to occur (discountable) or will not measurable or detectable (insignificant):

- Direct effects (i.e., disturbance) to bull trout spawning behaviors and redds/eggs/alevins;
- Exposure to chemical contamination during construction;
- Effects to prey resources and the bull trout prey base;
- Long term effects to riparian function and large wood recruitment.

The proposed project will require approximately 1,700 eight-ton, pre-cast concrete dolotimbers. The project will contract with an established, off-site, concrete manufacturing supplier located in Bellingham, or elsewhere within acceptable hauling distance. Activities at established concrete manufacturing facilities will be consistent with the current, established uses of those facilities. No concrete or equipment wash water, slurry, waste, or construction debris will be discharged to surface waters or onto land with a potential to reenter surface waters. We conclude that this item of work will have no temporary or permanent effects to the aquatic environment, and no measurable effects on bull trout individuals, their habitat, or prey base. Effects to the bull trout and designated bull trout critical habitat resulting from fabrication of dolotimbers will not be measurable, and are therefore considered insignificant.

On-site staging and temporary traffic control will utilize existing, suitable locations, including portions of the Sutter Creek Roadside Park and fields and fallow pasture surrounding Cascadia Farm. Figure 5 (p. 12) depicts the current, preliminary plans for traffic control. These on-site activities will require clearing, placement of temporary fill, and road surfacing materials, but will result in little or no temporary impact to floodplain wetlands or functioning riparian vegetation. We expect that these activities will result in little or no site stormwater runoff or erosion, and roadside restoration will stabilize all areas cleared for temporary access and staging at the completion of construction activities. The proposed action will not create, or result in a net increase of impervious surface within the project area. With implementation of the proposed conservation measures, we conclude that these activities will have no temporary or permanent effects to the aquatic environment, and no measurable effects on bull trout individuals, their habitat, or prey base. Effects to the bull trout and designated bull trout critical habitat resulting from on-site staging and temporary traffic control will not be measurable, and are therefore considered insignificant.

Construction of the proposed project will result in direct impacts to approximately two acres below the OHWM of the Skagit River (Acosta, pers. comm. 2011). Turbidity and sedimentation resulting from construction activities will travel as far as 600 ft downstream, and temporary effects to instream habitat may extend as far as 0.25 mile downstream. Despite the large area affected by construction activities, direct effects to bull trout spawning and redds/eggs/alevins are considered extremely unlikely and therefore discountable. The nearest known bull trout spawning habitat is located in Illabot Creek, outside of the action area and at higher elevations. Therefore, bull trout spawning habitats will not be affected, either directly or indirectly. Furthermore, construction activities will be focused along high energy portions of the reach, which do not provide suitable spawning substrates or conditions. The aquatic component of the action area encompasses spawning habitats used annually by Chinook and steelhead salmon, but local, expert knowledge of the area indicates no history of bull trout spawning (WSDOT 2011, p. 35).

Construction will require that one or more pieces of heavy equipment enter and operate below the OHWM of the Skagit River. However, except for the purposes of gaining access to and constructing the mid-channel island ELJ, heavy equipment shall operate from positions above and/or landward of the wetted channel (including temporary fills, timber platforms, or a barge).

A release of harmful materials (e.g., fuel, lubricants, hydraulic fluid, etc.) is possible, but extremely unlikely. The project will implement an Engineer-approved SPCC plan to guard against the release of any harmful pollutant or product. All equipment operating below the OHWM will use vegetable-based hydraulic fluid, and no oils, fuels, cleaning agents or solvents, concrete or equipment wash water, slurry, waste, or construction debris will be discharged to surface waters or onto land with a potential to reenter surface waters. With implementation of the proposed conservation measures, effects to the bull trout and designated bull trout critical habitat resulting from exposure to chemical contamination during construction are considered extremely unlikely and therefore discountable.

Construction of the proposed project will result in direct impacts to approximately two acres

below the OHWM of the Skagit River (Acosta, pers. comm. 2011). Turbidity and sedimentation resulting from construction activities will travel as far as 600 ft downstream, and temporary effects to instream habitat may extend as far as 0.25 mile downstream. Despite the large area directly and indirectly affected, we expect that temporary effects to prey resources and the bull trout prey base will not be measurable, and are therefore considered insignificant. The action area supports populations of Chinook, steelhead, pink, and coho salmon, cutthroat trout, and other native fishes, which together provide a sizable prey base for bull trout. There are no indications that either terrestrial organisms or aquatic macroinvertebrates are lacking. The food base is not a limiting factor within the action area, and the effects of the action will not measurably diminish the availability of prey in either the short or long term.

Construction of the proposed project will require clearing approximately 40,000 square ft (0.9 acre) of woody and herbaceous vegetation, including approximately 130 deciduous trees (10 to 42 inches diameter-at-breast-height). Most of the functioning riparian vegetation, approximately 12,000 of the 40,000 square ft, is located either at the upstream corner of the TNC's Kahn Preserve, or along the narrow riparian bench between SR 20 and the approximate location of ELJ #3. Because of the long history of bank erosion and maintenance repairs along the existing 2,000 ft riprap revetment, there is relatively little remaining functioning riparian vegetation within the project limits that would be affected by construction.

The project will restore areas cleared for temporary access and staging. Wherever feasible given site and safety constraints, the project will reestablish native, woody vegetation along the reconstructed embankment. The WSDOT's preliminary plans for landscape replanting and permanent stabilization include native woody shrubs for locations closest to the roadway, a mix of shrubs and native trees for locations further removed from the roadway, and a design for plantings placed on top of the constructed ELJs.

The proposed action will restore habitat functions provided by large wood. The project will install approximately 8,700 cy of stacked and complexed large wood. Large wood with rootwads intact will provide complex channel margin habitat and refugia across a range of surface water elevations. With implementation of the proposed conservation measures and permanent design elements, effects to the bull trout and designated bull trout critical habitat resulting from impacts to functioning riparian vegetation and large wood recruitment will not be measurable, and are therefore considered insignificant.

Adverse Effects of the Action (Bull Trout)

The actions taken under the declared emergencies of 2004, 2006, and 2007 resulted in direct impacts to habitats that support bull trout and their prey. These actions resulted in adverse, direct and indirect effects to the bull trout. Our analysis is focused on the measurable direct effects to instream habitat conditions and functions, and indirect effects to the channel bed and banks in close proximity to the actions, including subsequent bank instability and loss of functioning riparian vegetation. Some of the adverse effects have persisted for years, and will continue to persist until the proposed ELJs and revetments are constructed.

We expect that permanent stabilization of the site will result in additional direct and indirect

effects to the bull trout. Some of these effects will be temporary, construction-related and limited in both physical extent and duration. Others will be long term, lasting for the functional life of the constructed ELJs and revetments. Our analysis specifically addresses the following potential adverse exposures and effects, as well as any effects associated with interrelated and interdependent actions:

- Stress and/or injury resulting from fish capture and handling operations.

- Exposure to construction activities and resulting direct effects. Construction activities will directly affect instream habitat that supports bull trout. Adult, subadult, and juvenile bull trout will be temporarily exposed to elevated levels of turbidity and sedimentation. The effects of construction, including those resulting from flow diversion, will create a temporary barrier to free movement and migration.

- Permanent and temporary effects to instream habitat structure, function, and diversity. The proposed project will reinforce an existing artificial constraint on the channel migration zone and floodplain, but would also improve instream habitat function over the long term compared to the existing smooth riprap revetment. Temporary effects to instream habitat resulting from channel response during the months immediately following construction will include significant bedload movements and resulting turbidity and sedimentation.

The sub-sections that follow address the adverse effects of the action, beginning with those resulting from placement of riprap below the OHWM under declared emergency conditions.

Emergency Replacement of Failed Bank Armor

On three separate occasions the WSDOT replaced failed bank armor along the Skagit River's right-bank. These actions, which included placement of approximately 700 cy of riprap below the OHWM and direct impacts to 300 linear ft of streambank, were taken under declared emergency conditions. Subsequent to the actions, the Corps identified adverse, direct and indirect effects resulting from the actions (WSDOT 2009), and requested formal consultation.

The actions taken under the declared emergencies of 2004, 2006, and 2007, resulted in direct impacts to habitats that support bull trout and their prey. These actions resulted in adverse, direct and indirect effects to the bull trout. Some of the adverse effects have persisted for years, and will continue to persist until the proposed ELJs and revetments are constructed.

The Washington State Aquatic Habitat Guidelines Program has published a guidance document for the selection and design of streambank protection techniques that protect or restore aquatic and riparian habitats (Cramer et al. 2003). Chapter 6 of this document discusses appropriate application, design, construction, and maintenance of streambank protection, as well as the advantages, risks, and biological effects of specific techniques.

The *Integrated Streambank Protection Guidelines* (ISPG) describe riprap as "…the most extensively used method for controlling bank erosion…", a method "…habitually used to protect

[areas] …where other… methods could have addressed the mechanism and causes of failure more effectively." (Cramer et al. 2003, pp. 6-67, 6-75) The ISPG identify and describe a number of concerns regarding the use of riprap as a method for controlling bank erosion, concerns over the poor habitat value of riprap, and the localized and cumulative effects of riprap on river morphology and habitat forming processes (Cramer et al. 2003, pp. 6-67 thru 6-78):

- Smooth riprap revetments tend to transfer energy downstream. "Too often, the need for hardened banks is self-perpetuating, both in time and in a downstream direction."

- Meander migration is arrested, increasing bank erosion upstream and/or downstream of the riprap protection. Loss of habitat in the adjacent reach can be expected.

- Smooth riprap revetments tend to concentrate flow and erosive force. Frequently the channel will deepen in response, leading to increased scour depth and a risk of undermining or toe erosion.

- The technique is "…not appropriate for sites within the meander migration corridor."

- Smooth riprap revetments provide very little roughness, cover, or aquatic habitat complexity.

- Smooth riprap revetments increase velocity, and reduce complexity and diversity along the channel margin, thereby diminishing habitat value.

- Riprap revetments have detrimental effects on natural fluvial processes, by altering and interfering with natural channel migration, sediment dynamics, and large wood inputs. Use of the technique results in lost opportunities for sediment and large wood recruitment.

The ISPG cite studies, indicating that "…riprap sites [have] consistently lower fish densities than control sites…" (Peters et al. 1998), and "riprap revetments along the Skagit River have had a dramatic, adverse impact on juvenile [salmonid] habitat" (Beamer and Henderson 1998).

The Corps and WSDOT have documented that the emergency actions of 2004, 2006, and 2007, simplified and degraded habitat within the footprint of the placed bank armor, and caused (or may cause) additional, adverse impacts to instream, floodplain, and riparian habitats located upstream and downstream of the hardened banks (WSDOT 2009, pp. ii, 8, 23, 24, 27). The emergency actions filled scour pools, reduced cover and complexity at the channel margin, prevented the establishment of functioning riparian vegetation, exacerbated upstream and downstream erosion, and resulted indirectly in the loss or degradation of functioning side-channel, floodplain, and riparian habitats.

The Corps and WSDOT report that the site remains unstable, erosion continues, and unless and until more permanent repairs are constructed, the erosion threat "…will continue downstream over 2,200 ft…" (WSDOT 2009, pp. 8, 27). Portions of the right-bank, forested floodplain wetland located downstream (i.e., The TNC Kahn Preserve) have eroded, and there is concern that this erosion will continue until more permanent repairs are constructed (WSDOT 2009, p. 8; WSDOT 2011, p. 7).

Based on the information currently available, we conclude that the emergency actions of 2004, 2006, and 2007, directly modified, simplified, and degraded approximately 15,000 square ft (or approximately 0.3 acre) of instream habitat. In addition, these actions have also indirectly and adversely affected an unquantified amount of side-channel, floodplain, and riparian habitat located downstream. These adverse direct and indirect effects to instream habitat have persisted for years, and will continue to persist until more permanent and more functional repairs are constructed.

The emergency actions of 2004, 2006, and 2007, degraded instream, floodplain, and riparian habitats that support bull trout and their prey. This habitat degradation has caused, and will continue to result in a significant disruption of normal bull trout behaviors (i.e., ability to successfully feed, move, and/or shelter). Some of the adverse effects to habitat may persist indefinitely, but we expect that most will be temporary, lasting a duration measured in years, until the proposed ELJs and revetments are constructed. Emergency placement of riprap armor, bank hardening, encroachment on the channel migration zone, and associated adverse effects to 0.3 acre of instream habitat will significantly disrupt the normal behaviors of all associated bull trout for approximately 10 years (2004-2013).

Effects Resulting from Fish Capture and Handling

Construction of the ELJs and large wood and dolotimber revetments will require approximately 16 weeks of in-water work (January to April and August 1 to September 1, 2013). From May through July, coinciding with high spring and summer flows, the project will complete little or no in-water work (WSDOT 2011, pp. 11-14). The project will span, or otherwise seek to minimize impacts to Chinook and steelhead spawning habitats and shallow-water refugia. The project will use the best, most recent spawner survey information to adaptively manage plans for access during construction (WSDOT 2011, pp. 17-23).

Excavation and placement of materials for the mid-channel island ELJ will require a temporary water crossing and operation of heavy equipment on the exposed channel bed. In conjunction with this work, the project may temporarily divert stream flow with the use of gravel-filled bags, a constructed bypass flume, or culvert. The FHWA and WSDOT do not expect that it will be necessary to capture and handle fish. However, in the event that fish become stranded, or if construction results in temporary conditions (i.e., turbidity) with a potential for fish injury or mortality, the FHWA and WSDOT will implement the WSDOT's *Fish Exclusion Protocols and Standards* (included as Appendix A) (WSDOT 2011, p. 54).

Any pumps used to temporarily bypass water or to dewater residual pools will be screened at the intake. Fish screens or guards will comply with Washington State law (RCW 77.57.010 and 77.57.070), with guidelines prescribed by the NMFS (NMFS 1997), and any more stringent requirements contained in permits issued for the project by the WDFW. Pumps will not be operated without a screened intake unless the project has confirmed that there is no risk of entraining fish, and there are adequate plans in place to address contingencies (including a routine schedule for inspection).

Work area isolation, flow diversion, and partial dewatering are conservation measures intended to reduce the risk of fish stranding and other forms of injury (e.g., exposure to intense turbidity). The FHWA and WSDOT will implement these practices to avoid the more severe effects that bull trout might experience from remaining within the work area.

It is possible that a limited number of bull trout may be injured or killed when capturing and removing fish from the work area. However, it is more likely that adverse effects to adult, subadult, or juvenile bull trout resulting from fish capture and handling will occur in the form of increased stress and a temporary disruption to their normal bull trout behaviors.

The WSDOT's *Fish Exclusion Protocols and Standards* require that the fish capture operation be conducted by or under the supervision of an experienced biologist, and that all staff participating in the operation must have the necessary knowledge, skills, and abilities to ensure safe handling of fish. WSDOT protocols require that the fish capture operation must have proper equipment on-hand (e.g., buckets, aerators, etc.) and take appropriate steps to minimize the amount and duration of handling. The protocols require that captured fish be released to flowing waters in close proximity, in areas that offer adequate cover and suitable temperature and water quality conditions, as quickly as is practicable.

Electrofishing will be employed only as a last resort, after all other means of fish capture and removal have been exhausted (e.g. herding with block nets, seining, dip nets in conjunction with dewatering, etc.), and only after a qualified biologist determines that all or nearly all of the adult and subadult-sized fish have been effectively removed. Only biologists trained by qualified personnel and familiar with equipment handling, settings, maintenance, and safety may operate electrofishing equipment. Capture operations that utilize electrofishing equipment shall use the minimum voltage, pulse width, and rate settings necessary to immobilize fish, and shall measure water conductivity in the field before electrofishing in order to determine appropriate settings.

Electrofishing is typically used as a last resort to remove fish. The process involves passing an electrical current through water to immobilize fish and facilitate their capture and removal from the in-water work area. The process of running an electrical current through the water can cause a range of effects, including annoyance, startle, or avoidance behavior; temporary immobility; physical injury; and, mortality. The amount of unintentional (or incidental) injury or mortality attributable to electrofishing can vary widely, depending upon the equipment used, settings used, site conditions (e.g., clarity of water and visibility), and the expertise of the operator. Accidental

contact with the electrodes is a frequent cause for physical injury or mortality. When fish capture operations use the minimum voltage, pulse width, and rate settings necessary to immobilize fish, shocked fish normally revive quickly.

Electrofishing can more severely affect adult salmonids because of their larger size and surface area. Injuries, which may cause or contribute to delayed mortality, can include spinal hemorrhages, internal hemorrhages, fractured vertebra, spinal misalignment, and separated spinal columns (Dalbey et al. 1996; Hollender and Carline 1994; Thompson et al. 1997b). Sharber and Carothers (1988) report that electrofishing killed 50 percent of the adult rainbow trout in their study. The long term effects of electrofishing on juvenile and adult salmonids are not well understood, but long experience with electrofishing indicates that most measurable effects occur at the time of fish capture operations and are of relatively short duration.

Most studies on the effects of electrofishing have been conducted on adult fish greater than 300 millimeters in length (Dalbey et al. 1996). The relatively few studies that have been conducted on juvenile salmonids indicate that spinal injury rates are substantially lower than they are for large fish. Smaller fish intercept a smaller head-to-tail potential than larger fish (Sharber and Carothers 1988), and may therefore experience lower injury rates (Dalbey et al. 1996; Thompson et al. 1997a; Thompson et al. 1997b). McMichael et al. (1998) found a 5.1 percent injury rate for juvenile steelhead captured by electrofishing in the Yakima River.

The incidence and severity of electrofishing injury is partly related to the type of equipment used and the waveform produced (Dalbey et al. 1996; Dwyer and White 1997; Sharber and Carothers 1988). Continuous direct current or low-frequency pulsed direct current (equal or less than 30 Hz) have been recommended for electrofishing because lower spinal injury rates, particularly in salmonids, have resulted from these waveforms (Dalbey et al. 1996).

Only a few studies have examined the long term effects of electrofishing on salmonid survival and growth (Ainslie et al. 1998; Dalbey et al. 1996). These studies indicate that although some fish suffer spinal injury, few die as a result. However, severely injured fish grow at slower rates and sometimes exhibit no growth at all (Dalbey et al. 1996).

Adult and subadult salmonids, because of their larger size (i.e., older than one year and larger than 150 mm; with variation dependent on species), cannot seek refuge in gravels and are generally easier to detect, herd, seine, and/or net. Therefore, fish capture operations that exhaust other means of capture (e.g. herding with block nets, seining, dip nets in conjunction with dewatering, etc.) should not generally expose many adult or subadult salmonids to the added risks associated with electrofishing. However, some adults and subadults may hide under vegetation or other cover (e.g., cut banks, rootwads, etc.). While herding, seining, and netting are much safer means by which to capture and remove fish (i.e., they present lower risks of injury and/or incidental mortality), all forms of capture and handling contribute some degree of stress and otherwise disrupt normal behaviors (i.e., ability to successfully feed, move and/or shelter).

We expect that with careful, full implementation of the proposed conservation measures, and considering the small size of the area(s) where fish capture operations will or may be conducted,

a very modest number of juvenile, subadult, and adult bull trout may be affected by fish capture and handling. All, or nearly all, of the subadult and adult bull trout should be effectively removed prior to electrofishing, and the rate of injury and/or accidental (incidental) mortality should be low for juvenile, subadult, and adult bull trout. It is more likely that adverse effects to juvenile, subadult, or adult bull trout resulting from fish capture and handling will take the form of increased stress and a temporary disruption to their normal bull trout behaviors. While this added stress and disruption to their normal behaviors will have measurable short term effects (including interruption to feeding and increased energetic demands), we expect that all, or nearly all, of the exposed individuals will experience no long term effects.

Applying best professional judgment, and with consideration for the timing and location of construction activities, the amount and quality of affected habitat, methods for work area isolation and dewatering, and WSDOT's *Fish Exclusion Protocols and Standards* (Appendix A), we expect that no more than one adult or subadult bull trout, and one juvenile bull trout will suffer physical injury or mortality, and that no more than two adult or subadult bull trout, and three juvenile bull trout will suffer a disruption to their normal behaviors and stress as a result of fish capture and handling.

Exposure to Elevated Turbidity and Sedimentation During Construction

The proposed action includes in-water work to be completed during a single, extended construction season (January to April and August 1 to September 1, 2013). From May through July, coinciding with high spring and summer flows, the project will complete little or no in-water work (WSDOT 2011, pp. 11-14). Construction activities with the potential to cause significant temporary increases in turbidity include excavation and removal of existing riprap from the construction footprint, extending from the waterline landward; placement of temporary fills, timber platforms, or use of a barge, for positioning of heavy equipment; placement of dolotimber and large wood bundles, fill, and racked wood below the OHWM with the use of a crane, front loader, and/or log loader; flow diversion with the use of gravel-filled bags, a constructed bypass flume, or culvert; a temporary water crossing and operation of heavy equipment on the exposed channel bed; and, excavation and placement of materials for the mid-channel island ELJ. The FHWA and WSDOT propose measures to avoid and minimize effects to the environment, including in-water construction BMPs (WSDOT 2011, pp. 19-21).

Based upon the nature of the proposed work, the size, volume, and morphology of the Skagit River within the action area, and the conditions likely to prevail during construction of the project, we expect that turbidity and sedimentation resulting from construction activities will travel as far as 600 ft downstream before concentrations are diminished by dilution and deposition to levels that are difficult to distinguish from background/ambient concentrations. Temporary increases in turbidity resulting from construction may significantly disrupt normal bull trout behaviors (feeding, moving, and sheltering), and may create a temporary barrier to free movement and migration.

Although few studies have specifically examined the issue as it relates to bull trout, increases in suspended sediment affect salmonids in several recognizable ways. The variety of effects of suspended sediment may be characterized as lethal, sublethal, or behavioral (Bash et al. 2001, p.

10; Newcombe and MacDonald 1991, pp. 72-73; Waters 1995, pp. 81-82). Lethal effects include gill trauma (physical damage to the respiratory structures)(Curry and MacNeill 2004, p. 140) and smothering and other effects that can reduce egg-to-fry survival (Chapman 1988, pp. 12-16). Sublethal effects include physiological stress reducing the ability of fish to perform vital functions (Cederholm and Reid 1987, pp. 388, 390), severely reduced respiratory function and performance (Waters 1995, p. 84), increased metabolic oxygen demand (Servizi and Martens 1991, p. 497), susceptibility to disease and other stressors (Bash et al. 2001, p. 6), and reduced feeding efficiency (Newcombe and MacDonald 1991, p. 73). Sublethal effects can act separately or cumulatively to reduce growth rates and increase fish mortality over time. Behavioral effects include avoidance, loss of territoriality, and related secondary effects to feeding rates and efficiency (Bash et al. 2001, p. 7). Fish may be forced to abandon preferred habitats and refugia, and may enter less favorable conditions and/or be exposed to additional hazards (including predators) when seeking to avoid elevated concentrations of suspended sediment.

In order to assess the suspended sediment concentrations at which adverse effects will occur and to determine the downstream extent to which these effects may extend as a result of the proposed project, we used the analytical framework attached as Appendix E (USFWS 2010). This framework uses the findings of Newcombe and Jensen (1996) to evaluate the "severity-of-effect" based on suspended sediment concentration, exposure, and duration. Factors influencing suspended sediment concentration, exposure, and duration include waterbody size, volume of flow, the nature of the construction activity, construction methods, erosion controls, and substrate and sediment particle size. Factors influencing the severity-of-effect include duration and frequency of exposure, concentration, and life stage. Availability and access to refugia are other important considerations.

The framework in Appendix E requires an estimate of suspended sediment concentration (mg/L) and exposure duration. Monitoring data collected on the Skagit River at Marblemount (WDOE 2011) were used to determine the ratio of turbidity to suspended solids for the waterbody (1 NTU : 2.2 mg/L). To determine exposure duration, we assumed that work below the OHWM would occur 10 hours a day, for as many as 120 working days (February 1 to May 10 and August 1 to September 1). It is important to note we expect that any measurable increases in turbidity will be short term and episodic.

Using this approach, we expect that adverse effects to adult, subadult, and juvenile bull trout are likely to occur under the following circumstances:

(1) When background NTU levels are exceeded by 68 NTUs at any point in time.

(2) When background NTU levels are exceeded by 25 NTUs for more than 1 hour, continuously.

(3) When background NTU levels are exceeded by 25 NTUs for more than 3 hours, cumulatively, over a 10-hour workday.

(4) When background NTU levels are exceeded by 9 NTUs for more than 7 hours, cumulatively, over a 10-hour workday.

To assess the potential extent of these effects we relied on a limited set of monitoring data collected to determine the effectiveness of BMPs and compliance with State surface water quality standards. We also considered the nature and extent of the proposed in-water work, and the Skagit River's managed, seasonal, hydrological conditions. Based on this information we expect that suspended sediment concentrations resulting in adverse effects to bull trout are reasonably certain to occur as far as 600 ft downstream of construction activities.

We expect that a modest number of adult, subadult, and juvenile bull trout will be in the action area at the time of construction and may be exposed to elevated turbidity and sedimentation. We expect that some bull trout will avoid the area when elevated suspended sediment concentrations result from construction activities. Resulting turbidities may also impede or discourage free movement through the action area, and combined with other aspects of construction in and around the channel (including flow diversion), may delay or discourage adult bull trout from migrating up through and around the project area. However, bull trout will not be exposed to elevated turbidities outside daylight hours, and therefore nocturnal movements and migration through and around the project area should be relatively unimpeded.

Temporary increases in turbidity may prevent individuals from exploiting preferred habitats, and/or expose individuals to less favorable conditions. We expect that elevated turbidity and sedimentation extending as far as 600 ft downstream of construction activities will result in a significant temporary disruption of normal bull trout behaviors (i.e., ability to successfully feed, move, and/or shelter).

Permanent and Temporary Effects to Instream Habitat

We expect that the proposed action will result in both direct and indirect effects to bull trout FMO habitat. Some of these effects will be temporary, construction-related and limited in both physical extent and duration. Others will be permanent or long term, lasting for the functional life of the constructed ELJs and revetments.

Temporary Effects to Instream Habitat

Temporary effects to instream habitat will result from channel response to the constructed ELJs and revetments during the months immediately following construction. The FHWA and WSDOT have described significant bedload movements, turbidity, and sedimentation which they expect will occur during the first year post-construction (WSDOT 2011, pp. 43-45, 59-63). When activated under high flow events exceeding 20,000 cubic ft per second, the constructed ELJs and revetments will have pronounced, localized effects on flow velocities, bed shear stress, and patterns of sediment transport and channel bed formation.

We expect that channel response and temporarily altered patterns of sediment transport will cause a measurable increase in sedimentation along the downstream reach, extending as far as 0.25 mile downstream, to the vicinity of the mouth of Illabot Creek. Sediments deposited along the downstream reach may accumulate in pools or tailouts, and may for a time bury some of the native substrates. These temporary effects to instream habitat may reduce foraging and overwintering opportunities for individual bull trout (juveniles in particular). However, we

expect these effects will be limited in both physical extent and duration. We expect that within the action area the channel will adjust and resume natural patterns of bedload and sediment transport within two years of construction.

Increased sedimentation along the downstream reach will temporarily degrade bull trout FMO habitat. We expect that measurable increases in sedimentation will significantly disrupt normal bull trout behaviors (i.e., ability to successfully feed, move, and/or shelter) to a distance of 0.25 mile, and for a duration of up to two years.

Permanent Effects to Instream Habitat

The proposed project will reinforce an existing artificial constraint on the channel migration zone and floodplain along approximately 1,300 linear ft of the Skagit River. Bank hardening will reduce opportunities for interaction between the active channel and floodplain, will permanently (or indefinitely) reduce the potential for development of off-channel habitat complexity, and impair natural processes that contribute to the formation and maintenance of diverse instream habitats.

However, the project incorporates design elements which we expect will partially offset these adverse effects. The proposed bank-anchored ELJs and large wood and dolotimber revetments will provide continuous bank protection and channel bed and bank roughness, redirect flows and energies away from the roadway embankment, and create complex channel margin habitat and refugia across a range of surface water elevations. Furthermore, we expect that because the proposed ELJs and revetments will resist erosion and maintain structural integrity even with some amount of settling and deformation, the proposed action will avoid the environmental damage that might otherwise result from repetitive future roadway repairs. We expect that the constructed ELJs and revetments will improve instream habitat function compared to the smooth riprap revetment and entrained channel thalweg that exists at this location today.

Bank hardening impairs the natural processes that contribute to the formation and maintenance of diverse instream habitats. The adverse effects of bank hardening are well documented in the scientific literature. The extensive bank hardening that has occurred along the lower Sacramento River provides one good, thoroughly investigated example (USFWS 2000). The adverse effects of bank hardening can include: 1) Interruption of the dynamic equilibrium, which through patterns of erosion and sedimentation contributes, sorts, and distributes substrates of varying size within the active channel migration zone; 2) Uncoupling of the active channel and riparian zones, reducing the frequency of overbank flows and recruitment of large wood; 3) Confinement of the channel migration zone, reducing or eliminating opportunities for meander migration and development of off-channel habitat; and, 4) Straightening of the active channel and reduction in bank roughness, leading to intensification of water velocities and forces which cause channel incision and accelerated rates of bank erosion upstream and downstream of the hardened bank

(Schmetterling et al. 2001; USFWS 2000). These effects impair the natural processes that contribute to the formation and maintenance of diverse instream physical habitat.

Bank hardening most acutely affects the diversity of channel margin and off-channel habitats. Microhabitats in the form of point bars, backwaters and eddies, undercut banks, debris jams, side channels, oxbows, and overhanging bank vegetation are generally all substantially reduced as a result of bank hardening and channel confinement (Schmetterling et al. 2001; USFWS 2000). Furthermore, with decoupling of the natural processes and interactions within the floodplain, systems lose their ability to replace and repair degraded habitats.

The proposed action will further harden approximately 1,300 linear ft of the Skagit River's right-bank. In doing so, the project will eliminate the opportunity for meander migration and further development of off-channel habitats, and will further decouple the active channel and floodplain. The project will have significant indirect effects, occurring later in time but persisting for the functional life of the constructed ELJs and revetments. These indirect effects include a reduced incidence of overbank flows and interrupted patterns of erosion, sedimentation, and recruitment of large wood. Were it not for the inclusion of permanent design elements that partially offset these adverse effects, we would expect greatly simplified and homogenized instream structure to result in time along the affected bank.

We expect that the proposed action will create a more diverse and complex assemblage of instream habitats to replace the existing smooth riprap revetment and entrained channel thalweg. The constructed ELJs and large wood and dolotimber revetments should function to provide a range of channel depths, complex cover, and resting and refuge habitat from stream velocities and forces. We expect that resulting conditions will provide improved foraging and overwintering opportunities for bull trout.

Outside the limits of the constructed ELJs and revetments, we do not expect that the action will have measurable adverse effects to bull trout habitat. The project should substantially increase channel and floodplain roughness, and thereby lessen hydraulic forces and resulting bed and bank erosion along the downstream reach. The proposed action will redirect water velocities and forces locally, but we expect this will result in insignificant indirect effects along the downstream reach.

Hydraulic modeling predicts modest changes to backwater elevations, velocities, and bed shear stress throughout an approximately 250 acre portion of the Skagit River's channel and floodplain. This area includes much or all of the TNC's Kahn Preserve, the low floodplain forest and remnant meanders or oxbows on a left-bank property managed by the WDFW, and the mouth of Illabot Creek (Figure 7, p. 20). We expect that the constructed ELJs and revetments will or may have measurable effects to bedload movement, large wood transport and accumulation, and channel formation throughout this area. Over time, a number of beneficial effects may result, including activation of the remnant left-bank meanders and oxbows, further development of side-channel and off-channel refugia, and recruitment and retention of large wood.

However, because the project will further impair natural processes that contribute to the

formation and maintenance of diverse instream physical habitat, and because we don't expect that engineered bank treatments will function exactly as intended (or indefinitely), the proposed action does present some potential risk for future adverse effects to the bull trout. The proposed action will eliminate the opportunity for meander migration and further development of off-channel habitats along 1,300 linear ft of the Skagit River's right-bank. In doing so, the proposed action will permanently reduce the quantity and quality of available off-channel habitat, reducing foraging and overwintering opportunities for individual bull trout (juveniles in particular). Therefore, we anticipate that the project will have measurable, adverse effects to bull trout from degradation of habitat along 1,300 linear ft of the Skagit River, indefinitely and for the functional life of the constructed ELJs and revetments.

Summary of Effects (Matrix of Pathways and Indicators)

An earlier section applied the *Matrix of Diagnostics / Pathways and Indicators* (USFWS 1998) as a tool for describing whether aquatic habitat is properly functioning, functioning at risk, or functioning at unacceptable levels of risk at the scale of the action area (see Environmental Baseline in the Action Area). Table 3 summarizes the effects of the action using this same matrix. For a fuller description of the anticipated effects of the action see the preceding sub-sections.

Table 3. Effects of the action ("Matrix of Pathways & Indicators").

Pathway	Indicator	Baseline Conditions	Effect of the Action
Water Quality	Temperature	Properly Functioning	Maintain
	Sediment	Properly Functioning	**Degrade** (Temporary)
	Chemical Contamination & Nutrients	Properly Functioning	Maintain
Habitat Access	Physical Barriers	At Risk	Maintain
Habitat Elements	Substrate	Properly Functioning	**Degrade** (Temporary)
	Large Woody Debris	At Risk	**Restore**
	Pool Frequency / Quality	Properly Functioning	**Restore**
	Large Pools	Properly Functioning	Maintain
	Off-Channel Habitat	Properly Functioning	**Degrade**
	Refugia	Properly Functioning	Maintain
Channel	Width/Depth Ratio	Properly Functioning	Maintain

Pathway	Indicator	Baseline Conditions	Effect of the Action
Conditions & Dynamics	Streambank Condition	At Risk	**Degrade**
	Floodplain Connectivity	At Risk	**Degrade**
Flow / Hydrology	Peak / Base Flows	At Risk	Maintain
	Drainage Network	At Risk	Maintain
Watershed Conditions	Road Density / Location	At Risk	Maintain
	Disturbance History	At Risk	Maintain
	Riparian Reserve	Properly Functioning	Maintain

Effects of the Action (Designated Bull Trout Critical Habitat)

An earlier section identified the PCEs that define bull trout critical habitat and described their baseline condition in the action area (Environmental Baseline, Status of Critical Habitat in the Action Area). The following section discusses the effects of the action with reference to the nine PCEs.

The proposed action will have both direct and indirect effects to designated bull trout critical habitat. Some of these effects will be temporary, construction-related and limited in both physical extent and duration. Others will be permanent or long term, lasting for the functional life of the constructed ELJs and revetments. Suitable bull trout spawning and early rearing habitats do not occur within the action area and therefore will not be affected by the action.

Construction activities may temporarily impair function of the migratory corridor. We expect that construction activities may impede or discourage free movement through the action area during the course of in-water work (February 1 to May 10 and August 1 to September 1). In particular, adult bull trout may be delayed or discouraged from migrating up through and around the project area. However, bull trout will not be exposed to elevated turbidities outside daylight hours, and therefore nocturnal movements and migration through and around the project area should be relatively unimpeded.

We expect that channel response and temporarily altered patterns of sediment transport will cause a measurable increase in sedimentation along the downstream reach, as far as 0.25 mile downstream, to the vicinity of the mouth of Illabot Creek. However, we expect these effects will be limited in both physical extent and duration. We expect that within the action area the channel will adjust and resume natural patterns of bedload and sediment transport within two years of construction.

The proposed action will reinforce an existing artificial constraint on the channel migration zone and floodplain along approximately 1,300 linear ft of the Skagit River. Bank hardening will reduce opportunities for interaction between the active channel and floodplain, will permanently (or indefinitely) reduce the potential for development of off-channel habitat complexity, and impair natural processes that contribute to the formation and maintenance of diverse instream habitats. However, the project incorporates design elements which we expect will partially offset these adverse effects. The proposed bank-anchored ELJs and large wood and dolotimber revetments will provide continuous bank protection and channel bed and bank roughness, redirect flows and energies away from the roadway embankment, and create complex channel margin habitat and refugia across a range of surface water elevations. Furthermore, we expect that because the proposed ELJs and revetments will resist erosion and maintain structural integrity even with some amount of settling and deformation, the proposed action will avoid the environmental damage that might otherwise result from repetitive future roadway repairs at the site. Within the limits of the constructed ELJs and revetments, we expect that the project will improve instream habitat function compared to the existing smooth riprap revetment and entrained channel thalweg that exists today.

The project will have significant indirect effects, occurring later in time but persisting for the functional life of the constructed ELJs and revetments. These indirect effects include a reduced incidence of overbank flows and interrupted patterns of erosion, sedimentation, and recruitment of large wood. Were it not for the inclusion of permanent design elements that partially offset these adverse effects, we would expect greatly simplified and homogenized instream structure to result in time along the affected bank.

We expect that the proposed action will create a more diverse and complex assemblage of instream habitats to replace the existing smooth riprap revetment and entrained channel thalweg. The constructed ELJs and large wood and dolotimber revetments should function to provide a range of channel depths, complex cover, and resting and refuge habitat from stream velocities and forces. We expect that resulting conditions will provide improved foraging and overwintering opportunities for bull trout.

Outside the limits of the constructed ELJs and revetments, we do not expect that the action will have measurable adverse effects to bull trout habitat. The project should substantially increase channel and floodplain roughness, and thereby lessen hydraulic forces and resulting bed and bank erosion along the downstream reach. The proposed action will redirect water velocities and forces locally, but we expect this will result in insignificant indirect effects along the downstream reach.

Hydraulic modeling predicts modest changes to backwater elevations, velocities, and bed shear stress throughout an approximately 250 acre portion of the Skagit River's channel and floodplain. This area includes much or all of the TNC's Kahn Preserve, the low floodplain forest and remnant meanders or oxbows on a left-bank property managed by the WDFW, and the mouth of Illabot Creek (Figure 7, p. 20). We expect that the constructed ELJs and revetments will or may have measurable affects to bedload movement, large wood transport and accumulation, and channel formation throughout this area. Over time, a number of beneficial effects may result, including activation of the remnant left-bank meanders and oxbows, further

development of side-channel and off-channel refugia, and recruitment and retention of large wood.

Because the project will further impair natural processes that contribute to the formation and maintenance of diverse instream physical habitat, and because we don't expect that engineered bank treatments will function exactly as intended (or indefinitely), the proposed action does present some potential risk for permanent adverse effects to bull trout and their habitat. Therefore, we anticipate that the project will have measurable, adverse effects to bull trout from degradation of habitat along 1,300 linear ft of the Skagit River.

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

The proposed action will have no measurable effect on this PCE. Any temporary or permanent effect to this PCE will be insignificant. Within the action area this PCE will retain its current level of function.

(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 proposed action will have measurable adverse effects on this PCE. Construction activities may temporarily impair function of the migratory corridor during the course of in-water work (February 1 to May 10 and August 1 to September 1). However, nocturnal movements and migration through and around the project area should be relatively unimpeded.

The proposed action will have no measurable, permanent or long term effect on this PCE. The proposed action will not create or contribute to any existing impediments to migration. Within the action area this PCE will retain its current level of function.

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

The proposed action will result in direct impacts to approximately two acres below the OHWM of the Skagit River. Turbidity and sedimentation resulting from construction activities will travel as far as 600 ft downstream, and temporary effects to instream habitat may extend as far as 0.25 mile downstream. Despite the large area directly and indirectly affected, we expect that temporary effects to prey resources and the bull trout prey base will not be measurable, and are therefore considered insignificant. The action area supports populations of Chinook, steelhead, pink, and coho salmon, cutthroat trout, and other native fishes, which together provide a sizable prey base for bull trout. There are no indications that either terrestrial organisms or aquatic macroinvertebrates are lacking. The food base is not a limiting factor within the action area, and the effects of the action will not measurably diminish the availability of prey in either the short or long term.

The proposed action will have no measurable effect on this PCE. Any temporary or permanent effect to this PCE will be insignificant. Within the action area this PCE will retain its current level of function.

(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 proposed action will reinforce an existing artificial constraint on the channel migration zone and floodplain along approximately 1,300 linear ft of the Skagit River. Bank hardening will reduce opportunities for interaction between the active channel and floodplain, will permanently (or indefinitely) reduce the potential for development of off-channel habitat complexity, and impair natural processes that contribute to the formation and maintenance of diverse instream physical habitats. Because the project will further impair natural processes that contribute to the formation and maintenance of diverse instream physical habitat, we expect that the proposed action will have permanent or long term adverse effects on this PCE (including interrupted patterns of erosion, sedimentation, and recruitment of large wood).

However, we expect that the constructed ELJs and revetments will improve instream habitat function compared to the smooth riprap revetment and entrained channel thalweg that exists at this location today. The constructed ELJs and large wood and dolotimber revetments should function to provide a range of channel depths, complex cover, and resting and refuge habitat from stream velocities and forces. The action should substantially increase channel and floodplain roughness, and thereby lessen hydraulic forces and resulting bed and bank erosion along the downstream reach. We expect that resulting conditions will provide improved foraging and overwintering opportunities for bull trout. Within the action area this PCE will retain its current level of function.

(5) *Water temperatures ranging from 2 to 15 °C (36 to 59 °F), with adequate thermal refugia available for temperatures at the upper end of this range. Specific temperatures within this range will 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.*

The proposed action will have no measurable effect on this PCE. Any temporary or permanent effect to this PCE will be insignificant. Within the action area this PCE will retain its current level of function.

(6) *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. A minimal amount (e.g., less than 12 percent) of fine substrate less than 0.85 mm (0.03 in.) in diameter and minimal embeddedness of these fines in larger substrates are characteristic of these conditions.*

Suitable bull trout spawning habitats are not present in the action area, and therefore the proposed action will have no effect on bull trout spawning habitats. The nearest documented

bull trout spawning habitats are located in Illabot Creek, outside of the action area and at higher elevations. The proposed action will have no measurable temporary or permanent effect on this PCE. Within the action area this PCE will retain its current level of function.

(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.*

The proposed action will have no adverse effects on this PCE. We expect that the action should substantially increase channel and floodplain roughness, and thereby lessen hydraulic forces and resulting bed and bank erosion along the downstream reach. Any permanent or long term effect to this PCE will be insignificant and/or beneficial. Within the action area this PCE will retain its current level of function.

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

The proposed action will have measurable adverse effects on this PCE. Temporary, construction-related increases in turbidity may extend as far as 600 ft downstream of sediment generating activities. We expect that measurable, construction-related increases in turbidity will be short term and episodic, but may occur at any time during the course of in-water work (February 1 to May 10 and August 1 to September 1).

We expect periodic, post-construction pulses of turbidity and sedimentation, extending as far as 0.25 mile downstream, to the vicinity of the mouth of Illabot Creek. However, we expect these effects will be limited in both physical extent and duration. We expect that within the action area the channel will adjust and resume natural patterns of bedload and sediment transport within two years of construction.

The proposed action will have no measurable, permanent or long term effect on this PCE. The proposed action will not permanently degrade or impair water quality or quantity within the action area. Within the action area this PCE will retain its current level of function.

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

The proposed action will have no measurable effect on this PCE. Any temporary or permanent effect to this PCE will be insignificant. Within the action area this PCE will retain its current level of function.

Indirect Effects

Indirect effects are caused by or result from the proposed action, are later in time, and are reasonably certain to occur. Indirect effects may occur outside of the area directly affected by the action (USFWS and NMFS 1998). The action has had, and will have, significant indirect effects to the bull trout and designated bull trout critical habitat.

The emergency actions of 2004, 2006, and 2007, simplified and degraded habitat within the footprint of the placed bank armor, and caused (or may cause) additional, adverse impacts to instream, floodplain, and riparian habitats located upstream and downstream of the hardened banks. The proposed action will further harden approximately 1,300 linear ft of the Skagit River's right-bank. In doing so, the project will eliminate the opportunity for meander migration and further development of off-channel habitats, and will further decouple the active channel and floodplain. Were it not for the inclusion of permanent design elements that partially offset these adverse effects, we would expect greatly simplified and homogenized instream structure to result in time along the affected bank. For a fuller discussion of these indirect effects, see the related preceding sub-sections (Adverse Effects of the Action).

The project will not result in changes in the use or function of the highway infrastructure and there are no other foreseeable indirect effects to the bull trout or designated bull trout critical habitat that might occur later in time. Over the long term, the FHWA, Corps, WSDOT, and the Service expect that the proposed action will permanently stabilize the roadway embankment in a manner that creates and maintains functioning, diverse instream habitat, and avoids the damage resulting from repeat emergency repairs.

Effects of Interrelated and Interdependent Actions

Interrelated actions are defined as actions "that are part of a larger action and depend on the larger action for their justification"; interdependent actions are defined as actions "that have no independent utility apart from the action under consideration" (50 CFR 402.02).

The following may be considered interrelated or interdependent actions related to the proposed action under consideration:

- Off-site fabrication (forming and pouring) of concrete dolotimbers;
- On-site staging and temporary traffic control;
- Off-site acquisition of large wood from an approved, properly permitted source;
- Post-construction monitoring and maintenance activities that do not alter the function or as-built physical footprint of the constructed ELJs and revetments.

Previous sub-sections have addressed all of the anticipated direct and indirect effects that may result from off-site fabrication of concrete dolotimbers, on-site staging, and temporary traffic control. No additional effects to the bull trout or designated bull trout critical habitat are expected to result from these interrelated or interdependent actions.

The proposed project will require more than 8,700 cy of large wood (typical stem length 20 ft; 6-26 inches diameter). The FHWA and WSDOT will obtain all large wood needed in support of the project from an approved, properly permitted source. The project will obtain large wood on the open market at the time of construction (Acosta, pers. comm. 2011), with the expectation that

all sources are in compliance with the State of Washington's Forest Practices Rules and requirements (WSDOT 2011, p. 67).

The Forest Practices Rules establish standards for forest practices, such as timber harvest, pre-commercial thinning, road construction, fertilization, and chemical application (Title 222 Washington Administrative Code). The Service completed a formal consultation addressing implementation of the Forest Practices Rules during 2006. The Service concluded that while significant adverse effects to the bull trout and its habitat would result from some forest practices, these effects would not jeopardize the continued existence of the bull trout (USFWS 2006).

Private commercial timber operators may instead comply with alternative rules, such as those provided through a Habitat Conservation Plan (HCP). Requirements for private harvests were significantly revised during 2000, following the Forest and Fish Agreement, which culminated in the Washington State Forest Practices HCP for aquatic species (WDNR 2005). The Service completed a formal consultation addressing the Washington State Forest Practices HCP during 2006 (USFWS 2006).

The Service's previous formal consultations addressing implementation of the Forest Practices Rules and the Washington State Forest Practices HCP addressed any significant effects to the bull trout or designated bull trout critical habitat that are likely to result from off-site acquisition of large wood. No additional effects to the bull trout or designated bull trout critical habitat are expected to result from this interrelated or interdependent action.

Post-construction monitoring and maintenance activities that do not alter the function or as-built physical footprint of the constructed ELJs and revetments will result in no additional effects to the bull trout or designated bull trout critical habitat.

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. 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.

Managed public and private forest is the dominant land use throughout the middle and upper Skagit River watershed. Conditions that limit or reduce instream habitat function and productivity may improve over the long term as a result of modern forest practices and implementation of the Forest Practices Act.

Climate change and its potential effects cannot be ignored when describing possible future conditions within the action area. In particular, potential effects to seasonal patterns of precipitation, surface water temperatures, and stream hydrology could present dramatically altered conditions for bull trout and other cold-water fisheries of the Pacific Northwest. A recent, wide-ranging assessment of these potential effects has identified the following trends

(Littel et al. 2009):

- Wetter autumns and winters; drier summers; reductions in snowpack.
- Higher winter stream flows; earlier spring snowmelt and peak spring stream flow; lower summer stream flows in rivers that depend on snowmelt.
- Rising stream temperatures and a corresponding reduction in the quality and extent of cold-water habitats.

Littell et al. (2009) have concluded that the combined effects of warming stream temperatures and altered stream flows will very likely reduce the reproductive success of many salmon populations. As much as one-third of the current habitat in the Pacific Northwest may no longer be suitable by the end of the century. Rising stream temperatures and temporal shifts in stream hydrology will have more pronounced effects on the systems, populations, and life-history types that are most sensitive.

As a glacially-fed system, the Skagit River's seasonal hydrology and temperature profile are influenced by both snow and glacial melt. Glaciers and glacial melt are important sources of water augmenting late summer and early fall streamflows in the Skagit River watershed, and average annual temperature in the North Cascades region increased by approximately 0.9 ^{o}C over the last century (Portland State University 2011). In this respect, the middle and upper Skagit River watershed represents a sensitive system where climate change's effects to instream habitat function and productivity could be pronounced. Bull trout of the middle and upper Skagit River watershed could be at greater future risk for climate-mediated chronic and/or stochastic events which degrade and fragment habitats, suppress productivity, and increase the physical or genetic isolation of local populations.

Taken as a whole, the foreseeable future State, tribal, local, and private actions may have both beneficial effects and adverse effects to bull trout and designated bull trout critical habitat. At the scale of the action area, we expect that foreseeable future actions may be less important than the consequences of climate change and its potential effects to watershed functions.

CONCLUSION

We have reviewed the current status of the bull trout in its coterminous range, the environmental baseline for the action area, the direct and indirect effects of the proposed project, the effects of interrelated and interdependent actions, and the cumulative effects that are reasonably certain to occur in the action area.

Bull Trout

It is our Biological Opinion that the action, as proposed, is not likely to jeopardize the continued existence of the bull trout in its coterminous range. This determination is based on the following:

- The action area contains FMO habitat for fluvial and anadromous bull trout of the Lower Skagit River core area, and lies in close proximity to productive bull trout spawning and rearing habitats. The action area is presumed to support adult, subadult, and juvenile bull trout originating from 7 of the core area's 21 documented, local bull trout populations (Illabot Creek, Cascade River and South Fork Cascade River, Bacon Creek, Goodell Creek, Newhalem Creek, and Stetattle Creek). Current information suggests that each of these populations is stable or increasing. The action area does not contain suitable bull trout spawning or early rearing habitats.

- The proposed action incorporates both permanent design elements and conservation measures which will reduce effects to habitat and avoid and minimize impacts during construction. The action's temporary adverse effects are limited in both physical extent and duration. The incorporated permanent design elements will partially offset the action's permanent adverse effects, create and maintain functioning habitat, and avoid the damage resulting from repeat emergency repairs within the project area.

- With full implementation of the proposed conservation measures, we expect low numbers of adult, subadult, and juvenile bull trout will be adversely affected by construction activities. Exposure to construction activities may injure or kill a limited number of bull trout, estimated at two individuals in total. Construction activities will also significantly disrupt normal bull trout behaviors (feeding, moving, and sheltering). Construction activities may temporarily delay or discourage adult migration up through the action area, but will have no effect on bull trout spawning habitat or essential spawning behaviors.

- The proposed action would permanently reinforce an existing artificial constraint on the channel migration zone and floodplain, and thereby impair natural processes that contribute to the formation and maintenance of diverse instream physical habitat. However, these adverse effects would be limited in physical extent, partially offset by the incorporated permanent design elements, and would not extend beyond the limits of the constructed ELJs and large wood and dolotimber revetments.

- While the proposed action may injure or kill a limited number of bull trout and will significantly disrupt normal bull trout behaviors (feeding, moving, and sheltering), we expect that any temporary effects to bull trout numbers (abundance) or reproduction (productivity) will not be measurable at the scale of the local populations or core area. The action's temporary and permanent effects will not preclude bull trout from rearing, foraging, and migrating within the action area.

- The anticipated direct and indirect 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 bull trout reproduction, numbers, or distribution at the scale of the core area or Puget Sound interim recovery unit. The anticipated direct and indirect effects of the action will not alter the status of bull trout at the scale of the Puget Sound interim recovery unit or coterminous range.

Bull Trout Critical Habitat

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

- The action area extends over approximately 1.4 linear mi of the mainstem Skagit River's active channel migration zone, side-channels, and floodplain. Eight of the nine PCEs of designated bull trout critical habitat are present in the action area.

- The action area provides core FMO habitat and, based on proximity, is presumed to support bull trout originating from 7 of the core area's 21 documented, local bull trout populations (Illabot Creek, Cascade River and South Fork Cascade River, Bacon Creek, Goodell Creek, Newhalem Creek, and Stetattle Creek). The Lower Skagit River core area is believed to support some of the Puget Sound Management Unit's largest and most robust bull trout populations. Long term viability of the Lower Skagit River bull trout population is critically important to maintaining the overall distribution of migratory life history forms throughout the management unit.

- The proposed action will have both direct and indirect effects to bull trout critical habitat. Some of these effects will be temporary, construction-related and limited in both physical extent and duration. Others will be permanent or long term, lasting for the functional life of the constructed ELJs and revetments. The proposed action incorporates permanent design elements and conservation measures which will partially offset effects to critical habitat, and avoid and minimize impacts during construction.

- Construction activities will create a temporary, partial barrier to free movement, for approximately four months, over a single extended construction season. None of the proposed action's temporary adverse effects to the PCEs of bull trout critical habitat are expected to persist for more than two years after construction.

- The proposed action will reinforce an existing artificial constraint on the channel migration zone and floodplain along approximately 1,300 linear ft of the Skagit River. Because the project will further impair natural processes that contribute to the formation and maintenance of diverse instream physical habitat, we do expect permanent or long term adverse effects to PCE #4 (complex aquatic environments and processes). Bank hardening will reduce opportunities for interaction between the active channel and floodplain, and permanently (or indefinitely) reduce the potential for development of off-channel habitat complexity. However, we also expect that the constructed ELJs and revetments will improve instream habitat function compared to the smooth riprap revetment and entrained channel thalweg that exists at this location today. The constructed ELJs and large wood and dolotimber revetments should function to provide a range of channel depths, complex cover, and resting and refuge habitat from stream velocities and forces. The action should substantially increase channel and floodplain roughness, and thereby lessen hydraulic forces and resulting bed and bank erosion along

the downstream reach. Resulting conditions will provide improved foraging and overwintering opportunities for bull trout.

- The direct and indirect effects of the proposed action (permanent and temporary) will not preclude bull trout from foraging, migrating, or overwintering within the action area.

- Within the action area, designated bull trout critical habitat will retain its current ability to establish functioning PCEs. The anticipated direct and indirect 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 prevent the PCEs of designated bull trout critical habitat from being maintained, and will not degrade the current ability to establish functioning PCEs at the scale of the action area. Critical habitat within the action area will continue to serve the intended conservation role for the species at the scale of the core area, Puget Sound interim recovery unit, and coterminous range.

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 Service as an act which actually kills or injures wildlife. Such 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 Service 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.

The measures described below are non-discretionary, and must be undertaken by the Corps and FHWA so that they become binding conditions of any grant or permit issued, as appropriate, for the exemption in section 7(o)(2) to apply. The Corps and FHWA have a continuing duty to regulate the activity covered by this incidental take statement. If the Corps or FHWA (1) fail to assume and implement the terms and conditions or (2) fail to require the contractor or applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Corps and FHWA must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement [50 CFR 402.14(i)(3)].

AMOUNT OR EXTENT OF TAKE

We anticipate that take in the form of harm and harassment of adult, subadult, and juvenile bull trout from the Lower Skagit River core area will result from the proposed action.

(1) Incidental take of bull trout in the form of ***harm*** (physical injury or mortality) resulting from handling related to fish capture and removal operations.

- One adult or subadult bull trout and one juvenile bull trout will be harmed as a result of fish capture and removal operations conducted between February 1 and May 10, and between August 1 and September 1, 2013, or the year of construction should the project be delayed.

(2) Incidental take of bull trout in the form of ***harassment*** (stress not reaching the level of physical injury) resulting from handling related to fish capture and removal operations.

- Two adult or subadult bull trout and three juvenile bull trout will be harassed as a result of fish capture and removal operations conducted between February 1 and May 10, and between August 1 and September 1, 2013, or the year of construction should the project be delayed.

The following forms of incidental take will be difficult to detect or quantify for the following reasons: 1) the low likelihood of finding dead or injured adults, subadults, or juveniles; 2) delayed mortality; and, 3) the relationship between habitat conditions and the distribution and abundance of individuals is imprecise such that a specific number of affected individuals cannot be practically obtained. Where this is the case, we use post-project habitat conditions as a surrogate indicator of take.

(3) Incidental take of bull trout in the form of ***harassment*** resulting from emergency placement of riprap armor, bank hardening, encroachment on the channel migration zone, and associated adverse effects to instream habitat.

- Approximately 0.3 acre below the Skagit River's OHWM, persisting until more permanent and more functional bank repairs are constructed (year 2013 or soon after).

(4) Incidental take of bull trout in the form of ***harassment*** resulting from degraded surface water quality and exposure to elevated turbidity and sedimentation during construction. Water quality will be degraded intermittently during the approximately 120-day period when construction activities are being completed below the OHWM of the Skagit River. Take will result when levels of turbidity reach or exceed the following:

i) 68 NTUs above background at any time; or

ii) 25 NTUs above background for more than 1 hour, continuously; or

iii) 25 NTUs above background for more than 3 hours, cumulatively, over a 10-hour workday; or

iv) 9 NTUs above background for more than 7 hours, cumulatively, over a 10-hour workday.

- All adult, subadult, and juvenile bull trout within the wetted perimeter of the Skagit River, from a point approximately 100 ft upstream to a point approximately 600 ft downstream of construction activities, will be harassed between February 1 and May 10, and between August 1 and September 1, 2013, or the year of construction should the project be delayed.

(5) Incidental take of bull trout in the form of ***harassment*** resulting from temporary increased sedimentation along the downstream reach.

- All adult, subadult, and juvenile bull trout within the wetted perimeter of the Skagit River, extending to a distance of 0.25 mile downstream, and for a duration of up to two years after construction (September 2015).

(6) Incidental take of bull trout in the form of ***harassment*** resulting from bank hardening, encroachment on the channel migration zone and floodplain, and associated permanent adverse effects to instream and off-channel habitats.

- All bull trout associated with approximately 1,300 linear ft of the Skagit River's right-bank, indefinitely and for the functional life of the constructed ELJs and revetments.

EFFECT OF THE TAKE

In the accompanying Opinion, we determined that the level of anticipated take is not likely to result in jeopardy to the bull trout.

The proposed action incorporates design elements and conservation measures which we expect will reduce permanent effects to habitat and avoid and minimize impacts during construction.

REASONABLE AND PRUDENT MEASURES

The following reasonable and prudent measures (RPMs) are necessary and appropriate to minimize the impact of incidental take to bull trout:

(1) Minimize and monitor incidental take resulting from emergency placement of riprap armor.

(2) Minimize and monitor incidental take caused by handling related to fish capture and removal operations.

(3) Minimize and monitor incidental take caused by elevated turbidity and sedimentation during construction.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the ESA, the FHWA and Corps must comply with the following terms and conditions, which implement the RPMs described above. These terms and conditions are non-discretionary.

The following terms and conditions are required for the implementation of RPM 1:

(1) The Corps and WSDOT shall monitor the direct and indirect adverse effects resulting from emergency placement of riprap armor along the Skagit River's right-bank. These adverse effects have been quantified, in the current condition, as approximately 0.3 acre below the Skagit River's OHWM.

(2) The Corps and WSDOT shall monitor conditions at the site on an annual basis, at a minimum during 2011, 2012, and 2013, until the more permanent and more functional repairs are constructed. This monitoring shall include aerial photos and/or photos taken on-site from fixed reference points.

(3) The Corps and WSDOT shall quantify and track any measurable effects to side-channel, floodplain, and riparian habitats, including any erosion occurring along the right-bank, forested floodplain wetland located downstream.

(4) The Corps and WSDOT shall ensure that the measurable, direct and indirect adverse effects resulting from emergency placement of riprap armor do not exceed 0.3 acre below the Skagit River's OHWM. If the adverse effects resulting from emergency placement of riprap armor exceed 0.3 acre below the Skagit River's OHWM, then the amount of take authorized by the Incidental Take Statement will have been exceeded. The Corps and WSDOT shall contact the Service's consulting biologist at the Washington Fish and Wildlife Office in Lacey, Washington (Ryan McReynolds; 360-753-6047).

(5) The FHWA, Corps, and WSDOT shall ensure that the final plans and specifications for the proposed ELJs and large wood and dolotimber revetments address completely the measurable adverse effects resulting from emergency placement of riprap armor. The final plans and specifications shall fully replace any lost or impaired functions, including channel bed and bank roughness, channel margin complexity, off-channel habitat refugia, and riparian structure and thermal cover.

(6) The FHWA, Corps, and WSDOT shall submit the final design to the Service ("90 percent design" or better) prior to awarding the contract for the proposed ELJs and large wood and dolotimber revetments. The submitted documentation shall also quantify and report any measurable effects to side-channel, floodplain, and riparian habitats that have occurred since consultation, including any erosion occurring along the right-bank, forested floodplain wetland located downstream. The submitted documentation shall demonstrate how the final design fully replaces any lost or impaired functions.

(7) The FHWA, Corps, and WSDOT shall document the as-built condition, including, but not limited to, the final quantities of placed large wood and dolotimbers; a diagram in plan view; and, dated photo documentation from fixed reference points. The FHWA and Corps shall submit a report providing this information by November 30 following the in-water construction season. The FHWA and Corps shall monitor the ELJs and large wood and dolotimber revetments for stability and for signs of bed (toe) or bank scour. The FHWA and Corps shall submit a minimum of one additional report, between two years and four years after construction. The submitted report shall provide dated photo documentation from fixed reference points and shall describe and provide the dates for any post-construction monitoring or maintenance activities conducted in support of the project.

(8) All documentation shall be submitted to the Service's consulting biologist (Ryan McReynolds, 360- 753-6047) at the Washington Fish and Wildlife Office in Lacey, Washington.

The following terms and conditions are required for the implementation of RPM 2:

(1) The FHWA and WSDOT shall ensure that fish capture and removal operations are conducted by a qualified biologist, and that all staff participating in the operation have the necessary knowledge, skills, and abilities to ensure safe handling of fish. Fish capture and removal operations shall take all appropriate steps to minimize the amount and duration of handling. The operations shall maintain captured fish in water to the maximum extent possible during seining/netting, handling, and transfer for release, to prevent and minimize stress.

(2) The FHWA and WSDOT shall ensure that water quality conditions are adequate in the buckets or tanks used to hold and transport captured fish. The operations shall use aerators to provide for the circulation of clean, cold, well-oxygenated water, and/or shall stage fish capture, temporary holding, and release, to minimize the risks associated with

prolonged holding.

(3) The FHWA and WSDOT shall only employ electrofishing if all other means of fish capture and removal have been determined impracticable, and only after a qualified biologist determines that adult and subadult fish have been effectively removed. Electrofishing methods shall use the minimum voltage, pulse width, and rate settings necessary to immobilize fish. Water conductivity shall be measured in the field before electrofishing to determine appropriate settings. Electrofishing equipment and methods shall comply with the electrofishing guidelines outlined by the NMFS (NMFS 2000).

(4) The FHWA and WSDOT shall provide notice to the Service's consulting biologist (Ryan McReynolds, 360-753-6047) a minimum of ten days prior to fish capture and removal operations. Upon request, the FHWA and WSDOT shall permit the Service or its designated representative to observe fish capture and removal operations.

(5) The FHWA and WSDOT shall document and report all bull trout or other salmonids encountered during fish capture and removal operations. The FHWA and WSDOT shall submit a monitoring report to the Service's consulting biologist (Ryan McReynolds, 360-753-6047) at the Washington Fish and Wildlife Office in Lacey, Washington, by November 30 following the in-water construction season.

The following terms and conditions are required for the implementation of RPM 3:

(1) The FHWA and WSDOT shall monitor turbidity levels in the Skagit River during sediment-generating activities. Monitoring shall be conducted at a distance of 300 ft downstream of sediment-generating activities.

(2) Monitoring shall be conducted at 30-minute intervals from the start of sediment-generating activities. If turbidities measured over the course of three consecutive 30-minute sample intervals do not exceed 9 NTUs over background, then monitoring of sediment-generating activities will be conducted for the remainder of the workday at a frequency of once every three hours, or if there is a visually appreciable increase in turbidity.

(3) If, at any time, monitoring conducted 300 ft downstream of sediment-generating activities indicates turbidity in excess of 9 NTUs over background, then monitoring shall instead be conducted at 600 ft downstream of sediment-generating activities. Monitoring shall be conducted at 30-minute intervals until turbidity falls below 9 NTUs over background.

(4) If turbidity levels measured at 600 ft downstream of sediment-generating activities exceed 9 NTUs over background for more than 7 hours cumulatively over any 10-hour workday, 25 NTUs over background for more than 3 hours cumulatively over any 10-hour workday, or 68 NTUs over background at any time, then the amount of take authorized by the Incidental Take Statement will have been exceeded. Sediment-

generating activities shall cease, and the FHWA and/or WSDOT shall contact the Service's consulting biologist at the Washington Fish and Wildlife Office in Lacey, Washington (Ryan McReynolds; 360-753-6047).

(5) Monitoring shall be conducted to establish background turbidity levels away from the influence of sediment-generating activities. Background turbidity shall be monitored at least twice daily during sediment-generating activities. In the event of a visually appreciable change in background turbidity, an additional sample shall be taken.

(6) The FHWA and WSDOT shall submit a monitoring report to the Service's consulting biologist (Ryan McReynolds; Washington Fish and Wildlife Office, Lacey, Washington) by November 30 following the in-water construction season, to include at a minimum, the following: (a) dates and times of construction activities, (b) monitoring results, sample times, locations, and measured turbidities (in NTUs), (c) summary of construction activities and measured turbidities associated with those activities, and, (d) summary of corrective actions taken to reduce sediment/turbidity. The monitoring report shall also include a qualitative description of the final condition of the work area. The FHWA and WSDOT shall document any obvious signs of channel bed or bank instability (e.g., headcutting) resulting from the work, any additional actions taken to correct this instability, and the final condition of the work area.

We expect that the amount or extent of incidental take described above will not be exceeded as a result of the proposed action. The RPMs, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. The FHWA, Corps, and WSDOT must provide an explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.

The Service is to be notified within three working days upon locating a dead, injured or sick endangered or threatened species specimen. Initial notification must be made to the nearest U.S. Fish and Wildlife Service Law Enforcement Office. Notification must include the date, time, precise location of the injured animal or carcass, and any other pertinent information. Care should be taken in handling sick or injured specimens to preserve biological materials in the best possible state for later analysis of cause of death, if that occurs. In conjunction with the care of sick or injured endangered or threatened species or preservation of biological materials from a dead animal, the finder has the responsibility to ensure that evidence associated with the specimen is not unnecessarily disturbed. Contact the U.S. Fish and Wildlife Service Law Enforcement Office at (425) 883-8122, or the Service's Washington Fish and Wildlife Office at (360) 753-9440.

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 Service recommends the following to the FHWA:

(1) The FHWA and WSDOT should continue scoping and evaluating permanent solutions for other environmental deficiencies along SR 20, the Skagit River, and its tributaries. These solutions should take into consideration the effects of future climate change, which are likely to further exacerbate flooding and bed and bank instability throughout the middle and upper Skagit River watershed. These effects could heighten existing river-road conflicts, create new conflicts, and further degrade and fragment the habitats which support bull trout.

(2) The FHWA and WSDOT should review available bald eagle wintering, roosting, and nesting data for the action area, and evaluate the need for staging options or other measures directed at avoiding and minimizing potential effects to bald eagles. The FHWA and WSDOT should contact the Washington Fish and Wildlife Office in Lacey, Washington (Attn: Colleen Stinson and Jim Michaels), to discuss and proactively address potential eagle take, including take that might result from use of a helicopter during the first phase of construction (January to May).

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

REINITIATION NOTICE

This concludes formal consultation on the action outlined in the request. As provided in 50 CFR section 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.

LITERATURE CITED

Acosta, B. 2011. McReynolds, R. Communication between Beth Acosta and Ryan McReynolds re: SR 20 Skagit River CED (FWS Ref No.s 13410-2011-F-0141 and 13410-2010-F-0175). 05/06/2011.

Ainslie, B.J., J.R. Post, and A.J. Paul. 1998. Effects of pulsed and continuous DC electrofishing on juvenile rainbow trout. North American Journal of Fisheries Management 18:905-918.

Bash, J., C.H. Berman, and S. Bolton. 2001. Effects of turbidity and suspended solids on salmonids. Center for Streamside Studies, University of Washington, Seattle, WA, November 2001. 72 pp.

Beamer, E.M., and R.A. Henderson. 1998. Juvenile salmonid use of natural and hydromodified stream bank habitat in the mainstem Skagit River, northwest Washington. 55 pp.

Cederholm, C.J., and L.M. Reid. 1987. Impact of forest management on coho salmon (*Oncorhynchus kisutch*) populations of the Clearwater River, Washington: A project summary. Pages 373-398 *In* E.O. Salo, and T.W. Cundy, eds. Streamside management: Forestry and fishery interactions. University of Washington Institute of Forest Resource Contribution 57.

Chan, J. 2011. McReynolds, R. Communication between Jeff Chan (Listing and Recovery) and Ryan McReynolds re: presence of non-native in the Skagit River system. 06/20/2011.

Chapman, D.W. 1988. Critical-review of variables used to define effects of fines in redds of large salmonids. Transactions of the American Fisheries Society 117(1):1-21.

Cramer, M., K. Bates, D. Miller, K. Boyd, L. Fotherby, P.B. Sidmore, and T. Hoitsma. 2003. Integrated streambank protection guidelines. Washington State Departments of Ecology, Fish and Wildlife, and Transportation, Washington State Aquatic Habitat Guidelines Program, Olympia, WA.

Curry, R.A., and W.S. MacNeill. 2004. Population-level responses to sediment during early life in brook trout. Journal of the North American Benthological Society 23:140-150.

Dalbey, S.R., T.E. Mcmahon, and W. Fredenberg. 1996. Effect of electrofishing pulse shape and electrofishing-induced spinal injury on long-term growth and survival of wild rainbow trout. North American Journal of Fisheries Management 16(3):560-569.

Dwyer, W.P., and R.G. White. 1997. Effect of electroshock on juvenile arctic grayling and Yellowstone cutthroat trout growth, 100 days after treatment. North American Journal of Fisheries Management 17:174-177.

Hollender, B.A., and R.F. Carline. 1994. Injury to wild brook trout by backpack electrofishing. North American Journal of Fisheries Management 14:636-649.

Littel, J.S., M. McGuire Elsner, L.W. Binder, and A.K. Snover. 2009. The Washington climate change impacts assessment: evaluating Washington's future in a changing climate. Climate Impacts Group, University of Washington, Seattle, Washington.

McMichael, G.A., A.L. Fritts, and T.N. Pearson. 1998. Electrofishing injury to stream salmonids; Injury assessment at the sample, reach, and stream scales. North American Journal of Fisheries Management 18:894-904.

Newcombe, C.P., and J.O.T. Jensen. 1996. Channel suspended sediment and fisheries: synthesis for quantitative assessment of risk and impact. North American Journal of Fisheries Management 16(4):693-727.

Newcombe, C.P., and D.D. MacDonald. 1991. Effects of suspended sediments on aquatic ecosystems. North American Journal of Fisheries Management 11(1):72-82.

NMFS. 1997. Fish screening criteria for anadromous salmonids, Available: http://swr.nmfs.noaa.gov/hcd/fishscrn.htm. (11/18/2010).

NMFS. 2000. Guidelines for electrofishing waters containing salmonids listed under the Endangered Species Act. National Marine Fisheries Service, Portland, Oregon, June 2000. 5 pp.

Peters, R.J., B.M. Missildine, and D.L. Low. 1998. Seasonal fish densities near river banks stabilized with various stabilization methods - first year report of the flood technical assistance project. USFWS, Western Washington Office, Aquatic Resources Division, Lacey, WA. 50 pp.

Portland State University. 2011. Glacier change in teh Upper Skagit River basin: questions about glaciers, climate, and streamflow, 1. Available: http://www.glaciers.pdx.edu/Projects/LearnAboutGlaciers/Skagit/Basics00.html. (06/21/2011).

Raphael, M.G., G.M. Galleher, M.H. Huff, S.L. Miller, S.K. Nelson, and R. Young. 2006. Spatially-explicit estimates of potential nesting habitat for the marbled murrelet. Pages 97-146 *In* M.H. Huff, M. Raphael, S.L. Miller, S.K. Nelson, and J. Baldwin, eds. Northwest Forest Plan - The first 10 years (1994-2003): Status and trend of populations and nesting habitat for the marbled murrelet. Draft General. Technical Report. PNW-GTR-650. U.S. Department of Agriculture Forest Service, Pacific Northwest Research Station, Portland, Oregon.

Schmetterling, D.A., C.G. Clancy, and T.M. Brandt. 2001. Effects of riprap bank reinforcement on stream salmonids in the western United States. Fisheries 26(7):6-13.

Servizi, J.A., and D.W. Martens. 1991. Effect of temperature, season, and fish size on acute lethality of suspended sediments to coho salmon (*Oncorhynchus kisutch*). Canadian Journal of Fisheries and Aquatic Sciences 48(3):493-497.

Sharber, N.G., and S.W. Carothers. 1988. Influence of electrofishing pulse shape on spinal injuries in adult rainbow trout. North American Journal of Fisheries Management 8:117-122.

Thompson, K.G., E.P. Bergersen, R.B. Nehring, and D.C. Bowden. 1997a. Long-term effects of electroshocking on growth and body condition of brown trout and rainbow trout. North American Journal of Fisheries Management 17(1):154-159.

Thompson, K.G., P. Bergersen, and R.B. Nehring. 1997b. Injuries to brown trout and rainbow trout induced by capture with pulsed direct current. North American Journal of Fisheries Management 17:141-153.

USFWS. 1998. A framework to assist in making Endangered Species Act determinations of effect for individual or grouped actions at the bull trout subpopulation watershed scale. Western Washington Fish and Wildlife Office, Lacey, WA. 45 pp.

USFWS. 2000. Impacts of riprapping to ecosystem functioning, lower Sacramento River, California. U.S. Fish and Wildlife Service, Sacramento, CA.

USFWS. 2003. Biological opinion and letter of concurrence for effects to bald eagles, marbled murrelets, northern spotted owls, bull trout, and designated critical habitat for marbled murrelets and northern spotted owls from Olympic National Forest program of activities for August 5, 2003, to December 31, 2008. Western Washington Fish and Wildlife Office, 1-3-03-F-0833, Lacey, Washington, August 05, 2003.

USFWS. 2004. Draft Recovery Plan for the Coastal-Puget Sound distinct population segment of bull trout (*Salvelinus confluentus*). Volume I: Puget Sound Management Unit, 389+xvii pp and Volume II: Olympic Peninsula Management Unit, 277+xvi pp, Portland, Oregon.

USFWS. 2006. Biological opinion for the issuance of an incidental take permit (PRT-TE121202-0) to the state of Washington for the implementation of the Washington forest practices habitat conservation plan. Western Washington Fish and Wildlife Office, 1-3-06-FWF-0301, Lacey, WA, May 16, 2006. 1152 pp.

USFWS. 2008. Bull trout core area templates - an unpublished compilation of updated bull trout core area analysis to support the five-year review. U.S. Fish and Wildlife Service, Portland, OR, August 24, 2008. 1895 pp.

USFWS. 2010. Sediment analysis framework: determining effects for Section 7 consultations. USFWS, Lacey, WA, 2010. 21 pp.

USFWS, and NMFS. 1998. Final endangered species consultation handbook: Procedures for conducting consultation and conference activities under section 7 of the Endangered Species Act. U. S. Fish and Wildlife Service and National Marine Fisheries Service, U.S. GPO: 2004-690-278, Washington, D.C., March 1998. 189 pp.

Waters, T.F. 1995. Sediment in streams: Sources, biological effects, and control. American Fisheries Society, Monograph Monograph 7, Bethesda, Maryland. 251 pp.

WDFW. 2008. Priority habitats and species list, habitat program. Washington Department of Fish and Wildlife, Olympia, WA. 28 pp.

WDNR. 2005. Forest Practices Habitat Conservation Plan - final. Washington Department of Natural Resources, Olympia, WA.

WDOE. 2008. Information presented on: Washington state's water quality assessment [303(d)], .

WDOE. 2011. River and stream water quality monitoring: water quality monitoring station 04A100 (Skagit River @ Marblemount). 1. Available: http://www.ecy.wa.gov/apps/watersheds/riv/station.asp?wria=04. (06/21/2011).

WSCC (Washington State Conservation Commission). 2003. Salmon and Steelhead Limiting Factors Analysis in WRIA 3 and 4, the Skagit and Samish Basins. Wasington State Conservation Commission, Olympia, Washington. 63 pp.

WSDOT. 2009. Biological assessment - Skagit River emergency bank stabilization actions 2004, 2006, and 2007, state route 20 milepost 100.7 to 101.4. WSDOT, Seattle, WA, May 2009. 37 pp.

WSDOT. 2011. Biological assessment - state route 20, milepost 100 to 101 Skagit River CED / permanent stabilization. WSDOT, Seattle, WA, January 2011. 80 pp.

APPENDICES

Appendix A: WSDOT Fish Exclusion Protocols and Standards (2009)
Appendix B: Status of the Species (Bull Trout; Coterminous Range)
Appendix C: Status of Designated Critical Habitat (Bull Trout; Coterminous Range)
Appendix D: Lower Skagit River Core Area (Bull Trout)
Appendix E: Sediment Analysis Framework (2010)

APPENDIX A: WSDOT Fish Exclusion Protocols and Standards (2009)

Appendix A: WSDOT Fish Exclusion Protocols and Standards

Work below the Ordinary High-Water Mark (or Mean Higher High-Water Mark) shall, in general, be conducted in isolation from flowing waters. Exceptions to this general rule or performance measure include: 1) implementation of the work area isolation and fish capture and removal protocols described in this document; 2) placement or removal of small quantities of material (e.g., wood or rock), or installation of structural best management practices (e.g., turbidity curtain), under site conditions where potential exposures and effects to fish life are minimized without isolation from flowing waters[1]; 3) work conducted under a declared emergency or under emergency conditions; or, 4) work conducted where flow conditions prevent safe implementation of work area isolation and fish capture and removal protocols.

Implementation of the work area isolation and fish capture and removal protocols shall be planned and directed by a WSDOT biologist, or qualified biologist under contract to WSDOT, possessing all necessary knowledge, training, and experience (the directing biologist). If electrofishing will or may be used as a means of fish capture, the directing biologist shall have a minimum of 100 hours electrofishing experience in the field using similar equipment, and any individuals operating electrofishing equipment shall have a minimum of 40 hours electrofishing experience under direct supervision. All individuals participating in fish capture and removal operations shall have the training, knowledge, skills, and ability to ensure safe handling of fish, and to ensure the safety of staff conducting the operations.

The directing biologist shall work with Maintenance, Construction, and/or Environmental staff (as appropriate) to plan the staging and sequence for work area isolation, fish capture and removal, and dewatering. This plan should consider the size and channel characteristics of the area to be isolated, the method(s) of dewatering (e.g., diversion with bypass flume or culvert; diversion with sandbag, sheet pile or similar cofferdam; etc.), and what sequence of activities will provide the best conditions for safe capture and removal of fish. Where the area to be isolated is small, depths are shallow, and conditions are conducive to fish capture, it may be possible to isolate the work area and remove all fish life prior to dewatering or flow diversion. Where the area to be isolated is large, depths are not shallow, where flow volumes or velocities are high, and/or conditions are not conducive to easy fish capture, it may be necessary to commence with dewatering or flow diversion staged in conjunction with fish capture and removal. The directing biologist shall use his/her best professional judgment in deciding what sequence of activities is likely to minimize exposure of fish to conditions causing stress or injury (including stranding, exposure to extremes of temperature or reduced dissolved oxygen, risk of injury resulting from electrofishing, etc.).

[1] WSDOT shall make this determination with consultation or input from the regulatory agencies with jurisdiction, including the Washington State Department of Fish and Wildlife (WDFW), U.S. Fish and Wildlife Service (FWS), and NOAA-National Marine Fisheries Service (NMFS) as appropriate; also, this exception shall not permit work that requires in-water excavation or that presents a risk of increased turbidity beyond the immediate work area or for a duration of more than 15 minutes.

The directing biologist shall plan work area isolation, fish capture and removal, and dewatering with consideration for the following: habitat connectivity and fish habitat requirements; the duration and extent of planned in-water work; anticipated flow and temperature conditions over the duration of planned in-water work; and, the risk of exposure to turbidity or other unfavorable conditions during construction. If the area to be isolated includes only a portion of the wetted channel width (e.g., large or deep rivers where diversion from the entirety of the wetted channel is difficult or impossible), or if the bypass flume or culvert will effectively maintain connectivity and fish passage for the duration of construction activities, it may be less important whether fish are herded (and/or captured and released) upstream or downstream of the isolated work area. However, if the area to be isolated includes the entire wetted channel width, and especially if conditions make it unlikely that connectivity (i.e., upstream/ downstream fish passage) can be effectively maintained for the duration of construction activities, then the directing biologist should carefully consider whether to herd fish (and/or capture and release fish) upstream or downstream of the isolated work area.

If conditions upstream of the isolated work area will or may become unfavorable during construction, then fish should not be herded or released to an upstream location; this situation is probably most common where the waterbody in question is small, where seasonal flows are substantially diminished, and conditions of elevated temperature and/or reduced dissolved oxygen are foreseeable. However, the directing biologist shall also consider whether planned in-water work presents a significant risk of downstream turbidity and sedimentation; fish herded or released to a downstream location may be exposed to these conditions.

If large numbers of fish are to be herded (and/or captured and released), and in order to avoid overcrowding or concentrating fish in areas where their habitat needs cannot be met, it may be appropriate to relocate fish both upstream and downstream of the isolated work area. At locations where habitat connectivity or quality is poor, including along reaches upstream and/or downstream of the isolated work area, the directing biologist should carefully consider whether relocated fish can meet their minimum habitat requirements for the duration of planned in-water work. On rare occasions it may be appropriate to relocate fish at a greater distance upstream and/or downstream (e.g., thousands of feet or miles), so as to ensure fish are not concentrated in areas where their habitat needs cannot be met, or where they may be exposed to unfavorable conditions during construction. On those rare occasions where relocation to a greater distance is deemed necessary, the WSDOT shall provide notice to the agencies with jurisdiction in advance of the operations.

Plans for staging work area isolation, fish capture and removal, and dewatering must comply with WSDOT safety requirements. Safe implementation is a high priority. The directing biologist shall design and adjust the plan as necessary to ensure the safety of all individuals implementing the plan. Under some conditions it may be appropriate to conduct work without isolation from flowing waters, without placement of block nets, fish capture or removal; for a fuller discussion of this topic see page 1.

In order to comply with WSDOT safety requirements, work in or around water outside of daylight hours is not generally permissible. If, under unusual circumstances, the directing

biologist identifies work that will or may be necessary outside of daylight hours, he/she shall coordinate and gain approval for this work with appropriate managers (including the WSDOT safety officer and/or supervisors with authority).

Work Area Isolation

The directing biologist shall determine appropriate locations for the placement of block nets, based on site characteristics and a consideration of the type and extent of planned in-water work. Sites that exhibit reduced flow volume or velocity, uniformity of depth, and good accessibility are preferred; sites with heavy vegetation, large cobble or boulders, undercut banks, deep pools, etc. should be avoided due to the difficulty of securing and/or maintaining nets. Sites with a narrow channel cross-section ("constriction") should be avoided if foreseeable flow conditions might overwhelm or dislodge the block nets, posts, or anchors.

Except when planning and intending to herd fish upstream, an upstream block net shall be placed first. With a block net secured to prevent movement of fish into the work area from upstream, a second block net should be used as a seine to herd fish in a downstream direction. Where the area to be isolated includes a culvert(s), deep pools, undercut banks, or other cover attractive to fish (e.g., thick overhanging vegetation, rootwads, logjams, etc.) it may be appropriate to isolate a portion or portions of the work area, rather than attempting to herd fish from the entirety of the work area in a single downstream pass. Fish capture and removal will be most successful if an effort is made to strategically focus and concentrate fish in areas where they can be easily seined and netted. Care shall be taken not to concentrate fish where they are exposed to sources of stress, or to leave them concentrated in such areas for a long duration (e.g., more than 30 minutes).

Depending upon site characteristics, and the planned staging and sequence for work area isolation and dewatering, it may or may not be necessary to place a downstream block net. Typically, however, site characteristics and/or the duration of planned in-water work will necessitate placement of a net(s) to prevent movement of fish into the work area from downstream. If groundwater seepage or site drainage has a tendency to re-wet the area, if the area to be isolated is low-gradient or subject to a backwatering influence, or if the area to be isolated is large and considerable effort will be expended in capturing and removing fish life, a downstream block net should be placed. If foreseeable flow conditions over the duration of planned in-water work might enable fish to re-enter the work area from downstream, a downstream block net should be placed.

In most instances where gradual dewatering or flow diversion is staged in conjunction with fish capture and removal, it is appropriate to delay installation of the downstream block net(s) until after fish have been given sufficient time to move downstream by their own choosing. If flows are reduced gradually over the course of several hours, or the length of an entire workday, some (perhaps many) fish will make volitional movements downstream beyond the area to be isolated. Gradual dewatering can be an effective means by which to reduce the risk of fish stress or injury. Gradual dewatering and the encouragement of volitional movement are particularly important where the area to be isolated is large and may hold many fish. However, where the area to be isolated includes a culvert(s), deep pools, undercut banks, or other cover attractive to fish, some (perhaps many) fish will not choose to move downstream regardless of how gradually flows are

reduced. The directing biologist should use his/her best professional judgment in deciding what sequence of activities is likely to minimize fish stress or injury (including stranding).

Where the area to be isolated is small, depths are shallow, and conditions are conducive to fish capture, it may be possible to remove all fish life prior to dewatering, or to implement plans for dewatering staged with fish capture over a relatively short timeframe (e.g., 1-2 hours). Where the area to be isolated is large, depths are not shallow, where flow volumes or velocities are high, and/or conditions are not conducive to easy fish capture, dewatering or flow diversion should be staged in conjunction with fish capture and removal over a longer timeframe (e.g., 3-6 hours). The largest areas and/or most difficult site conditions may warrant or require that plans for dewatering and fish capture proceed over the length of an entire workday, or multiple workdays. Where this is the case, fish shall be given sufficient time and a means to move downstream by their own choosing so as to reduce the total number of fish exposed to sources of stress and injury (including fish handling).

The directing biologist shall select suitable block nets. Type of material, length, and depth may vary based on site conditions. It may be necessary and appropriate to contact other WSDOT Regions or offices with access to nets (or other materials) suitable for placement under unique or unusual circumstances. Typically block nets will be composed of 9.5 millimeter stretched nylon mesh and should be installed at an angle to the direction of flow (i.e., not directly perpendicular to flow) so as to reduce the risk of impinging fish. Anchor bags filled (or half-filled) with clean, washed gravel are preferred over sandbags, especially for nets and anchors that will or may remain in-place for a long duration (i.e., more than two weeks). Any use or movement of native substrates or other materials found onsite should be incidental and shall not appreciably affect channel bed or bank conditions.

Block nets shall remain in-place until work is complete and conditions are suitable for the reintroduction of fish[2]. Block nets require frequent inspection and debris removal. A qualified biologist, or other field staff trained in safe fish handling, shall be assigned the responsibility of inspecting the nets and safely capturing and relocating any impinged fish. The frequency of these inspections shall be determined on a case-by-case basis. However, block nets shall, at a minimum, be inspected for impinged fish (especially juvenile fish) at least three times daily for the first 48 hours after installation (approximate), and for the first 24 hours after significant rainfall (or change in flow volume or velocity). In the event fish are found impinged on the net(s), or if weather or flow conditions change significantly, the directing biologist shall re-consider and adjust the frequency of net inspections so as to minimize the risk of impinging and injuring fish.

[2] If plans for work area isolation and fish capture and removal include the installation of temporary cofferdams, and once the directing biologist has confirmed fish life have been successfully excluded from the entire area enclosed by the cofferdam(s), it may be appropriate to remove block nets and allow fish to re-enter the previously isolated work area; this approach is particularly relevant and appropriate where many weeks or months of construction are planned for completion within temporary cofferdams (i.e., isolated from flowing waters).

Field staff shall be assigned the responsibility of frequently checking and maintaining the nets for accumulated debris, general stability, and proper function. The frequency of these inspections shall be determined on a case-by-case basis, dependent upon the site, seasonal, and weather conditions. Block nets must be secured along both banks and the channel bottom to prevent failure as a result of debris accumulation, high flows, and/or flanking. Some locations may require additional block net support (e.g., galvanized hardware cloth, affixed metal fence posts, etc.).

Fish Capture and Removal

If dewatering and/or flow diversion are deemed necessary[1], this work (including related fish capture and removal operations) shall comply with any provisions contained in the Hydraulic Project Approval (HPA), or applicable General HPA, issued by the WDFW. If the FWS and/or NMFS have provided relevant Terms and Conditions from a Biological Opinion addressing the work (or action), this work shall also comply with those Terms and Conditions.

If pumps are used to temporarily bypass water or to dewater residual pools or cofferdams, pump intakes shall be screened to prevent aquatic life from entering the intake. Fish screens or guards shall comply with Washington State law (RCW 77.57.010 and 77.57.070), with guidelines prescribed by the NMFS[3], and any more stringent requirements contained in the HPA or General HPA issued by the WDFW. If pumps are to be used on a more permanent basis, as the primary or secondary method for diverting flow around the isolated work area, plans for dewatering shall address contingencies (i.e., extremes of flow or weather). These plans shall include ready access to a larger or additional "back-up" pump with screened intake. If the directing biologist has confirmed that all fish life has been successfully excluded from the area, if there is no risk of entraining fish, and adequate plans are in-place to address contingencies (including a routine schedule for inspection), then pumps may be operated without a screened intake.

<u>Fish Capture and Removal Methods</u>:

Methods for safe capture and removal of fish from the isolated work area are described below. These methods are given in order of preference. At most locations, a combination of methods will be necessary. In order to avoid and minimize the risk of injury to fish, attempts to seine and/or net fish shall always precede the use of electrofishing equipment. Visual observation techniques (e.g. snorkeling, surveying with polarized glasses or Plexiglas bottomed buckets, etc.) may be used to assess the effectiveness of these methods, to identify locations where fish are concentrating, or otherwise adjust methods for greater effectiveness.

If the planned fish capture and removal operations have not been addressed through consultation (or programmatic consultation), if seining and netting are impracticable (i.e., electrofishing is deemed the only viable means of fish capture), and fish listed under the ESA will or may be present, the directing biologist shall provide notice to the FWS and/or NMFS (as appropriate).

---

[3] National Marine Fisheries Service. 1997. Fish screening criteria for anadromous salmonids. NMFS Southwest Region, January 1997, 12p. << http://swr.nmfs.noaa.gov/hcd/fishscrn.pdf >>.

This notice shall be provided in advance of the operations, and shall include an explanation of the unique site conditions or circumstances. Work conducted under a declared emergency (or emergency conditions) shall follow established ESA notification protocols.

Where fish listed under the ESA will or may be present, the directing biologist shall ensure that fish capture and removal operations adhere to the following minimum performance measures or expectations:

1) Only dip nets and seines composed of soft (non-abrasive) nylon material shall be used.

2) The operations shall not resort to the use of electrofishing equipment unless and until other, less injurious methods have been effective in removing most or all of the adult and subadult fish (i.e., fish in excess of 300 millimeters); the operations shall conduct a minimum of three complete passes without capture using seines and/or nets.

3) The operations shall confirm success of fish capture and removal before completely dewatering or commencing with other work within the isolated work area; the operations shall conduct a minimum of two complete passes without capture using electrofishing equipment.

4) Fish listed under the ESA shall not be held in containers for more than 10 minutes, unless those containers are dark-colored, lidded, and fitted with a portable aerator.

· **Seining** shall be the preferred method for fish capture. Other methods shall be used when seining is not possible, or when/after attempts at seining have proven ineffective. Seines, once pursed, shall remain partially in the water while fish are removed with dip nets. Seines with a "bag" minimize handling stress and are preferred. Seines with a bag are also preferred where obstructions make access to the water (or deployment/ retrieval of the seine) difficult.

In general, seining will be more effective if fish, especially juvenile fish, are moved (or "flushed") out from under cover. Methods which may increase effectiveness and/or efficiency include conducting seining operations at dawn or dusk (i.e., during low-light conditions), in conjunction with snorkeling, and/or flushing of the cover. In flowing waters, and especially where flow volume or velocity is high or moderately-high, seines that employ a heavy lead line and variable mesh size are preferred. Small mesh sizes are more effective across the full range of fish size (and age class), but also increase resistance and can make deployment/ retrieval more difficult in flowing waters. Seines which use a small mesh size in the bag (or body), and a larger, less resistant mesh size in the wings may under some conditions be most effective and efficient.

· **Baited Minnow Traps** are typically used before and in conjunction with seining. Traps may be left in the isolated work area overnight. Traps shall be inspected at least four times daily to remove captured fish and thereby minimize predation within the trap. Traps should be checked more frequently if temperatures are in excess of 15 degrees C. Predation within the trap may be an unacceptable risk when/ where minnow traps are left in-place over night; large sculpin and

other predators that feed on juvenile fish are typically much more active at night. The directing biologist shall consider the need and plan for work outside daylight hours (i.e., inspection and removal) before leaving minnow traps in-place over night.

· **Dip Nets** shall be used in conjunction with seining. This method is particularly effective when employed during gradual dewatering or flow diversion. To be most effective, and to minimize stress and risk of injury to fish (including stranding), the directing biologist shall coordinate fish capture operations with plans for dewatering or flow diversion. Plans for dewatering and/or flow diversion shall proceed at a measured pace (within constraints), to encourage the volitional downstream movement of fish, and reduce the risk of stranding. Plans for dewatering and/or flow diversion shall not proceed unless there are sufficient staff and materials onsite to capture and safely remove fish in a timely manner. Generally this will require a minimum of two persons (three if electrofishing), but the directing biologist may find that some sites (especially large or complicated sites) warrant or require a more intensive effort (i.e., additional staffing).

Once netted, fish shall remain partially in water until transferred to a bucket, cooler, or holding tank. Dip nets which retain a volume of water ("sanctuary nets") are preferred. However, sanctuary nets may be ineffective where flow volume or velocity is high or moderately-high (i.e., increased resistance lessens ability to net and capture fish). In addition, where water depths are very shallow and/or fish are concentrated in very small receding pools or coarse substrate, "aquarium" nets may be a better, more effective choice. Use of dip nets in conjunction with snorkeling, flushing of the cover, or around the hours of dawn or dusk (i.e., during low-light conditions), can be effective for capturing fish sheltered below cover.

· **Connecting Rod Snakes** may be used to flush fish out of stream crossing structures (i.e., culverts). Connecting rod snakes are composed of wood sections approximately three feet in length. Like other cover attractive to fish, culverts (especially long culverts), can present a challenge to fish capture and removal operations. The directing biologist should plan a strategy for focusing and concentrating fish in areas where they can be easily seined and netted, and should take active steps to prevent fish from evading capture. When first implementing plans for work area isolation, fish capture and removal, and dewatering, it may be appropriate to place block nets immediately upstream and/or downstream of culverts so as to minimize the number of fish that might seek cover within the culvert(s). Once most or all of the fish have been removed from other parts of the work area, the block net placed downstream of the culvert(s) should be removed to encourage volitional downstream movement of fish.

· **Electrofishing** shall be performed only when other methods of fish capture and removal have proven impracticable or ineffective at removing all fish. The directing biologist shall ensure that attempts to seine and/or net fish always precede the use of electrofishing equipment. Larger fish (i.e., adult and subadult fish with comparatively longer spine lengths) are more susceptible to electrofishing injury than smaller fish. To minimize the risk of injury (and the number of fish potentially injured), the directing biologist shall confirm that other methods have been effective in removing most or all of the adult and subadult fish before resorting to the use of electrofishing equipment; see the related performance measure appearing on page 6. As a general rule or performance measure, electrofishing should not be conducted under conditions that offer poor visibility (i.e., visibility of less than 0.5 meter).

The following performance measures shall apply to the use of electrofishing equipment as a means of fish capture and removal:

1) If the planned fish capture and removal operations have not been addressed through consultation (or programmatic consultation), and fish listed under the ESA will or may be present, WSDOT shall provide notice to the FWS and/or NMFS prior to the initiation of electrofishing attempts. Upon request, the WSDOT shall permit the FWS, NMFS, and/or their designated representative to observe fish capture and removal operations. Work conducted under a declared emergency (or emergency conditions) shall follow established ESA notification protocols.

2) Electrofishing shall only be conducted when a biologist with at least 100 hours of electrofishing experience is onsite to conduct or direct all related activities. The directing biologist shall be familiar with the principles of electrofishing, including the effects of voltage, pulse width and pulse rate on fish, and associated risk of injury or mortality. The directing biologist shall have knowledge regarding galvanotaxis, narcosis and tetany, their relationships to injury/mortality rates, and shall have the ability to recognize these responses when exhibited by fish.

3) The directing biologist shall ensure that electrofishing attempts use the minimum voltage, pulse width, and rate settings necessary to achieve the desired response (galvanotaxis). Water conductivity shall be measured in the field prior to each electrofishing attempt to determine appropriate settings. Electrofishing methods and equipment shall comply with guidelines outlined by the NMFS[4].

4) The initial and maximum settings identified below shall serve as guidelines when electrofishing in waters that may support ESA-listed fish. Only DC or pulsed DC current shall be used. [Note: some newer, late-model electrofishing equipment includes a "set-up" or initialization function; the directing biologist shall have the discretion to use this function as a means to identify proper initial settings.]

[4] National Marine Fisheries Service. 2000. Guidelines for electrofishing waters containing salmonids listed under the Endangered Species Act. NMFS Northwest Region, June 2000, 5p.
<< http://www.nwr.noaa.gov/ESA-Salmon-Regulations-Permits/4d-Rules/upload/electro2000.pdf >>.

Guidelines for initial and maximum settings for backpack electrofishing.[5]

	Initial Settings	Conductivity (µS/cm)	Maximum Settings
Voltage	100 V	≤ 300 > 300	800 V 400 V
Pulse Width	500 µs		5 ms
Pulse Rate	15 Hz		60 Hz [*In general*, exceeding 40 Hz will injure more fish.]

Each attempt shall begin with low settings for pulse width and pulse rate. If fish present in the area being electrofished do not exhibit a response, the settings shall be gradually increased until the appropriate response is achieved (galvanotaxis). The lowest effective settings for pulse width, pulse rate and voltage shall be used to minimize risks to both personnel and fish. Safe implementation is a high priority. The directing biologist shall ensure the safety of all individuals assisting with electrofishing attempts; this includes planning for and providing all necessary safety equipment and materials (e.g., insulated waders and gloves, first aid/cpr kit, a current safety plan with emergency contacts and phone numbers, etc.). Only individuals that are trained and familiar with the use of electrofishing equipment shall provide direct assistance during electrofishing attempts.

5) Electrofishing shall not be conducted where spawning adults or redds with incubating eggs may be exposed to the electrical current. As a general rule or performance measure, waters that support anadromous salmon should not be electrofished from October 15 through May 15, and resident waters from November 1 through May 15. If located within waters that support bull trout, especially waters located within a local bull trout population (i.e., that support spawning and rearing), seasonal limitations on the use of electrofishing equipment may be more restrictive; if you have questions, contact the FWS. If any, more restrictive work windows have been identified through consultation, those windows shall apply. The directing biologist shall ensure that electrofishing attempts are made only during appropriate times of year, and not where spawning adults or redds with incubating eggs may be exposed to the electrical current.

6) An individual shall be stationed at the downstream block net(s) during electrofishing attempts to recover stunned fish in the event they are flushed downstream and/or impinged against the block net(s).

7) The operator shall use caution so as to prevent fish from coming into direct contact with the anode. Under most conditions, the zone of potential fish injury extends approximately 0.5 meter from the anode. Netting shall not be attached to the anode, as this practice presents an increased risk of direct contact and injury. Extra care shall be taken near in-water

[5] Adapted from NMFS (June 2000) and WDFW Electrofishing Guidelines for Stream Typing (May 2001).

structures or undercut banks, in shallow waters, or where fish densities are high. Under these conditions fish are more likely to come into close or direct contact with the anode and/or voltage gradients may be intensified. Voltage and other settings shall be readjusted to accommodate changing conditions in the field, including channel depth. When electrofishing near undercut banks, overhanging vegetation, large cobble or boulders, or where structures provide cover, fish that avoid capture may be exposed to the electrical current repeatedly. Repeated or prolonged exposures to the electrical current present a higher risk of injury, and therefore galvanotaxis should be used to draw fish out of cover.

8) Electrofishing shall be conducted in a manner that minimizes harm to fish. Once an appropriate fish response (galvanotaxis) is achieved, the isolated work area shall be worked systematically. The number of passes shall be kept to a minimum, but is dependent upon the numbers of fish and site characteristics and shall be at the discretion of the directing biologist. Electrofishing shall not be conducted unless there are sufficient staff and materials onsite, to both minimize the number of passes required and to locate, net, recover, and release fish in a timely manner. Generally this will require a minimum of three persons, but the directing biologist may find that some sites (especially large or complicated sites) warrant or require a more intensive effort (i.e., additional staffing). Care shall be taken to remove fish from the electrical field immediately and to avoid exposing the same fish repeatedly. Fish shall not be held in dip nets while electrofishing is in progress (i.e., while continuing to capture additional fish). [Note: where flow velocity or turbulence is high or moderately-high (e.g., within riffles) it may be difficult to see and net fish; these fish may evade capture (resulting in repeated exposure), or may become impinged on the downstream block net(s); a "frame" net, or small and portable block net approximately 3 feet in width, can be effective under these conditions when held downstream in close proximity to the anode.]

9) The condition of captured fish shall be carefully observed and documented. Dark bands on the body and/or extended recovery times are signs of stress or injury. When such signs are noted, settings for the electrofishing unit may require readjustment. The directing biologist shall also review and consider changes to the manner in which the electrofishing attempt is proceeding. If adjustments to the electrofishing attempt do not lessen the frequency (or severity) of observed stress, the directing biologist shall have the authority to postpone fish capture and removal operations[6]. Each fish shall be capable of remaining upright and actively swimming prior to release (see Fish Handling, Holding and Release).

10) Electrofishing shall not be conducted when turbidity reduces visibility to less than 0.5 meter, when water conductivity exceeds 350 μS/cm, or when water temperature is above 18°C or below 4°C.

[6] If the FWS and/or NMFS have provided an Incidental Take Statement from a Biological Opinion addressing the work (or action), the directing biologist shall ensure limits on take have not been exceeded; if the limits on take are exceeded, or if take is approaching these limits, the directing biologist shall postpone fish capture and removal operations and immediately notify the federal agency (or agencies) with jurisdiction.

Fish Handling, Holding and Release:

• Fish handling shall be kept to the minimum necessary to remove fish from the isolated work area. Fish capture and removal operations shall be planned and conducted so as to minimize the amount and duration of handling. The operations shall maintain captured fish in water to the maximum extent possible during seining/netting, handling, and transfer for release.

• The directing biologist shall document and maintain accurate records of the operations, including: fish species, number, age/size class estimate, condition at release, and release location. Fish shall not be sampled or anesthetized, unless for valid purposes consistent with the WSDOT's Section 10 scientific collection permits.

• Individuals handling fish shall ensure that their hands are free of harmful and/or deleterious products, including but not limited to sunscreen, lotion, and insect repellent.

• The operations shall ensure that water quality conditions are adequate in the buckets, coolers, or holding tanks used to hold and transfer captured fish. The operations shall use aerators to provide for clean, cold, well-oxygenated water, and/or shall stage capture, temporary holding, and release to minimize the risks associated with prolonged holding. The directing biologist shall ensure that conditions in the holding containers are monitored frequently and operations adjusted appropriately to minimize fish stress. If fish listed under the ESA will or may be held for more than a few minutes prior to release, the directing biologist should consider using dark-colored, lidded containers only. Fish listed under the ESA shall not be held in containers for more than 10 minutes, unless those containers are dark-colored, lidded, and fitted with a portable aerator; small coolers meeting this description are preferred over buckets.

• The operations shall provide a healthy environment for captured fish, including low densities in holding containers to avoid effects of overcrowding. Large fish shall be kept separate from smaller fish to avoid predation. The operations shall use water-to-water transfers whenever possible.

• The release site(s) shall be determined by the directing biologist. The directing biologist should consider both site characteristics (e.g., flow, temperature, available refuge and cover, etc.) and the types of fish captured (e.g., out-migrating smolt, kelt, prespawn migrating adult, etc.) when selecting a release site(s). More than one site may be designated to provide for varying needs, and to separate prey-sized fish from larger fish. The directing biologist shall consider habitat connectivity and fish habitat requirements, seasonal flow and temperature conditions, and the duration and extent of planned in-water work when selecting a fish release site(s). If conditions upstream of the isolated work area will or may become unfavorable during construction, then fish should not be released to an upstream location. However, the directing biologist should also consider whether planned in-water work presents a significant risk of downstream turbidity and sedimentation; fish released to a downstream location may be exposed to these conditions. Site conditions may warrant releasing fish both upstream and downstream, or relocating fish at a greater distance (e.g., thousands of feet or miles), so as to ensure fish are not concentrated in areas where their habitat needs cannot be met. For a fuller discussion of this topic see page 2.

- The directing biologist shall ensure that each fish is capable of remaining upright and has the ability to actively swim upon release.

- Any ESA-listed fish incidentally killed as a result of fish capture and removal operations shall be preserved and delivered to the appropriate authority upon request (see Documentation).

- If the limits on take of ESA-listed species are exceeded (harm or harassment), or if incidental take is approaching and may exceed specified limits, the directing biologist shall postpone fish capture and removal operations and immediately notify the federal agency (or agencies) with jurisdiction. If dewatering or flow diversion is incomplete and still in-progress, WSDOT shall take remedial actions directed at maintaining sufficient quantity and quality of flow and lessening sources of fish stress and/or injury. If conditions contributing to fish stress and/or injury may worsen before the federal agency with jurisdiction can be contacted, WSDOT should attempt to move fish to a suitable location near the capture site while keeping fish in water and reducing stress as much as possible.

Reintroduction of Flow and Fish to the Isolated Work Area

If conducting work in isolation from flowing waters has required placement of a block net(s), fish capture and removal, and temporary dewatering, the directing biologist shall ensure that the block net(s) remain in-place until work is complete and conditions are suitable for the reintroduction of fish[2]. Flows shall be gradually reintroduced to the isolated work area, so as to prevent channel bed or bank instability, excessive scour, or turbidity and sedimentation. The directing biologist shall inspect the work area and downstream reach to ensure no fish are stranded or in distress during reintroduction of flows. If conditions causing or contributing to fish stress and/or injury are observed, WSDOT shall take remedial actions directed at lessening these sources of stress. This may include a more gradual reintroduction of flow, so as to reduce resulting turbidity and sedimentation.

All temporary structures and materials (e.g., block nets, posts, and anchors; bypass flume or culvert; sandbag, sheet pile or similar cofferdam; etc) shall be removed at the completion of work. The directing biologist shall document in qualitative terms the final condition of the isolated work area (including temporary bypass). The directing biologist shall identify and document any obvious signs of channel bed or bank instability resulting from the work, and shall report these conditions to the appropriate Maintenance, Construction, and/or Environmental staff for remedy. WSDOT shall document any additional actions taken to correct channel instability, and the final condition of the isolated work area (including temporary bypass).

To avoid and minimize the risk of introducing or spreading nuisance or invasive species, aquatic parasites, or disease, the directing biologist shall ensure that all equipment and materials are cleaned and dried before transporting them for use at another site or waterbody.

Documentation

• All work area isolation, and fish capture and handling shall be documented in a log book with the following information: project location, date, methods, personnel, water temperature, conductivity, visibility, electrofishing equipment settings, and other comments.

• All fish captured or handled shall be documented: species, number of each species, age/ size class estimate, condition at release, and location of release.

• If at any time, fish are observed in distress, a fish kill occurs, or water quality problems develop (including equipment leaks or spills), WSDOT shall provide immediate notification to the WDFW consistent with any provisions contained in the HPA (or applicable General HPA). Notification shall consist of a phone call or voice mail message directed to the Area Habitat Biologist identified on the HPA and/or the Washington Military Department Emergency Management Division at (800) 258-5990, as appropriate.

• Any ESA-listed fish incidentally killed as a result of fish capture and removal operations shall be documented with notification provided to the appropriate authority (FWS and/or NMFS) within two working days. Initial notifications may consist of a phone call or voice mail message. Initial notifications shall be directed to the following: (FWS) the nearest FWS Law Enforcement Office, and the Washington Fish and Wildlife Office at (360) 753-9440; (NMFS) the NMFS Office of Law Enforcement at (800) 853-1964, and the Washington State Habitat Office at (360) 753-9530. Any dead specimens shall be kept whole and preserved on-ice or frozen until WSDOT receives a response and further directions from the appropriate authority; if WSDOT receives no response within 5 working days, the directing biologist shall have the discretion to dispose of specimens. Initial notifications shall be followed by a second notification in writing. All notifications shall provide at a minimum the following: date, time, WSDOT point-of-contact (the directing biologist and/or supervisor), project name (and FWS and/or NMFS tracking number if available), precise location of any incidentally killed or injured and unrecovered fish, number of specimens and species, and cause of death or unrecoverable injury. If the limits on incidental take are exceeded (harm or harassment), the written notification shall also include an explanation of the circumstances causing or contributing to observed levels of take.

• The final condition of the isolated work area (including temporary bypass) shall be documented in qualitative terms, including any obvious signs of channel bed or bank instability resulting from the work. WSDOT shall document any additional actions taken to correct channel instability, and the final condition of the isolated work area (including temporary bypass).

APPENDIX B: Status of the Species (Bull Trout; Coterminous Range)

Appendix B: 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. 2; Brewin and Brewin 1997, p. 215; Cavender 1978, pp. 165-166; Leary and Allendorf 1997, pp. 716-719).

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, pp. 6672-6673; Rieman et al. 2007, p. 1552). 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, pp. iv, 2, 7, 98; 2004a, Vol. 1 & 2, p. 1; 2004b, p. 1). 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 Service's draft recovery plans for the bull trout (USFWS 2002a, pp. vi-viii; 2004a, Vol. 2 p. iii-x; 2004b, pp. iii-xii).

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, pp. 49-50; 2004a, Vol 1 & 2 pp. 12-18; 2004b, pp. 60-86) 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, pp. 53-54; 2004a, Vol. 1 pp. 210-218, Vol 2. pp. 61-62; 2004b, pp. 15-30, 64-67). 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, pp. 6, 48, 98; 2004a, Vol. 1 p. vi, Vol. 2 pp. 14, 134; 2004b, pp. iv, 2; 2005, p. ii).

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 2002a). Bull trout populations in this interim recovery unit face a high risk of extirpation (USFWS 2002a). The draft Klamath River bull trout recovery plan (USFWS 2002a) 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 2002a).

Columbia River Interim Recovery Unit

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 (IDFG, in litt. 1995). The draft Columbia River bull trout recovery plan (USFWS 2002c) 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 Service 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, pp. 2, Map A, and pp. 73-83).

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 2002b). 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 2002b). 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 2002b). The draft St. Mary-Belly River bull trout recovery plan (USFWS 2002b) 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, pp. 1-18) . 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, p. 1; Goetz 1989, pp. 15-16). 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, pp. 135-137; Goetz 1989, pp. 22-25), or saltwater (anadromous form) to rear as subadults and to live as adults (Cavender 1978, pp. 139, 165-68; McPhail and Baxter 1996, p. 14; WDFW et al. 1997, pp. 17-18, 22-26). 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, pp. 135-137; Leathe and Graham 1982, p. 95; Pratt 1992, p. 6; Rieman and McIntyre 1996, p. 133).

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, pp. 29-32; Pratt 1984, p. 13) 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, p. 7). 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, pp. 137, 141; Goetz 1989, pp. 19-26; Bond in Hoelscher and Bjornn 1989, p. 57; Howell and Buchanan 1992, p. 1; Pratt 1992, p. 6; Rich 1996, pp. 35-38; Rieman and McIntyre 1993, pp. 4-7; Rieman and McIntyre 1995, pp. 293-294; Sedell and Everest 1991, p. 1; Watson and Hillman 1997, pp. 246-250). Watson and Hillman (1997, pp. 247-249) 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, p. 7), bull trout should not be expected to simultaneously occupy all available habitats (Rieman et al. 1997, p. 1560).

Migratory corridors link seasonal habitats for all bull trout life histories. The ability to migrate is important to the persistence of bull trout (Gilpin, in litt. 1997, pp. 4-5; Rieman and McIntyre 1993, p. 7; Rieman et al. 1997, p. 1114). 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, p. 7; Spruell et al. 1999, pp. 118-120). 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, p. 133; Pratt 1992, p. 6; Rieman and McIntyre 1993, p. 7).

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, pp. 426-427; Pratt 1992, p. 6; Rieman and McIntyre 1993, p. 7; Rieman et al. 1997, p. 1117). 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, pp. 121-122; Goetz 1989, pp. 22-24; McPhail and Murray 1979, pp. 41, 50, 53, 55). 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, pp. 121-122; Fraley and Shepard 1989, pp. 135-137; Rieman and McIntyre 1993, p. 2; Rieman and McIntyre 1995, p. 288; Rieman et al. 1997, p. 1114). 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 Gamett, pers. comm. 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, pp. 135-137; Goetz 1989, pp. 22-25; Hoelscher and Bjornn 1989, p. 54; Pratt 1992, p. 6; Rich 1996, pp. 35-38; Sedell and Everest 1991, p. 1; Sexauer and James 1997, pp. 367-369; Thomas 1992, pp. 4-5; Watson and Hillman 1997, pp. 247-249). Maintaining bull trout habitat requires stability of stream channels and maintenance of natural flow patterns (Rieman and McIntyre 1993, p. 7). Juvenile and adult bull trout frequently inhabit side channels, stream margins, and pools with suitable cover (Sexauer and James 1997, pp. 367-369). 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, pp. 135-137; Pratt 1992, p. 6; Pratt and Huston 1993, pp. 70-72). Pratt (1992, p. 6) 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, p. 135). Redds are often constructed in stream reaches fed by springs or near other sources of cold groundwater (Goetz 1989, p. 15; Pratt 1992, p. 8; Rieman and McIntyre 1996, p. 133). Depending on water temperature, incubation is normally 100 to 145 days (Pratt 1992, p. 8). 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 (Ratliff and Howell 1992 in Howell and Buchanan 1992, pp. 10, 15; Pratt 1992, pp. 5-6).

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, pp. 54-55). 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, pp. 1073, 1079-1080; Frissell 1993, p. 350; Goetz et al. 2004, pp. 45, 55, 60, 68, 77, 113-114, 123, 125-126). 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, pp. 15-16; MBTSG 1998, pp. iv, 48-50; Rieman and McIntyre 1993, pp. 18-19; USFWS 2004a, Vol. 2, p. 63). 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 fish with higher fecundity is lost (Rieman and McIntyre 1993, pp. 1-18).

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, p. 58; Donald and Alger 1993, pp. 239-243; Goetz 1989, pp. 33-34). Subadult and adult migratory bull trout feed on various fish species (Brown 1994, p. 21; Donald and Alger 1993, p. 242; Fraley and Shepard 1989, p. 135; Leathe and Graham 1982, p. 95). Bull trout of all sizes other than fry have been found to eat fish up to 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, p. 114; WDFW et al. 1997, p. 23).

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, p. 1079; Goetz et al. 2004, pp. 36, 60).

Changes in Status of the Coastal-Puget Sound Interim Recovery Unit

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 (now Green Diamond Resources), 3) Tacoma Public Utilities Green River HCP, 4) Plum Creek Cascades HCP, 5) Washington State Department of Natural Resources (WSDNR) State Trust Lands HCP, 6) West Fork Timber HCP, and 7) WSDNR 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, Storedahl Daybreak Mine HCP, and WSDNR 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.

LITERATURE CITED

Battin, J., M.W. Wiley, M.H. Ruckelshaus, R.N. Palmer, E. Korb, K.K. Bartz, and H. Imaki. 2007. Projected impacts of climate change on salmon habitat restoration. Proceedings of the National Academy of Sciences of the United States of America 104(16):6720-6725.

Baxter, C.V. 2002. Fish movement and assemblage dynamics in a Pacific Northwest riverscape. Doctoral dissertation. Oregon State University, Corvallis, OR.

Baxter, J.S., E.B. Taylor, and R.H. Devlin. 1997. Evidence for natural hybridization between dolly varden (*Salvelinus malma*) and bull trout (*Salvelinus confluentus*) in a northcentral British Columbia watershed. Canadian Journal of Fisheries and Aquatic Sciences 54:421-429.

Beauchamp, D.A., and J.J. VanTassell. 2001. Modeling seasonal trophic interactions of adfluvial bull trout in Lake Billy Chinook, Oregon. Transactions of the American Fisheries Society 130:204-216.

Boag, T.D. 1987. Food habits of bull char (*Salvelinus confluentus*), and rainbow trout (*Salmo gairdneri*), coexisting in a foothills stream in northern Alberta. Canadian Field-Naturalist 101(1):56-62.

Bond, C.E. 1992. Notes on the nomenclature and distribution of the bull trout and the effects of human activity on the species. Pages 1-4 *In* P.J. Howell, and D.V. Buchanan, eds. Proceedings of the Gearhart Mountain bull trout workshop, Oregon Chapter of the American Fisheries Society, Corvallis, OR.

Bonneau, J.L., and D.L. Scarnecchia. 1996. Distribution of juvenile bull trout in a thermal gradient of a plunge pool in Granite Creek, Idaho. Transactions of the American Fisheries Society 125(4):628-630.

Brenkman, S.J., and S.C. Corbett. 2005. Extent of anadromy in bull trout and implications for conservation of a threatened species. North American Journal of Fisheries Management 25:1073-1081.

Brewin, P.A., and M.K. Brewin. 1997. Distribution maps for bull trout in Alberta. Pages 209-216 *In* W.C. Mackay, M.K. Brewin, and M. Monita, eds. Friends of the Bull Trout Conference Proceedings, Bull Trout Task Force (Alberta), c/o Trout Unlimited, Calgary.

Brown, L.G. 1994. The zoogeography and life history of Washington native charr. Washington Department of Fish and Widlife, Fisheries Management Division, Report # 94-04, Olympia, WA, November, 1992. 47 pp.

Buchanan, D.V., and S.V. Gregory. 1997. Development of water temperature standards to protect and restore habitat for bull trout and other cold water species in Oregon. Pages 119-126 *In* W.C. Mackay, M.K. Brewing, and M. Monita, eds. Friends of the Bull Trout Conference Proceedings, , Alberta, Canada.

Cavender, T.M. 1978. Taxonomy and distribution of the bull trout, *Salvelinus confluentus* (Suckley), from the American Northwest. California Fish and Game 64(3):139-174.

Donald, D.B., and D.J. Alger. 1993. Geographic distribution, species displacement, and niche overlap for lake trout and bull trout in mountain lakes. Canadian Journal of Zoology 71:238-247.

Dunham, J., B. Rieman, and G. Chandler. 2003. Influence of temperature and environmental variables on the distribution of bull trout within streams at the southern margin of its range. North American Journal of Fisheries Management 23:894-905.

Fraley, J.J., and B.B. Shepard. 1989. Life history, ecology and population status of migratory bull trout (*Salvelinus confluentus*) in the Flathead Lake and River system, Montana. Northwest Science 63:133-143.

Frissell, C.A. 1993. Topology of extinction and endangerment of native fishes in the Pacific Northwest and California. Conservation Biology 7(2):342-354.

Frissell, C.A. 1999. An ecosystem approach to habitat conservation for bull trout: groundwater and surface water protection. Flathead Lake Biological Station, University of Montana, Open File Report Number 156-99, Polson, MT. 46 pp.

Gamett, B.L. 2002. Telephone conversation between Bart L. Gamett, Salmon-Challis National Forest, and Shelley Spalding, USFWS, re: relationship between water temperature and bull trout distribution and abundance in the Little Lost River, Idaho. June 20, 2002.

Gerking, S.D. 1994. Feeding ecology of fish. Academic Press, San Diego, California.

Giles, M.A., and M. Van der Zweep. 1996. Dissolved Oxygen Requirements for Fish of the Peace, Athabasca and Slave River Basins: A Laboratory Study of Bull Trout *(Salveninus Confluentus)* and Mountain Whitefish *(Prosopium Williamsoni)* , Northern River Basins Study Technical Report No. 120 ed.

Gilpin, M. 1997. Memo to Shelly Spalding, Montana Department of Fish, Wildlife, and Parks. Connectivity on the Clark Fork River: The Bigger Picture. August 27, 1997.

Goetz, F. 1989. Biology of the bull trout, *Salvelinus confluentus*, a literature review. Willamette National Forest, Eugene, Oregon.

Goetz, F., E.D. Jeanes, and E.M. Beamer. 2004. Bull trout in the nearshore. U.S. Army Corps of Engineers, Preliminary draft, Seattle, Washington, June, 2004. 396 pp.

Hoelscher, B., and T.C. Bjornn. 1989. Habitat, density, and potential production of trout and char in Pend Oreille Lake tributaries. Idaho Department of Fish and Game, Project F-710R-10, Subproject III, Job No. 8., Boise, Idaho.

Howell, P.J., and D.V. Buchanan. 1992. Proceedings of the Gearhart Mountain bull trout workshop. Oregon Chapter of the American Fisheries Society, Corvallis, Oregon.

IDFG (Idaho Department of Fish and Game). 1995. List of streams compiled by IDFG where bull trout have been extirpated.

Leary, R.F., and F.W. Allendorf. 1997. Genetic confirmation of sympatric bull trout and Dolly Varden in western Washington. Transactions of the American Fisheries Society 126:715-720.

Leathe, S.A., and P.J. Graham. 1982. Flathead Lake fish food habits study. US EPA, Region VIII, Water Division, Contract R008224-01-4, Denver, Colorado, October, 1982. 209 pp.

MBTSG (The Montana Bull Trout Scientific Group). 1998. The relationship between land management activities and habitat requirements of bull trout. Montana Fish, Wildlife, and Parks, Helena, MT, May 1998. 77 pp.

McPhail, J.D., and J.S. Baxter. 1996. A review of bull trout (*Salvelinus confluentus*) life-history and habitat use in relation to compensation and improvement opportunities. Department of Zoology, University of British Columbia, Fisheries Management Report Number 104, Vancouver, BC. 31 pp.

McPhail, J.D., and C.B. Murray. 1979. The early life-history and ecology of dolly varden (*Salvelinus Malma*) in the upper Arrow Lakes. Department of Zoology and Institute of Animal Resource Ecology, Fort Steele, British Columbia. 113 pp.

Myrick, C.A., F.T. Barrow, J. Dunham, B.L. Gamett, G.R. Haas, J.T. Peterson, B. Rieman, L.A. Weber, and A.V. Zale. 2002. Bull trout temperature thresholds: Peer review summary. U.S. Fish and Wildlife Service, Lacey, Washington. 13 pp.

ODEQ (Oregon Department of Environmental Quality). 1995. 1992-1994 water quality standards review: dissolved oxygen - final issue paper. Oregon Department of Environmental Quality, Portland, OR.

Pratt, K.L. 1984. Habitat use and species interactions of juvenile cutthroat, *Salmo clarki*, and bull trout, *Salvelinus confluentus*, in the upper Flathead River basin. Master's Thesis. University of Idaho, Moscow, ID.

Pratt, K.L. 1992. A review of bull trout life history. Pages 5-9 *In* P.J. Howell, and D.V. Buchanan, eds. Proceedings of the Gearhart Mountain bull trout workshop, Oregon Chapter of the American Fisheries Society, Corvallis, OR.

Pratt, K.L., and J.E. Huston. 1993. Status of bull trout (*Salvelinus confluentus*) in Lake Pend Oreille and the lower Clark Fork River. Washington Water Power Company, Spokane, WA. 200 pp.

Quigley, T.M., and S.J. Arbelbide. 1997. An assessment of ecosystem components in the interior Columbia Basin and portions of the Klamath and Great Basins: Volume 3. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station 3:1174-1185.

Rich, C.F. 1996. Influence of abiotic and biotic factors on occurrence of resident Bull Trout in fragmented habitats, Western Montana. Master's Thesis. Montana State University, Bozeman, MT.

Rieman, B.E., D. Isaak, S. Adams, D. Horan, D. Nagel, C.H. Luce, and D. Myers. 2007. Anticipated climate warming effects on bull trout habitats and populations across the interior Columbia River Basin. Transactions of the American Fisheries Society 136(6):1552-1565.

Rieman, B.E., D. Lee, D. Burns, R.E. Gresswell, M.K. Young, R. Stowell, and P. Howell. 2003. Status of native fishes in western United States and issues for fire and fuels management. Forest Ecology and Management 178(1-2):197-211.

Rieman, B.E., D.C. Lee, and R.F. Thurow. 1997. Distribution, status, and likely future trends of bull trout within the Columbia River and Klamath River basins. North American Journal of Fisheries Management 7:1111-1125.

Rieman, B.E., and J.D. McIntyre. 1993. Demographic and habitat requirements for conservation of bull trout. U.S. Department of Agriculture, Forest Service, Intermountain Research Station, General Technical Report INT-302, Ogden, Utah. 38 pp.

Rieman, B.E., and J.D. McIntyre. 1995. Occurrence of bull trout in naturally fragmented habitat patches of varied size. Transactions of the American Fisheries Society 124(3):285-296.

Rieman, B.E., and J.D. McIntyre. 1996. Spatial and temporal variability in bull trout redd counts. North American Journal of Fisheries Management 16:132-141.

Sedell, J.R., and F.H. Everest. 1991. Historic changes in pool habitat for Columbia River Basin salmon under study for TES listing. Pacific Northwest Research Station, Draft U.S. Department of Agriculture Report, Corvallis, Oregon. 6 pp.

Sexauer, H.M., and P.W. James. 1997. Microhabitat use by juvenile trout in four streams located in the eastern Cascades, Washington. Pages 361-370 *In* W.C. McKay, M.K. Brewin, and M. Monita, eds. Friends of the Bull Trout Conference Proceedings, Bull Trout Task Force (Alberta), c/o Trout Unlimited, Calgary, Alberta, Canada.

Simpson, J.C., and R.L. Wallace. 1982. Fishes of Idaho. University of Idaho Press, Moscow, ID.

Spruell, P., B.E. Rieman, K.L. Knudsen, F.M. Utter, and F.W. Allendorf. 1999. Genetic population structure within streams: Microsatellite analysis of bull trout populations. Ecology of Freshwater Fish 8:114-121.

Stewart, D.B., N.J. Mochnacz, C.D. Sawatzky, T.J. Carmichael, and J.D. Reist. 2007. Fish life history and habitat use in the Northwest territories: Bull trout (*Salvelinus confluentus*). Department of Fisheries and Oceans, Canadian Manuscript Report of Fisheries and Aquatic Sciences 2801, Winnipeg, MB, Canada, 2007. 54 pp.

Thomas, G. 1992. Status of bull trout in Montana. Montana Department of Fish, Wildlife and Parks, Helena, MT. 83 pp.

USFWS. 2002a. Bull trout (*Salvelinus confluentus*) draft recovery plan - Chapter 2: Klamath River. U.S. Fish and Wildlife Service, Portland, Oregon.

USFWS. 2002b. Bull trout (*Salvelinus confluentus*) draft recovery plan - Chapter 25: Saint Mary-Belly River. U.S. Fish and Wildlife Service, Portland, Oregon.

USFWS. 2002c. Chapter 20 of the bull trout *(Salvelinus confluentus)* draft recovery plan: Lower Columbia Recovery Unit, Washington. USFWS, Region 1, Portland, Oregon. 102 pp.

USFWS. 2004a. Draft Recovery Plan for the Coastal-Puget Sound distinct population segment of bull trout (*Salvelinus confluentus*). Volume I: Puget Sound Management Unit, 389+xvii pp and Volume II: Olympic Peninsula Management Unit, 277+xvi pp, Portland, Oregon.

USFWS. 2004b. Draft recovery plan for the Jarbridge River distinct population segment of the bull trout (*Salvelinus confluentus*). U.S. Fish and Wildlife Service, Portland, Oregon. xii + 132 pp.

USFWS. 2005. Bull trout core area template - complete core area by core area analysis. U.S. Fish and Wildlife Service, Portland, Oregon. 662 pp.

Watson, G., and T.W. Hillman. 1997. Factors affecting the distribution and abundance of bull trout: an investigation at hierarchical scales. North American Journal of Fisheries Management 17(2):237-252.

WDFW, FishPro Inc., and Beak Consultants. 1997. Grandy Creek trout hatchery biological assessment. Washington Department of Fish and Wildlife, Olympia, WA, March 1997. 47 pp.

WDOE. 2002. Evaluating criteria for the protection of freshwater aquatic life in Washington's surface water quality standards - dissolved oyxgen: Draft discussion paper and literature summary. Washington Department of Ecology, Publication Number 00-10-071, Olympia, WA, December 2002. 90 pp.

APPENDIX C: Status of Designated Critical Habitat (Bull Trout; Coterminous Range)

Appendix C:
Status of Designated Critical Habitat (Bull Trout; Coterminous Range)

Legal Status

Current Designation

The Service published a final critical habitat designation for the coterminous United States population of the bull trout on October 18, 2010 (70 FR 63898); the rule becomes effective on November 17, 2010. A justification document was also developed to support the rule and is available on our website (http://www.fws.gov/pacific/bulltrout). The scope of the designation involved the species' coterminous range, which includes the Jarbidge River, Klamath River, Columbia River, Coastal-Puget Sound, and Saint Mary-Belly River population segments (also considered as interim recovery units)7. Rangewide, the Service designated reservoirs/lakes and stream/shoreline miles as bull trout critical habitat (Table 1). Designated bull trout critical habitat is of two primary use types: 1) spawning and rearing, and 2) foraging, migration, and overwintering (FMO).

Table 1. Stream/shoreline distance and reservoir/lake area designated as bull trout critical habitat by state.

State	Stream/Shoreline Miles	Stream/Shoreline Kilometers	Reservoir /Lake Acres	Reservoir/ Lake Hectares
Idaho	8,771.6	14,116.5	170,217.5	68,884.9
Montana	3,056.5	4,918.9	221,470.7	89,626.4
Nevada	71.8	115.6	-	-
Oregon	2,835.9	4,563.9	30,255.5	12,244.0
Oregon/Idaho	107.7	173.3	-	-
Washington	3,793.3	6,104.8	66,308.1	26,834.0
Washington (marine)	753.8	1,213.2	-	-
Washington/Idaho	37.2	59.9	-	-
Washington/Oregon	301.3	484.8	-	-
Total	19,729.0	31,750.8	488,251.7	197,589.2

The 2010 revision increases the amount of designated bull trout critical habitat by approximately 76 percent for miles of stream/shoreline and by approximately 71 percent for acres of lakes and reservoirs compared to the 2005 designation.

This rule also identifies and designates as critical habitat approximately 1,323.7 km (822.5 miles) of streams/shorelines and 6,758.8 ha (16,701.3 acres) of lakes/reservoirs of unoccupied habitat to address bull trout conservation needs in specific geographic areas in several areas not occupied at the time of listing. No unoccupied habitat was included in the 2005 designation. These

7 The Service's 5 year review (USFWS 2008, pg. 9) identifies six draft recovery units. Until the bull trout draft recovery plan is finalized, the current five interim recovery units are in affect for purposes of section 7 jeopardy analysis and recovery. The adverse modification analysis does not rely on recovery units.

unoccupied areas were determined by the Service to be essential for restoring functioning migratory bull trout populations based on currently available scientific information. These unoccupied areas often include lower main stem river environments that can provide seasonally important migration habitat for bull trout. This type of habitat is essential in areas where bull trout habitat and population loss over time necessitates reestablishing bull trout in currently unoccupied habitat areas to achieve recovery.

The final rule continues to exclude some critical habitat segments based on a careful balancing of the benefits of inclusion versus the benefits of exclusion. Critical habitat does not include: 1) waters adjacent to non-Federal lands covered by legally operative incidental take permits for habitat conservation plans (HCPs) issued under section 10(a)(1)(B) of the Endangered Species Act of 1973, as amended (Act), in which bull trout is a covered species on or before the publication of this final rule; 2) waters within or adjacent to Tribal lands subject to certain commitments to conserve bull trout or a conservation program that provides aquatic resource protection and restoration through collaborative efforts, and where the Tribes indicated that inclusion would impair their relationship with the Service; or 3) waters where impacts to national security have been identified (75 FR 63898). Excluded areas are approximately 10 percent of the stream/shoreline miles and 4 percent of the lakes and reservoir acreage of designated critical habitat. Each excluded area is identified in the relevant Critical Habitat Unit (CHU) text, as identified in paragraphs (e)(8) through (e)(41) of the final rule. See Tables 2 and 3 for the list of excluded areas. 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. Because exclusions reflect the often complex pattern of land ownership, designated critical habitat is often fragmented and interspersed with excluded stream segments.

Table 2. Stream/shoreline distance excluded from bull trout critical habitat based on tribal ownership or other plan.

Ownership and/or Plan	Kilometers	Miles
Lewis River Hydro Conservation Easements	7.0	4.3
DOD – Dabob Bay Naval	23.9	14.8
HCP – Cedar River (City of Seattle)	25.8	16.0
HCP – Washington Forest Practices Lands	1,608.30	999.4
HCP – Green Diamond (Simpson)	104.2	64.7
HCP – Plum Creek Central Cascades (WA)	15.8	9.8
HCP – Plum Creek Native Fish (MT)	181.6	112.8
HCP–Stimson	7.7	4.8
HCP – WDNR Lands	230.9	149.5
Tribal – Blackfeet	82.1	51.0
Tribal – Hoh	4.0	2.5
Tribal – Jamestown S’Klallam	2.0	1.2
Tribal – Lower Elwha	4.6	2.8
Tribal – Lummi	56.7	35.3
Tribal – Muckleshoot	9.3	5.8
Tribal – Nooksack	8.3	5.1
Tribal – Puyallup	33.0	20.5
Tribal – Quileute	4.0	2.5

Ownership and/or Plan	Kilometers	Miles
Tribal – Quinault	153.7	95.5
Tribal – Skokomish	26.2	16.3
Tribal – Stillaguamish	1.8	1.1
Tribal – Swinomish	45.2	28.1
Tribal – Tulalip	27.8	17.3
Tribal – Umatilla	62.6	38.9
Tribal – Warm Springs	260.5	161.9
Tribal – Yakama	107.9	67.1
Total	3,094.9	1,923.1

Table 3. Lake/Reservoir area excluded from bull trout critical habitat based on tribal ownership or other plan.

Ownership and/or Plan	Hectares	Acres
HCP – Cedar River (City of Seattle)	796.5	1,968.2
HCP – Washington Forest Practices Lands	5,689.1	14,058.1
HCP – Plum Creek Native Fish	32.2	79.7
Tribal – Blackfeet	886.1	2,189.5
Tribal – Warm Springs	445.3	1,100.4
Total	7,849.3	19,395.8

Conservation Role and Description of Critical Habitat

The conservation role of bull trout critical habitat is to support viable core area populations (75 FR 63898:63943 [October 18, 2010]). 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. CHUs generally encompass one or more core areas and may include FMO areas, outside of core areas, that are important to the survival and recovery of bull trout.

Thirty-two CHUs within the geographical area occupied by the species at the time of listing are designated under the revised rule. Twenty-nine of the CHUs contain all of the physical or biological features identified in this final rule and support multiple life-history requirements. Three of the mainstem river units in the Columbia and Snake River basins contain most of the physical or biological features necessary to support the bull trout's particular use of that habitat, other than those physical biological features associated with Primary Constituent Elements (PCEs) 5 and 6, which relate to breeding habitat.

The primary function of individual CHUs 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, p. 19); 2) provide for persistence of strong local populations, in part, by providing habitat conditions that encourage movement of migratory fish (MBTSG 1998, pp. 48-49; Rieman and McIntyre 1993, pp. 22-23); 3) are large enough to incorporate genetic and phenotypic diversity, but small enough to ensure connectivity between populations (Hard 1995, pp. 314-315; Healey and Prince 1995, p.

182; MBTSG 1998, pp. 48-49; Rieman and McIntyre 1993, pp. 22-23); and 4) are distributed throughout the historic range of the species to preserve both genetic and phenotypic adaptations (Hard 1995, pp. 321-322; MBTSG 1998, pp. 13-16; Rieman and Allendorf 2001, p. 763; Rieman and McIntyre 1993, p. 23).

The Olympic Peninsula and Puget Sound CHUs are essential to the conservation of amphidromous bull trout, which are unique to the Coastal-Puget Sound population segment. These CHUs contain marine 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 PCEs that are critical to adult and subadult foraging, overwintering, and migration.

Primary Constituent Elements for Bull Trout

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. Based on our current knowledge of the life history, biology, and ecology of this species and the characteristics of the habitat necessary to sustain its essential life-history functions, we have determined that the following PCEs are essential for the conservation of bull trout.

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

2. Migration 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.

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

4. Complex river, stream, lake, reservoir, and marine shoreline aquatic environments, and processes that establish and maintain these aquatic environments, with features such as large wood, side channels, pools, undercut banks and unembedded substrates, to provide a variety of depths, gradients, velocities, and structure.

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

6. In spawning and rearing areas, substrate 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. A minimal amount of fine sediment, generally ranging in size from silt to coarse sand, embedded in larger substrates, is characteristic of these

conditions. The size and amounts of fine sediment suitable to bull trout will likely vary from system to system.

7. A natural hydrograph, including peak, high, low, and base flows within historic and seasonal ranges or, if flows are controlled, minimal flow departure from a natural hydrograph.

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

9. Sufficiently low levels of occurrence of non-native predatory (e.g., lake trout, walleye, northern pike, smallmouth bass); interbreeding (e.g., brook trout); or competing (e.g., brown trout) species that, if present, are adequately temporally and spatially isolated from bull trout.

The revised PCE's are similar to those previously in effect under the 2005 designation. The most significant modification is the addition of a ninth PCE to address the presence of nonnative predatory or competitive fish species. Although this PCE applies to both the freshwater and marine environments, currently no non-native fish species are of concern in the marine environment, though this could change in the future.

Note that only PCEs 2, 3, 4, 5, and 8 apply to marine nearshore waters identified as critical habitat. Also, lakes and reservoirs within the CHUs also contain most of the physical or biological features necessary to support bull trout, with the exception of those associated with PCEs 1 and 6. Additionally, all except PCE 6 apply to FMO habitat designated as critical habitat.

Critical habitat includes the stream channels within the designated stream reaches and has a lateral extent as defined by the bankfull elevation on one bank to the bankfull elevation on the opposite bank. 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. If bankfull elevation is not evident on either bank, the ordinary high-water line must be used to determine the lateral extent of critical habitat. The lateral extent of designated lakes is defined by the perimeter of the waterbody as mapped on standard 1:24,000 scale topographic maps. The Service assumes in many cases this is the full-pool level of the waterbody. In areas where only one side of the waterbody is designated (where only one side is excluded), the mid-line of the waterbody represents the lateral extent of critical habitat.

In marine nearshore areas, the inshore extent of critical habitat is the mean higher high-water (MHHW) line, including the uppermost reach of the saltwater wedge within tidally influenced freshwater heads of estuaries. The MHHW line refers to the average of all the higher high-water heights of the two daily tidal levels. Marine critical habitat extends offshore to the depth of 10 meters (m) (33 ft) relative to the mean low low-water (MLLW) line (zero tidal level or average of all the lower low-water heights of the two daily tidal levels). This area between the MHHW line and minus 10 m MLLW line (the average extent of the photic zone) is considered the habitat

most consistently used by bull trout in marine waters based on known use, forage fish availability, and ongoing migration studies and captures geological and ecological processes important to maintaining these habitats. This area contains essential foraging habitat and migration corridors such as estuaries, bays, inlets, shallow subtidal areas, and intertidal flats.

Adjacent 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 no longer serving the intended conservation role for the species or retaining those PCEs that relate to the ability of the area to at least periodically support the species. Activities that may destroy or adversely modify critical habitat are those that alter the PCEs to such an extent that the conservation value of critical habitat is appreciably reduced (75 FR 63898:63943; USFWS 2004, Vol. 1. pp. 140-193, Vol. 2. pp. 69-114). The Service'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, pp. 4-39). Thus, 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, Jarbidge River, Columbia River, Coastal-Puget Sound, and Saint Mary-Belly River population segments. However, we consider all 32 CHUs to contain features or areas essential to the conservation of the bull trout (75 FR 63898:63901, 63944). Therefore, if a proposed action would alter the physical or biological features of critical habitat to an extent that appreciably reduces the conservation function of one or more critical habitat units for bull trout, a finding of adverse modification of the entire designated critical habitat area may be warranted (75 FR 63898:63943).

Current Critical Habitat 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. The decline of bull trout is primarily due to habitat degradation and fragmentation, blockage of migratory corridors, poor water quality, past fisheries management practices, impoundments, dams, water diversions, and the introduction of nonnative species (63 FR 31647, June 10 1998; 64 FR 17112, April 8, 1999).

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 (Dunham and Rieman 1999, p. 652; Rieman and McIntyre 1993, p. 7); 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, p. 141; MBTSG 1998, pp. ii - v, 20-45); 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, p. 857; Rieman et al. 2006, pp. 73-76); 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.

Effects of Climate Change on Bull Trout Critical Habitat

One objective of the final rule was to identify and protect those habitats that provide resiliency for bull trout use in the face of climate change. Over a period of decades, climate change may directly threaten the integrity of the essential physical or biological features described in PCEs 1, 2, 3, 5, 7, 8, and 9. Protecting bull trout strongholds and cold water refugia from disturbance and ensuring connectivity among populations were important considerations in addressing this potential impact. Additionally, climate change may exacerbate habitat degradation impacts both physically (e.g., decreased base flows, increased water temperatures) and biologically (e.g., increased competition with non-native fishes).

Consulted on Effects for Critical Habitat

The Service has formally consulted on the effects to bull trout critical habitat throughout its range. Section 7 consultations include actions that continue to degrade the environmental baseline in many cases. However, long-term restoration efforts have also been implemented that provide some improvement in the existing functions within some of the critical habitat units.

LITERATURE CITED

Dunham, J.B. and B.E. Rieman. 1999. Metapopulation structure of bull trout: influences of physical, biotic, and geometrical landscape characteristics. Ecological Applications 9(2):642-55.

Fraley, J.J. and B.B. Shepard. 1989. Life history, ecology and population status of migratory bull trout (*Salvelinus confluentus*) in the Flathead Lake and River system, Montana. Northwest Science 63:133-43.

Hard, J. 1995. A quantitative genetic perspective on the conservation of intraspecific diversity. American Fisheries Society Symposium 17:304-26.

Healey, M.C. and A. Prince. 1995. Scales of variation in life history tactics of Pacific salmon and the conservation of phenotype and genotype. American Fisheries Society Symposium 17:176-84.

Leary, R.F., F.W. Allendorf, and S.H. Forbes. 1993. Conservation genetics of bull trout in the Columbia and Klamath River drainages. Conservation Biology 7(4):856-65.

MBTSG (The Montana Bull Trout Scientific Group). 1998. The relationship between land management activities and habitat requirements of bull trout. Montana Fish, Wildlife, and Parks, Helena, MT, May 1998, 77 pp.

Rieman, B.E. and F.W. Allendorf. 2001. Effective population size and genetic conservation criteria for bull trout. North American Journal of Fisheries Management 21:756-64.

Rieman, B.E. and J.D. McIntyre. 1993. Demographic and habitat requirements for conservation of bull trout. General Technical Report INT-302. U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Ogden, Utah, 38 pp.

Rieman, B.E., J.T. Peterson, and D.E. Myers. 2006. Have brook trout (*Salvelinus fontinalis*) displaced bull trout (*Salvelinus confluentus*) along longitudinal gradients in central Idaho streams? Canadian Journal of Fish and Aquatic Sciences 63:63-78.

USFWS (U.S. Fish and Wildlife Service). 2004. Draft Recovery Plan for the Coastal-Puget Sound distinct population segment of bull trout (*Salvelinus confluentus*). Volume I: Puget Sound Management Unit, 389+xvii pp and Volume II: Olympic Peninsula Management Unit, 277+xvi pp. Portland, Oregon.

USFWS (U.S. Fish and Wildlife Service) and NMFS (National Marine Fisheries Service). 1998. Endangered Species Consultation Handbook: Procedures for conducting consultation and conference activities under Section 7 of the Endangered Species Act. U.S. GPO:2004-690-278. March 1998.

APPENDIX D: Lower Skagit River Core Area (Bull Trout)

Appendix D: Lower Skagit Core Area

The Lower Skagit core area comprises the Skagit basin downstream of Seattle City Light's Diablo Dam, including the mainstem Skagit River and the Cascade, Sauk, Suiattle, White Chuck, and Baker River including the lake systems (Baker Lake and Lake Shannon) upstream of upper and lower Baker Dams.

Bull trout, which occur throughout the Lower Skagit core area, include fluvial, adfluvial, resident, and anadromous life history forms. Resident life history forms, found in several locations in the core area, often occur with migratory life history forms. Adfluvial bull trout occur in Baker, Shannon, and Gorge Lakes. Fluvial bull trout forage and overwinter in the larger pools of the upper portion of the mainstem Skagit River and, to a lesser degree, in the Sauk River (Kraemer 2003; WDFW et al. 1997).

Many bull trout extensively use the lower estuary and nearshore marine areas for extended rearing and subadult and adult foraging. Key spawning and early rearing habitat, found in the upper portion of much of the basin, is generally on federally protected lands, including North Cascades National Park, North Cascades Recreation Area, Glacier Peak Wilderness, and Henry M. Jackson Wilderness Area.

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 (USFWS 2004, Vol. I p. 215, Vol. II p. 135).

Number and Distribution of Local Populations

Nineteen local populations were identified in the draft recovery plan (USFWS 2004, Vol. II p. 76) 1) Bacon Creek, 2) Baker Lake, 3) Buck Creek, 4) Cascade River, 5) Downey Creek, 6) Forks of Sauk River, 7) Goodell Creek, 8) Illabot Creek, 9) Lime Creek, 10) Lower White Chuck River, 11) Milk Creek, 12) Newhalem Creek, 13) South Fork Cascade River, 14) Straight Creek, 15) Sulphur Creek, 16) Tenas Creek, 17) Upper South Fork Sauk River, 18) Upper Suiattle River, and 19) Upper White Chuck River. Although initially identified as potential local populations in the draft recovery plan (USFWS 2004, p. 76, 84), Sulphur Creek (Lake Shannon) and Stetattle Creek each now meets the definition of local population based on subsequent observations of juvenile bull trout and prespawn migratory adult bull trout (R2 Resource Consultants and Puget Sound Energy 2005, p. 3-7; Jim Shannon in litt. 2004). With 21 local populations, the bull trout in the Lower Skagit core area is at diminished risk of extirpation and adverse effects from random naturally- occurring events (see "Life History").

Adult Abundance

The Lower Skagit core area, with a spawning population of migratory bull trout that numbers in the thousands, is probably the largest population in Washington (Kraemer 2001). Consequently, the bull trout population in this core area is not considered at risk from genetic drift.

Based upon snorkel strip-count surveys, researchers from the University of Washington have provided an estimate for the approximate number of adult bull trout that reside in the 26-mile section of the mainstem Skagit between the Sauk River and the town of Newhalem. Most of these adults are fluvial fish which spawn in tributaries, including Newhalem Creek, Goodell Creek, Bacon Creek, Diabsud Creek, Illabot Creek, and the Cascade River. These surveys indicate that between 1,600 and 5,000 adult bull trout reside in the 26-mile section of the mainstem Skagit River between the Sauk River and the town of Newhalem (E. Lowery, UW, pers. comm. 2008 in USFWS 2008, p. 1638). Genetic analyses completed in conjunction with these surveys found that bull trout were genetically diverse, with statistically significant differences in genetics observed on a longitudinal basis along this section of the river (Smith, UW, unpublished data 2008 in USFWS 2008, p. 1643). This finding, in conjunction with migration data from acoustic tag studies, suggests that the local bull trout populations situated along the mainstem Skagit River, including Bacon Creek, Goodell Creek, Illabot Creek, Diabsud Creek, and the Cascade River are genetically distinct even though adult fish freely migrate among these areas (E. Connor, Seattle City Light, unpublished data 2008 in USFWS 2008, p. 1643).

Primary snorkeling indexes include locations along Goodell, Downey, and Bacon Creeks, and the South Fork Sauk River. Snorkeling indexes also now include locations on Illabot Creek and the Cascade River. Numbers of holding adult bull trout and bull trout redds increased from 2006 to 2007 in Goodell, Bacon, and Illabot Creeks, and the South Fork Sauk River (Downen 2009, p. 2). In Downey Creek and the Cascade River, live adult counts were up while redd counts were down. Live adult counts rose in Goodell Creek despite continued absence of passage above the 2003 slide to historic spawning habitat (Downen 2009, p. 2).

Overall numbers of adult bull trout in the Skagit basin appear to have increased from 2006 to 2008 based on both live adult counts and redd counts (Figures 1 and 2)(Downen 2009, p. 2). The Sauk River and Illabot Creek populations are still significantly depressed compared to levels observed in 2002 through 2004. However, overall, the currently monitored Sauk River population is larger than it has been throughout the decade of the 1990's (Figure 3)(Downen 2009, p. 2).

.

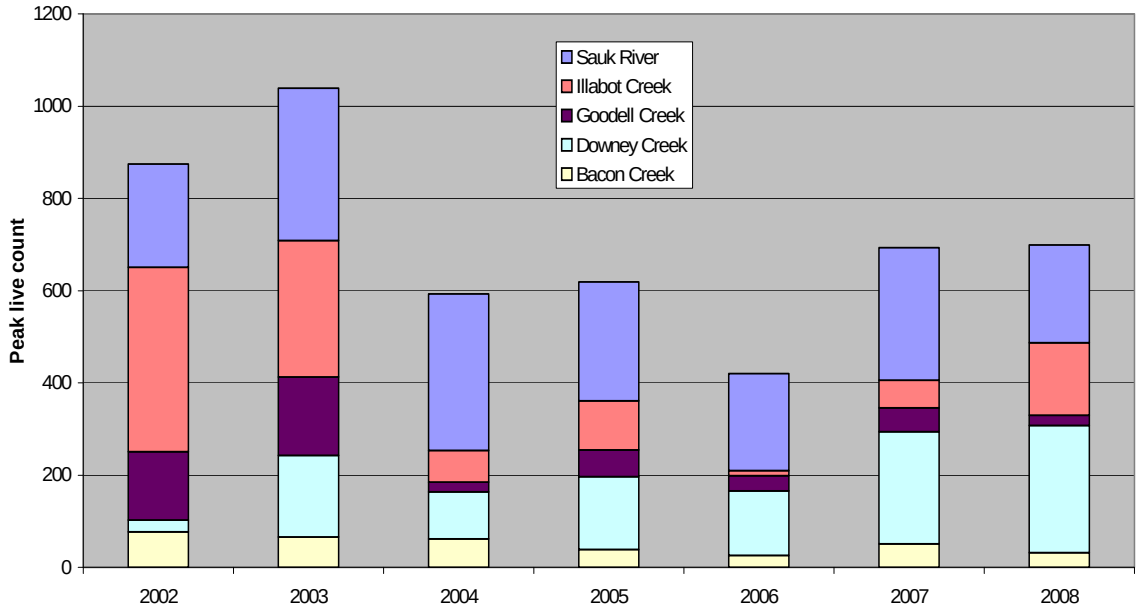


Figure 1. Trends in peak adult index counts from 2002 through 2008 (Downen 2009, p. 3)

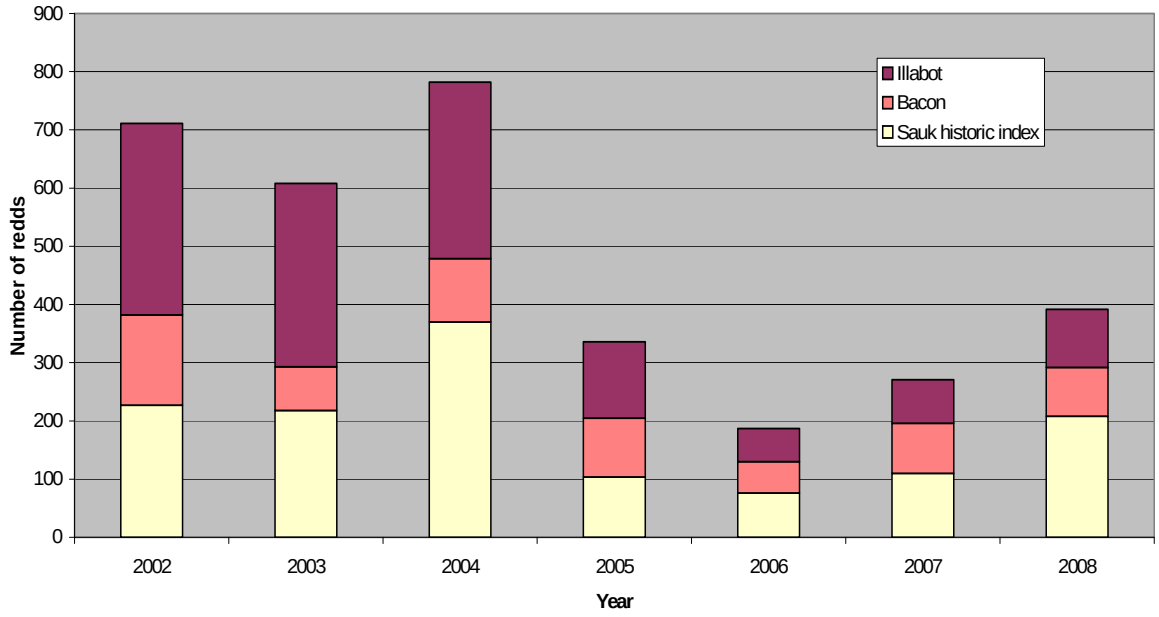


Figure 2. Trends in cumulative redd counts from 2002 through 2008 (Downen 2009, p. 3).

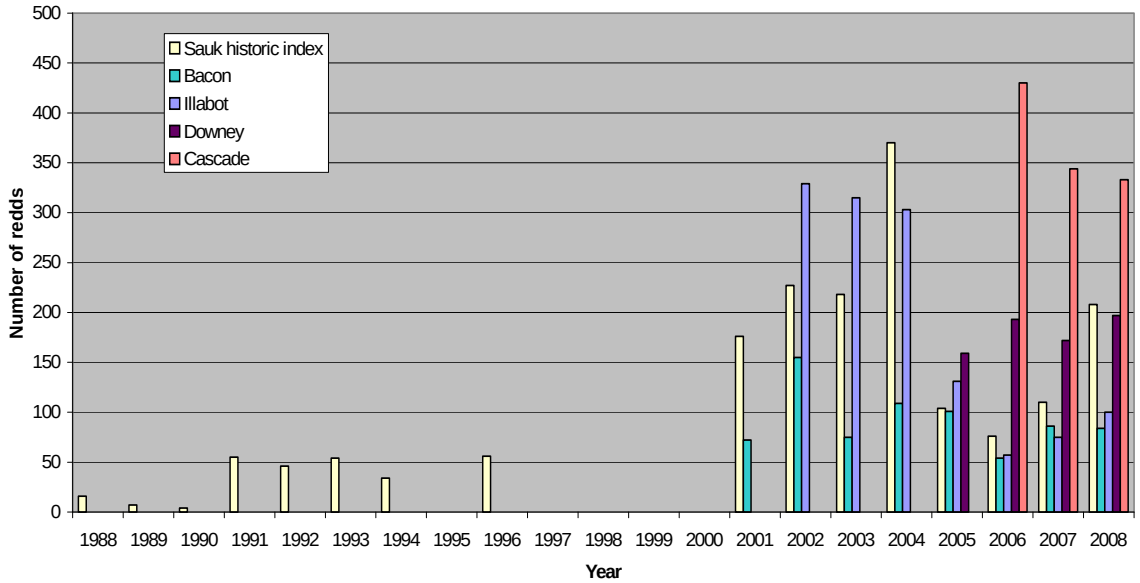


Figure 2. Long term trends in redd counts (Downen 2009, p. 4).

The majority of local populations in the core area include 100 adults or more; therefore, they are at a diminished risk of extirpation. However, some local populations probably have fewer than 100 adults and may be at risk from inbreeding depression. There is some risk of extirpation of the following local populations due to their lower numbers of adults; however, other factors, such as stable or increasing population trends may reduce this risk.

Fewer than 100 adults probably occur in Tenas Creek, but this local population is presumed to be increasing. The Straight Creek local population includes fewer than 100 migratory adults and an unknown number of resident fish (Kraemer 2001), but the migratory component appears stable. The Lime Creek local population probably has fewer than 100 migratory adults, but resident and migratory components are considered abundant.

The South Fork Cascade River local population probably has fewer than 100 migratory adults (Kraemer 2001); however, resident and migratory components are considered stable. Surveys completed on the Cascade River since 2006 have revealed large numbers of holding bull trout between Sibley Creek and the North Fork confluence. These results re-enforce 2006 and 2007 redd survey data that indicated the Cascade River harbors one of the largest and most diverse populations of bull trout in the Skagit basin (Downen 2009, p. 1).

Based on recent observations, the Sulphur Creek local population in the Lake Shannon system also has fewer than 100 adults (R2 Resource Consultants and Puget Sound Energy 2006). Prior to 2004, Goodell Creek supported more than 100 adult spawners. In October 2003, a large landslide in Goodell Creek blocked access to the majority of spawning habitat for migratory bull trout in the Goodell Creek local population. Adult counts of migratory bull trout in 2004 and 2005 have been fewer than 100 individuals (Downen 2006) in this local population. In the Baker Lake local population, annual peak counts of 85 adults have been recorded between 2001 and

2005 (R2 Resource Consultants and Puget Sound Energy 2006). Since the most upstream accessible habitat was not surveyed in these efforts, and bull trout typically spawn as far upstream as they can within a stream system, this would suggest that on average there may be at least 100 adults in this local population. Total adult abundances in Newhalem and Stettatle Creek local populations are unknown.

Productivity

Long-term redd counts in the index areas of the Lower Skagit core area generally indicate stable to increasing population trends (USFWS 2004). Therefore, this core area is not considered at risk of extirpation at this time. However, recent declines in redd counts may indicate a potential change to this long-term trend (Downen 2006).

Redd count data is available for the spawning index on the South Fork Sauk River. Redds have been counted at this location since 1988. The annual total has ranged from 4 redds in 1990 to 370 redds in 2004 (WDFW 1998 Downen, WDFW, pers. comm. 2003 and 2005 in USFWS 2008, p. 1637). The annual total averaged around 50 redds during the 1990s, but increased significantly during the early 2000s. Another reach of the South Fork Sauk River was included as an additional index area beginning in 2002.

Redd counts have been conducted in additional survey areas since 2001 (Downen, WDFW, pers. comm. 2007 in USFWS 2008, p. 1637). Counts were initiated in the Bacon Creek index area in 2001, with counts ranging between 72 and 155 redds, averaging 103 redds, between 2001 and 2004. Counts were initiated in the Illabot Creek index area in 2002, with counts ranging between 303 and 329 redds, averaging 315 redds, between 2002 and 2004. Redd counts have been conducted within index sites in Downey Creek (Suiattle River subbasin) since 2005, with an average of 170 redds counted in 2005 and 2006. Redd counts were initiated within an index site in the Cascade River in 2006, with 440 redds counted that year.

A series of flood and drought events have recently resulted in temporary declines in population abundance. A record flood event in October 2003 is thought to have impacted 2001 and 2002 brood years (WDFW, in litt. 2007 in USFWS 2008, p. 1646). A 60 percent decline in redd counts was observed in 2005 and is attributed to an extreme low summer flow event of that year (WDFW, in litt. 2007 in USFWS 2008, p. 1646). Low summer flows in 2006, followed by a record flood event in November 2006 is believed to have likely further impacted spawning success.

While redd counts in the primary indexes, including Bacon and Illabot Creeks, and the South Fork Sauk River increased modestly during 2008, counts in the Cascade River decreased somewhat. This reinforces conclusions drawn from data collected in 2006, suggesting population variations within sub-basins are not always correlated and expanded monitoring is essential to tracking basin wide trends (Downen 2009, p. 2).

The total cumulative bull trout redd count was 62.5 percent greater in 2010 than observed in 2009. However despite improved redd counts in some indexes, other indexes declined from

2009 counts (Table 1). The total cumulative redd count was below the mean from the years 2005 through 2009 for all index reaches in 2010 except for the South Fork Sauk River (Fowler 2011, p. 1).

Table 1. Yearly cumulative redd counts from 2005 through 2010 (based on Fowler 2011, p. 1).

IndexStream	Basin	Indexes	2010	2009	2008	2007	2006	2005
WF Bacon Creek	Skagit	1	67	21	84	86	59	101
Cascade/SF Cascade Rivers	Skagit	2	207	91	333	344	434	no data
Downey Creek	Skagit	2	95	103	197	172	193	158
SF Sauk River	Skagit	2	152	77	208	110	143	104
		Total redds:	521	292	822	712	829	363

The status and trend of bull trout in this core area was considered "strong" based on information available at the time of listing (USFWS 1998). Recent data would suggest that the population within the overall core area still remains strong. However, trends across the core area are not completely clear, given that year-to-year counts in the recently established index areas are variable (USFWS 2008, p. 1640). Furthermore, obtaining consistently accurate redd counts is complicated by at least two factors; recent work suggests significant year-to-year variation in habitat usage within some index areas, and timing and accessibility (including weather constraints) make these some of the most difficult surveys completed anywhere in the north Puget Sound (Fowler 2011, pp. 3, 4, 10).

Connectivity

The presence of migratory bull trout in most of the local populations indicates the bull trout in the Lower Skagit core area has a diminished risk of extirpation from habitat isolation and fragmentation. However, the lack of connectivity of the Baker Lake and Sulphur Creek local populations in the Baker River system and Stetattle Creek local population in the Gorge Lake system with other local populations in the core area is a concern with respect to long-term persistence, life history expression, and refounding. In addition, there is currently only partial connectivity within the Baker Lake system, with no upstream passage for adults within Lake Shannon at upper Baker Dam.

Changes in Environmental Conditions and Population Status

Since the bull trout listing, Federal actions occurring in the Lower Skagit core area have caused harm to, or harassment of, bull trout. These actions include statewide Federal restoration programs that include riparian restoration, replacement 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 Habitat Conservation Plans addressing forest management practices. Capture and handling, and indirect mortality, during implementation of section 6 and section 10(a)(1)(A) permits have negatively directly affected bull trout in the Lower Skagit core area.

The number of non-Federal actions occurring in the Lower Skagit core area since the bull trout listing is unknown. Activities conducted on a regular basis, such as emergency flood control, development, and infrastructure maintenance, affect riparian and instream habitat and probably have negatively affected bull trout and parts of their forage base.

A number of major restoration and conservation land protection projects have been completed in the Skagit River watershed that improve and protect bull trout habitat. Many of these projects were implemented as the result of project prioritization processes and state and federal funding coordinated by the Skagit Watershed Council (E. Connor, Seattle City Light, pers. comm. 2008 in USFWS 2008, p. 1647). Major restoration projects that have been implemented or completed since 2004 include the Milltown Island and Wiley Slough Estuary Restoration Project sponsored by the Skagit River System Cooperative (SRSC) and WDFW, and the sediment reduction projects in the middle Skagit and Suiattle River watersheds sponsored by the U.S. Forest Service. Over 1,100 acres of habitat in the Cascade River was put into permanent conservation protection through the partnership of Seattle City Light, Washington Department of Natural Resources, and USFWS (USFWS 2008, p. 1647). Several miles of FMO habitat along the middle Skagit River have been protected since 2004 by the Skagit Land Trust and The Nature Conservancy, and major areas along the middle Skagit are being restored by the Skagit Fisheries Enhancement Group and SRSC. The SRSC has been reducing the impacts of bank armoring on FMO habitats in the Sauk River by acquiring lands and subsequently removing riprap (USFWS 2008, p. 1647).

Threats

Threats to bull trout in the Lower Skagit core area include:

- Gorge and Baker Dams restrict connectivity of the Stetattle Creek, Baker Lake, and Sulphur Creek (Lake Shannon) local populations with the majority of other local populations in the core area due to impaired fish passage.

- Operations of the Lower Baker Dam occasionally have significantly affected water quantity in the lower Baker and Skagit Rivers.

- Agricultural practices, residential development, and the transportation network, with related stream channel and bank modifications, have caused the loss and degradation of foraging, migration, and overwintering habitats in mainstem reaches of the major forks and in a number of the tributaries.

- Estuarine nearshore foraging habitats have been, and continue to be, negatively affected by agricultural practices and development activities.

- The abundance of Chinook, chum, and pink salmon has substantially declined in the Skagit River since 2004, and steelhead have been declining in the watershed for over a decade (WDFW Salmon and Steelhead Stock Inventory-SASSI database 2008 in USFWS 2008, p. 1644). The eggs and juveniles produced by salmon, steelhead, and whitefish provide a major portion of the forage base for subadult and adult bull trout in the Skagit River (E. Lowery, UW, unpublished data 2008 in USFWS 2008, p. 1644). The

abundance of the forage base has been undergoing a long-term decline in the Skagit River watershed. The declining forage base may result in long-term declines in the core area's bull trout populations (USFWS 2008, p. 1650).

- Recent model results predict that impacts from climate change will be most pronounced in high-elevation streams (Battin et al. 2007 in USFWS 2008, p. 1654). These impacts may include higher water temperatures, lower spawning flows, and, most importantly, increased magnitude of winter peak flows (Battin et al. 2007 in USFWS 2008, p. 1654). Increased peak flows and sediment loads, and related channel bed instability, will likely reduce spawning and incubation success and increase redd scour for bull trout and their prey. However, because of the size of the Skagit River basin, the large number of local populations, and number of protected areas (North Cascades National Park, Henry M. Jackson Wilderness, Glacier Peak Wilderness), there is likely greater resiliency here than in other core areas (USFWS 2008, p. 1654).

LITERATURE CITED

Downen, M.R. 2009. 2008 Skagit bull trout monitoring program annual report. Washington Department of Fish and Wildlife, 2009. 4 pp.

Downen, M.R. 2006. Region 4 bull trout monitoring summary report, September 2006.

Fowler, A. 2011. 2010 Skagit, Stillaguamish, and North Fork Skykomish Rivers bull trout monitoring report. Washington Department of Fish and Wildlife, La Connor, Washington, 2011. 12 pp.

Kraemer, C. 2001. Draft: Puget Sound bull trout core areas - lower Skagit core area. Washington Department of Fish and Wildlife, Olympia, WA, July 31, 2001. 8 pp.

Kraemer, C. 2003. Management brief: Lower Skagit bull trout, age and growth information developed from scales collected from anadromous and fluvial char. Washington Department of Fish and Wildlife, Olympia, WA, January 1, 2003. 16 pp.

R2 Resource Consultants, and Puget Sound Energy. 2005. Native char investigations. Results of 2004 activities and proposed 2005 activities. Baker River hydroelectric project (FERC No. 2150), FERC No.2150, April 2005. 57 pp.

R2 Resource Consultants, and Puget Sound Energy. 2006. Native char investigations. Results of 2005 activities. Baker River hydroelectric project (FERC No. 2150), FERC No. 21050, Bellevue, Washington, January 2006. 68 pp.

Shannon, J. 2004. Email from Jim Shannon, Fish Biologist, Taylor Associates, Inc., Seattle, WA, to Jeffrey Chan, Fish Biologist, USFWS, Re: Gorge Lake bull trout observations. October 8, 2004.

USFWS. 2004. Draft Recovery Plan for the Coastal-Puget Sound distinct population segment of bull trout (*Salvelinus confluentus*). Volume I: Puget Sound Management Unit, 389+xvii pp and Volume II: Olympic Peninsula Management Unit, 277+xvi pp, Portland, Oregon.

USFWS. 2008. Bull trout core area templates - an unpublished compilation of updated bull trout core area analysis to support the five-year review. U.S. Fish and Wildlife Service, Portland, OR, August 24, 2008. 1895 pp.

WDFW, FishPro Inc., and Beak Consultants. 1997. Grandy Creek trout hatchery biological assessment. Washington Department of Fish and Wildlife, Olympia, WA, March 1997. 47 pp.

APPENDIX E: Sediment Analysis Framework (2010)

APPENDIX E: Sediment Analysis Framework (2010)

DETERMINING EFFECTS FOR SECTION 7 CONSULTATIONS

There are numerous factors that can influence project-specific sediment effects on bull trout and other salmonids. These factors include the concentration and duration of sediment input, existing sediment conditions, stream conditions (velocity, depth, etc.) during construction, weather or climate conditions (precipitation, wind, etc.), fish presence or absence (bull trout plus prey species), and best management practice effectiveness. Many of these factors are unknown.

Newcombe and Jensen (1996) and Anderson et al. (1996) provide the basis for analyzing sediment effects to bull trout and other salmonids and their habitat. Newcombe and Jensen (1996) conducted a literature review of pertinent documents on sediment effects to salmonids and nonsalmonids. They developed a model that calculated the severity of ill effect (SEV) to fish based on the suspended sediment dose (exposure) and concentration. No data on bull trout were used in this analysis. Anderson et al. (1996), using the methods used by Newcombe and Jensen (1996), developed a model to estimate sediment impacts to salmonid habitat.

A 15-point scale was developed by Newcombe and Jensen (1996, p. 694) to qualitatively rank the effects of sediment on fish (Table 1). Using a similar 15-point scale, Anderson et al. (1996) ranked the effects of sediment on fish habitat (Table 2).

We analyzed the effects on different bull trout life history stages to determine when adverse effects of project-related sediment would occur. Table 3 shows the different ESA effect calls for bull trout based on severity of ill effect.

Table 1 – Scale of the severity (SEV) of ill effects associated with excess suspended sediment on salmonids.

SEV	Description of Effect
	Nil effect
0	No behavioral effects
	Behavioral effects
1	Alarm reaction
2	Abandonment of cover
3	Avoidance response
	Sublethal effects
4	Short-term reduction in feeding rates; short-term reduction in feeding success
5	Minor physiological stress; increase in rate of coughing; increased respiration rate
6	Moderate physiological stress
7	Moderate habitat degradation; impaired homing
8	Indications of major physiological stress; long-term reduction in feeding rate; long-term reduction in feeding success; poor condition
	Lethal and paralethal effects
9	Reduced growth rate; delayed hatching; reduced fish density
10	0-20% mortality; increased predation; moderate to severe habitat degradation
11	> 20 – 40% mortality
12	> 40 – 60% mortality
13	> 60 – 80% mortality
14	> 80 – 100% mortality

The effect determination for a proposed action should consider all SEV values resulting from the action because sediment affects individual fish differently depending on life history stage and site-specific factors. For juvenile bull trout, an SEV of 5 is likely to warrant a "likely to adversely affect" (LAA) determination. However, abandonment of cover (SEV 2), or an avoidance response (SEV 3), may result in increased predation risk and mortality if habitat features are limiting in the project's stream reach. Therefore, a LAA determination may be warranted at an SEV 2 or 3 level in certain situations. For subadult and adult bull trout, however, abandonment of cover and avoidance may not be as important. A higher SEV score is more appropriate for adverse effects to subadult and adult bull trout. In all situations, we assume that SEV scores associated with adverse effects are also sufficient to represent a likelihood of harm or harass8.

Table 2 – Scale of the severity (SEV) of ill effects associated with excess suspended sediment on salmonid habitat.

SEV	Description of Effect
3	Measured change in habitat preference
7	Moderate habitat degradation – measured by a change in invertebrate community
10	Moderately severe habitat degradation – defined by measurable reduction in the productivity of habitat for extended period (months) or over a large area (square kilometers).
12	Severe habitat degradation – measured by long-term (years) alterations in the ability of existing habitats to support fish or invertebrates.
14	Catastrophic or total destruction of habitat in the receiving environment.

When evaluating impacts to habitat as a surrogate for species effects, adverse effects may be anticipated when there is a notable reduction in abundance of aquatic invertebrates, and an alteration in their community structure. These effects represent a reduction in food for bull trout and other salmonids, and correspond to an SEV of 7 – moderate habitat degradation.

Newcombe and Jensen (1996) used six data groups to conduct their analysis. These groups were 1) juvenile and adult salmonids (Figure 1), 2) adult salmonids (Figure 2), 3) juvenile salmonids (Figure 3), 4) eggs and larvae of salmonids and non-salmonids (Figure 4), 5) adult estuarine nonsalmonids (no figure provided), and 6) adult freshwater nonsalmonids (no figure provided). No explanation was provided for why juvenile and adult salmonids were combined for group 1. As juveniles are more adapted to turbid water (Newcombe 1994, p. 5), their SEV levels are generally lower than for adult salmonids given the same concentration and duration of sediment (Figures 1-3).

8 Harm and harass in this context refers to the FWS's regulatory definition at 50 CFR 17.3. E.g., Harm means "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."

Table 3 – ESA Effect calls for different bull trout life stages in relation to the duration of effect and severity of ill effect. Effect calls for habitat, specifically, are provided to assist with analysis of effects to individual bull trout.		
	SEV	**ESA Effect Call**
Egg/alevin	1 to 4	Not applicable - alevins are still in gravel and are not feeding.
	5 to 14	LAA - any stress to egg/alevin reduces survival
Juvenile	1 to 4	NLAA
	5 to 14	LAA
Subadult and Adult	1 to 5	NLAA
	6 to 14	LAA
Habitat	1 to 6	NLAA
	7 to 14	LAA due to indirect effects to bull trout

The figures of Newcombe and Jensen (1996) have been modified in this document. In each figure, values (in mg/L) are provided for each duration to determine when adverse effects would occur. Specific values are also given for when harm would be likely to occur. For example:

> Figure 1 – This figure is for both juveniles and adults. From Table 2, bull trout are "likely to be adversely affected" given an SEV of 5. On Figure 1, a sediment concentration of 99 mg/L for one hour is anticipated to be the maximum concentration for an SEV of 4. At 100 mg/L, an SEV of 5 occurs. In addition, one hour of exposure to 5,760 mg/L is the maximum for an SEV of 7. Exposure to 5,761 mg/L for one hour would warrant an SEV of 8. This would be the threshold between harassment and harm. An SEV of 7 would be harassment, and an SEV of 8 would be considered harm.

The following provides some guidance on use of the figures.

Definitions from Newcombe and Jensen (1996, p. 696). These definitions are provided for consultations that may have impacts to bull trout prey such as Chinook and coho salmon.

> Eggs and larvae – eggs, and recently hatched fish, including yolk-sac fry, that have not passed through final metamorphosis.
>
> Juveniles – fry, parr, and smolts that have passed through larval metamorphosis but are sexually immature.
>
> Adults – mature fish.

Bull trout use:

Newcombe and Jensen (1996) conducted their analysis for freshwater, therefore the use of the figures within this document in marine waters should be used with caution.

Figure 1 – Juvenile and Adult Salmonids. This figure should be used in foraging, migration and overwintering (FMO) areas. In FMO areas, downstream of local populations, both subadult and adult bull trout may be found.

Figure 2 – Adult Salmonids. This figure will not be used very often for bull trout. There may be circumstances, downstream of local population spawning areas that may have just adults, but usually this would not be the case. Justification for use of this figure should be stated in your consultation.

Figure 3 – Juvenile Salmonids. This figure should be used in local population spawning and rearing areas outside of the spawning period. During this time, only juveniles and sub-adults should be found in the area. Adults would migrate to larger stream systems or to marine water. If the construction of the project would occur during spawning, then Figure 1 should be used.

Figure 4 – Eggs and Alevins. This figure should be used if eggs or alevins are expected to be in the project area during construction.

Figure 5 – Habitat. This figure should be used for all projects to determine whether alterations to the habitat may occur from the project.

Background and Environmental Baseline

In determining the overall impact of a project on bull trout, and to specifically understand whether increased sediment may adversely affect bull trout, a thorough review of the environmental baseline and limiting factors in the stream and watershed is needed. The following websites and documents will help provide this information.

1. Washington State Conservation Commission's Limiting Factors Analysis. A limiting factors analysis has been conducted on watersheds within the State of Washington. Limiting factors are defined as "conditions that limit the ability of habitat to fully sustain populations of salmon, including all species of the family Salmonidae." These documents will provide information on the current condition of the individual watersheds within the State of Washington. The limiting factors website is http://salmon.scc.wa.gov. Copies of the limiting factors analysis can be found at the Western Washington Fish and Wildlife Library.

2. Washington Department of Fish and Wildlife's (1998) Salmonid Stock Inventory (SaSI). The Washington Department of Fish and Wildlife (WDFW) inventoried bull trout and Dolly Varden (*S. malma*) stock status throughout the State. The intent of the inventory is to help identify available information and to guide future restoration planning and implementation. SaSI defines the stock within the watershed, life history

forms, status and factors affecting production. Spawning distribution and timing for different life stages are provided (migration, spawning, etc.), if known. SaSi documents can be found at http://wdfw.wa.gov/fish/sasi/index.htm.

3. U.S. Fish and Wildlife Service's (USFWS 1998a) Matrix of Diagnostics/Pathways and Indicators (MPI). The MPI was designed to facilitate and standardize determination of project effects on bull trout. The MPI provides a consistent, logical line of reasoning to aid in determining when and where adverse effects occur and why they occur. The MPI provides levels or values for different habitat indicators to assist the biologist in determining the level of effects or impacts to bull trout from a project and how these impacts may cumulatively change habitat within the watershed.

4. Individual Watershed Resources. Other resources may be available within a watershed that will provide information on habitat, fish species, and recovery and restoration activities being conducted. The action agency may cite a publication or identify a local watershed group within the Biological Assessment or Biological Evaluation. These local groups provide valuable information specific to the watershed.

5. Washington State Department of Ecology (WDOE) - The WDOE has long- and short-term water quality data for different streams within the State. Data can be found at http://www.ecy.wa.gov/programs/eap/fw_riv/rv_main.html. Clicking on a stream or entering a stream name will provide information on current and past water quality data (when you get to this website, scroll down to the Washington map). This information will be useful for determining the specific turbidity/suspended sediment relationship for that stream (more information below).

6. Washington State Department of Ecology (WDOE) - The WDOE has also been collecting benthic macroinvertebrates and physical habitat data to describe conditions under natural and anthropogenic disturbed areas. Data can be found at http://www.ecy.wa.gov/programs/eap/fw_benth/index.htm. You can access monitoring sites at the bottom of the website.

7. U.S. Forest Service, Watershed Analysis Documents - The U.S. Forest Service (USFS) is required by the Record of Decision for Amendments to the USFS and Bureau of Land Management Planning Documents within the Range of the Northern Spotted Owl to conduct a watershed analysis for watersheds located on FS lands. The watershed analysis determines the existing condition of the watershed and makes recommendations for future projects that move the landscape towards desired conditions. Watershed analysis documents are available from individual National Forests or from the Forest Plan Division.

8. U.S. Fish and Wildlife Service - Bull Trout Recovery Plans and Critical Habitat Designations. The draft Bull Trout Recovery Plan for the Columbia River Distinct Population Segment (DPS) (also the Jarbidge River and the St. Mary-Belly River DPS) and the proposed and final critical habitat designations provide current species status, habitat requirements, and limiting factors for bull trout within specific individual

recovery units. These documents are available from the Endangered Species Division as well as the Service's web page (www.fws.gov).

These documents and websites provide baseline and background information on stream and watershed conditions. This information is critical to determining project-specific sediment impacts to the aquatic system. The baseline or background levels need to be analyzed with respect to the limiting factors within the watershed.

Consultation Sediment Analysis

The analysis in this section only applies to construction-related physiological and behavioral impacts, and the direct effects of fine sediment on current habitat conditions. Longer-term effects to habitat from project-induced channel adjustments, post-construction inputs of coarse sediment, and secondary fine sediment effects due to re-mobilization of sediment during the following runoff season, are not included in the quantitative part of this effects determination. Those aspects are only considered qualitatively.

The background or baseline sediment conditions within the project area or watershed will help to determine whether the project will have an adverse effect on bull trout. The following method should be followed to assist in reviewing effects determinations and quantifying take in biological opinions.

1) Determine what life stage(s) of bull trout will be affected by sedimentation from the project. Life history stages include eggs and alevins, juveniles, and sub-adults and adults. If projects adhere to approved work timing windows, very few should be constructed during periods when eggs and alevins are in the gravels. However, streambed or bank adjustments may occur later in time and result in increased sedimentation during the time of the year when eggs and alevins may be in the gravels and thus affected by the project.

2) Table 4 provides concentrations, durations, and SEV levels for different projects. This table will help in analyzing similar projects and to determine sediment level impacts associated with that type of project. Based on what life history stage is in the project area and what SEV levels may result from the project, a determination may be made on effects to bull trout. (Table 4 located on the Q drive: Q:\linked Literature Materials\Species & Issues & BO Templates with RefMan\Sediment Issue Paper)

3) Once a "likely to adversely affect" determination has been made for a project, the figures in Newcombe and Jensen (1996) or Anderson et al. (1996) are used to determine the concentration (mg/L) at which adverse effects9 and "take" will occur (see Figures 1-5). For example, if a project is located in FMO habitat, Figure 1 would be used to determine the concentrations at which adverse effects will occur. Since Figure 1 is used for both adults and juveniles, an SEV of 5 (for juveniles) is used (see Table 2). For (a.) the level when instantaneous adverse effects occur, find the SEV level of 5 in the one hour

9 For the remainder of the document, references to "adverse effects" also refer to harm and harass under 50 CFR 17.3.

column. The corresponding concentration is the instantaneous value where adverse effects occur. In this example, it is 148 mg/L. For (b), (c), and (d), adverse effects will occur when sediment concentrations exceed SEV 4 levels. The exact concentrations for this have been provided. For each category, find the SEV 4 levels and the corresponding concentration levels are the values used.

For impacts to individual bull trout, adverse effects would be anticipated in the following situations:

a. Any time sediment concentrations exceed 148 mg/L over background.
b. When sediment concentrations exceed 99 mg/L over background for more than one hour continuously.
c. When sediment concentrations exceed 40 mg/L over background for more than three hours cumulatively.
d. When sediment concentrations exceeded 20 mg/L over background for over seven hours cumulatively.

For habitat effects, use Figure 5 and the same procedure as above for individual bull trout. For example, adverse effects would be expected to occur in the following situations:

a. Any time sediment concentrations exceed 1,097 mg/L over background.
b. When sediment concentrations exceed 885 mg/L over background for more than one hour continuously.
c. When sediment concentrations exceed 345 mg/L over background for more than three hours cumulatively.
d. When sediment concentrations exceeded 167 mg/L over background for over seven hours cumulatively.

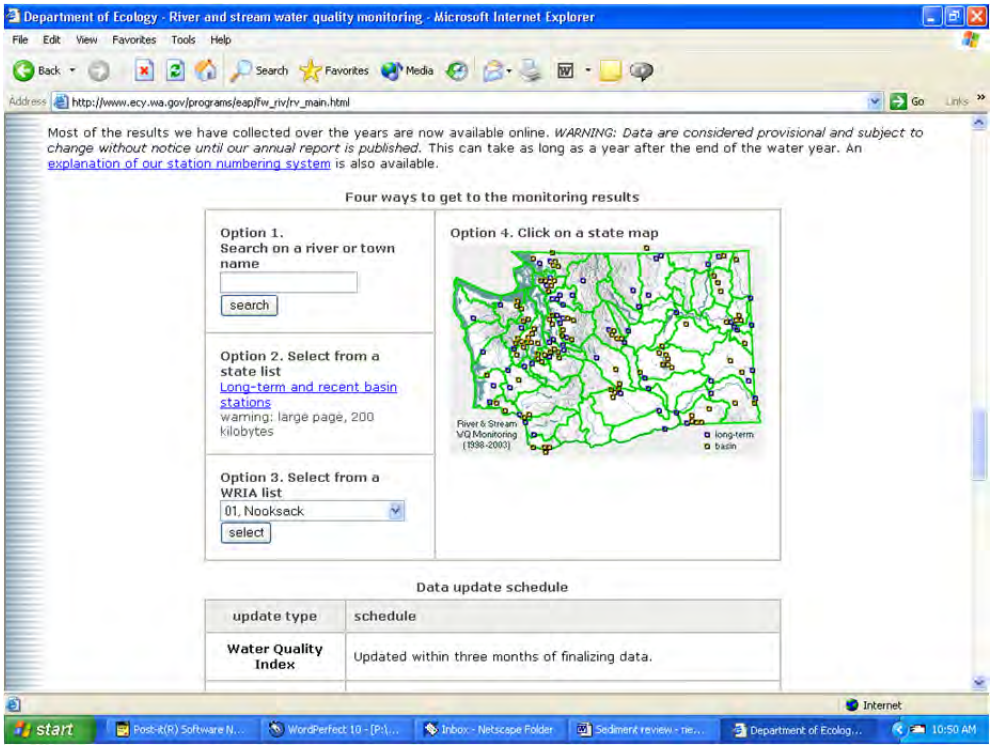
4) Because sediment sampling for concentration (mg/L) is labor intensive, many applicants prefer to monitor turbidity as a surrogate. To do this, the sediment concentration at which adverse effects to the species and/or habitat occurs is converted to NTUs. Two methods, regression analysis and turbidity to suspended solid ratio, are available for this conversion. The regression analysis method should be used first. If not enough data are available then the turbidity to suspended solid ratio method should be used.

   a. Data – as described above in Background and Environmental Baseline, an attempt should be made to find turbidity and suspended solid information from the project area, action area, or the stream in which the project is being constructed. This information may be available from the Tribes, watershed monitoring groups, etc. Try to obtain information for the months in-water construction will occur, which is usually during the fish timing window (in most cases, July through September). If you are unable to find any data for the action area, use the WDOE water quality

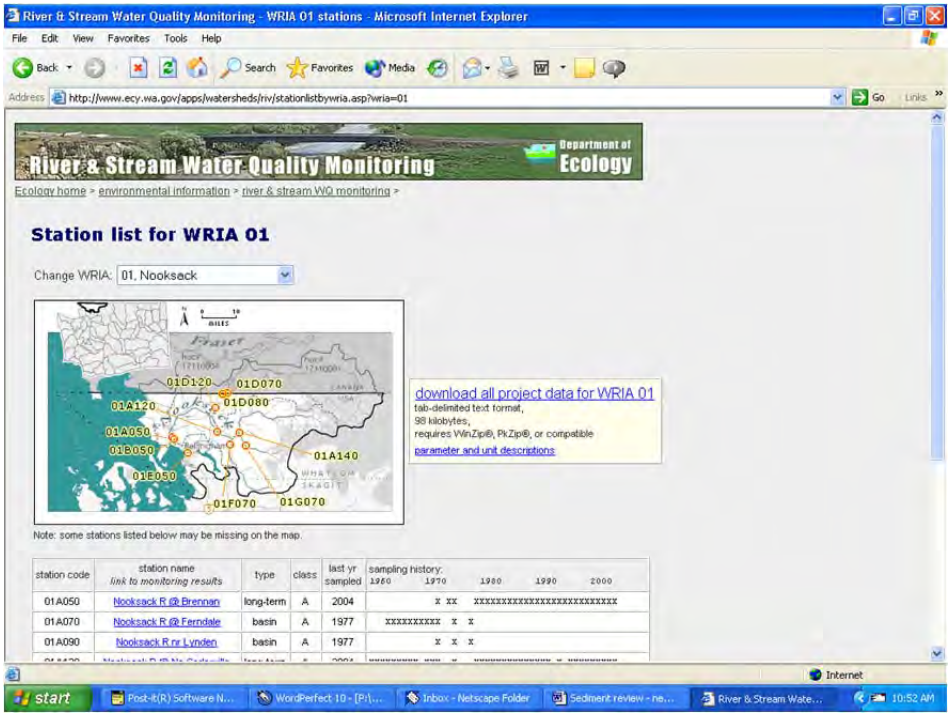
monitoring data. The following are the steps you need to go through to locate the information on the web and how to download the data:

i. Go to the WDOE webpage (http://www.ecy.wa.gov/programs/eap/fw_riv/rv_main.html).

ii. When you get to the website, the page will state "River and Stream Water Quality Monitoring." If you scroll down the page, you will see the following text and map.



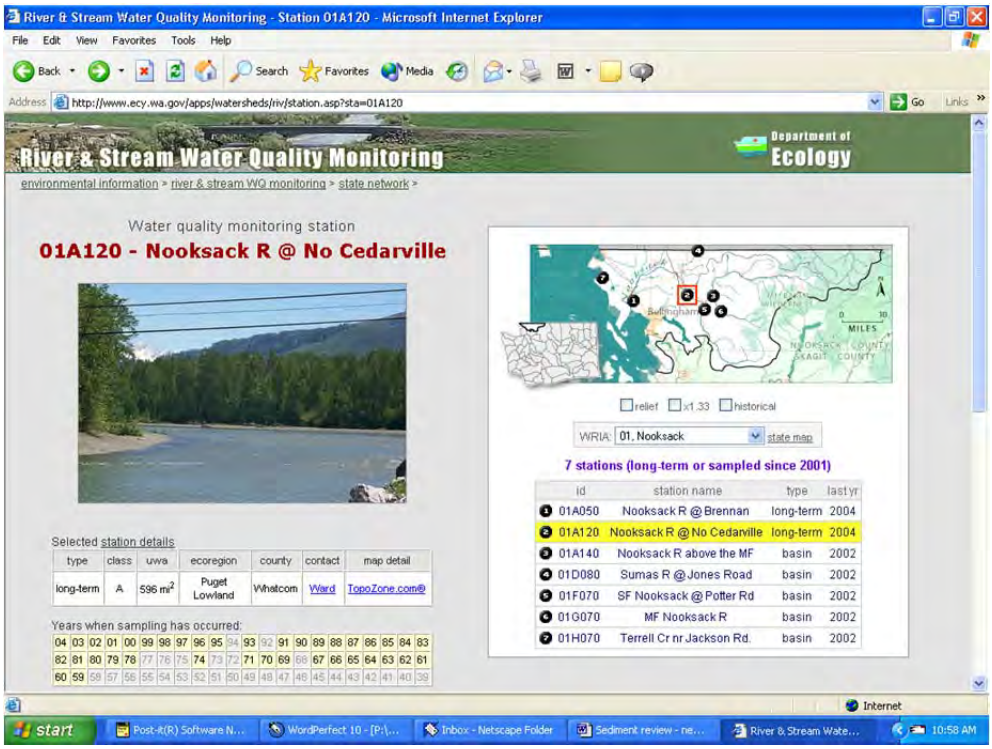
iii. The map shows all the water quality monitoring stations in Washington. You can click on a watershed, or go to Option 3, click on the down arrow and find your watershed. You will then get the following webpage. This is an example for the Nooksack River.



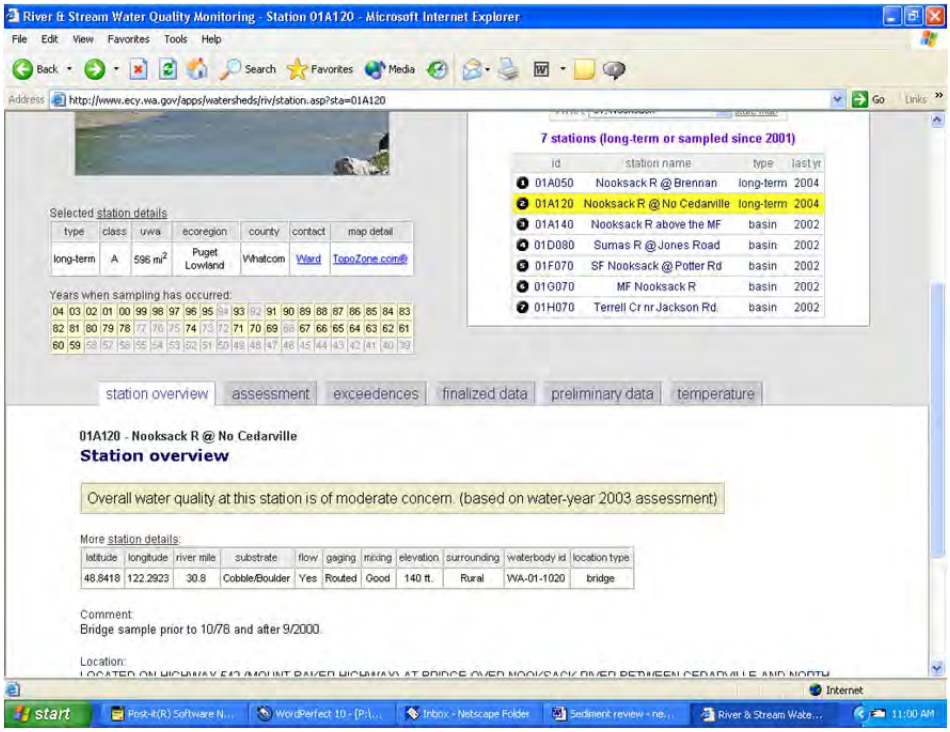
iv. This webpage shows you all the monitoring stations in this watershed. Scrolling down a little on the webpage, you get a list of the monitoring stations and the years that data were collected. The more years in which data were collected the better; however, you want to pick the monitoring station closest to the project site. If a project is located on a tributary, do not use data from the main river in the watershed. Find a monitoring station on a tributary and use that data. **Justification for the use of the data needs to be made in the BO.** The following language was used in the Anthracite Creek Bridge Scour BO. Changes to this paragraph to represent regression analysis are not italicized.

"*The guidance of Newcombe and Jensen (1996) requires a measurement of the existing suspended sediment concentration levels (mg/L) and duration of time that sediment impacts would occur. The Service used data available on the Washington Department of Ecology (WDOE) website to determine a ratio of turbidity (NTU) to suspended solids (mg/L)*(website to find the correlation between turbidity and suspended solids) *in Anthracite Creek. No water quality data was available for Anthracite Creek, so the Service used water quality monitoring data from a different tributary within the Snohomish River watershed. Patterson Creek, which is a tributary to the Snoqualmie River, was used to determine the ratio of turbidity to suspended solids* (correlation between turbidity and suspended solids). *The Service believes that Patterson Creek would have very comparable water quality data as Anthracite Creek. The turbidity to suspended solid ratio for Patterson Creek is 1:2.4 during the proposed months of construction (July through September).*" Delete the last sentence for regression analysis or put in the equation used for analysis and the R^2.

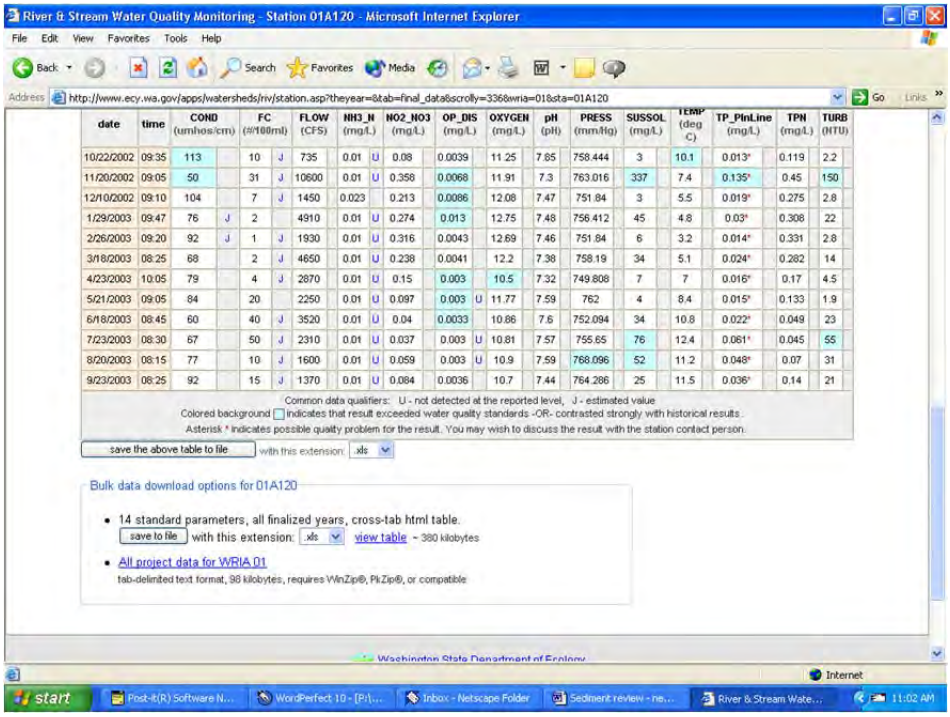
v. When you select the monitoring station, the following webpage appears. This monitoring station is on the Nooksack River at North Cedarville.



vi. Moving down the webpage, you find the following. The page shows the years data were collected and 4 to 6 tabs that provide different information. Click on the finalized data tab.



vii. Selecting the finalized data, a new page comes up; scrolling down that page you see the following. The top part of the page shows the finalized data for the most recent year data were collected. Below the data is a box that says “Bulk data download options...” Click on the “save to file” button for the 14 standardized data parameters. Follow the instructions to save this file. This saves all the data from that monitoring station so the regression analysis can be conducted.



date	time	COND (umhos/cm)		FC (#/100ml)		FLOW (CFS)	NH3_N (mg/L)		NO2_NO3 (mg/L)	OP_DIS (mg/L)	OXYGEN (mg/L)	pH (pH)	PRESS (mm/Hg)	SUSSOL (mg/L)	TEMP (deg C)	TP_PInLine (mg/L)	TPN (mg/L)	TURB (NTU)
10/22/2002	09:35	113		10	J	735	0.01	U	0.08	0.0039	11.25	7.85	758.444	3	10.1	0.013*	0.119	2.2
11/20/2002	09:05	50		31	J	10600	0.01	U	0.358	0.0068	11.91	7.3	763.016	337	7.4	0.135*	0.45	150
12/10/2002	09:10	104		7	J	1450	0.023		0.213	0.0086	12.08	7.47	751.84	3	5.5	0.019*	0.275	2.8
1/29/2003	09:47	76	J	2		4910	0.01	U	0.274	0.013	12.75	7.48	756.412	45	4.8	0.03*	0.308	22
2/26/2003	09:20	92	J	1	J	1930	0.01	U	0.316	0.0043	12.69	7.46	751.84	6	3.2	0.014*	0.331	2.8
3/18/2003	08:25	68		2	J	4650	0.01	U	0.238	0.0041	12.2	7.38	758.19	34	5.1	0.024*	0.282	14
4/23/2003	10:05	79		4	J	2870	0.01	U	0.15	0.003	10.5	7.32	749.808	7	7	0.016*	0.17	4.5
5/21/2003	09:05	84		20		2250	0.01	U	0.097	0.003	U 11.77	7.59	762	4	8.4	0.015*	0.133	1.9
6/18/2003	08:45	60		40	J	3520	0.01	U	0.04	0.0033	10.86	7.6	752.094	34	10.8	0.022*	0.049	23
7/23/2003	08:30	67		50	J	2310	0.01	U	0.037	0.003	U 10.81	7.57	755.65	76	12.4	0.061*	0.045	55
8/20/2003	08:15	77		10	J	1600	0.01	U	0.059	0.003	U 10.9	7.59	768.096	52	11.2	0.048*	0.07	31
9/23/2003	08:25	92		15	J	1370	0.01	U	0.084	0.0036	10.7	7.44	764.286	25	11.5	0.036*	0.14	21

viii. Open Excel and open the file that was just downloaded. Verify that all data appear to be available. After you have worked with these files, you will get an idea if something appears wrong. If the data looks like something is wrong, verify it by comparing the data to the finalized data on the webpage (look at each year's finalized data). After the file is open, delete all columns except the date, sussol (mg/L) and turb (NTU).

ix. Next delete the rows that do not need to be included. Only save the months in which the project will be constructed. For example, if work will be conducted during the work timing window of July 15 through August 31, delete all rows except those that contain data for July and August. The data consist of one data collection point each month. In addition, delete any values that have a "U" or "J" in the column to the right of the NTU value. This data may not be accurate; data may not be detectable at reported level or is an estimated value. The blue cells indicate the value exceeds water quality standards or contrasted strongly with historical results.

x. After deleting the unnecessary columns and rows, your data should contain 5 columns. You can now delete the columns to the right of the values. This will give you 3 columns. The first being the date, the second column contains the suspended solid data (mg/L) and the third column the turbidity (NTU) data.

b. Regression analysis. Once you have the data reduced to the months construction will occur, you can determine the relationship between turbidity and suspended

solids using regression. The following steps will provide the regression equation using the data obtained above. These steps are for Excel 2007.

i. With your mouse, highlight both columns of data (suspended solid and turbidity), but do not include the heading information.

ii. Then click on “Insert”, “Scatter” and then the graph that does not have any lines on it (should be the upper left graph).

iii. The graph is placed on your Excel sheet, so move it over so you can see all the data and the graph.

iv. Now add the trendline to the graph. This is done by clicking (left button) once on any of the points on the graph. Then right click. A window pops open and click on “Add Trendline.” A “Format Trendline” window appears. Make sure Linear is checked, and down on the bottom, check Display Equation on chart and Display R-squared value on chart. Click on close.

    1. The X and Y data are opposite of what you want so you need to swap the values. This is done by left clicking once anywhere on the graph and then right click and click on “select data.” A window pops open and you want to click on Edit. An Edit Series window appears and you want to click on the little red arrow next to Series X values. This allows you to select the data in the table. Upon clicking the red arrow, you will see the column under sussol (mg/L) being selected by a moving line around the cells. Select the data under Turb (NTU) by left clicking and holding the button down and drag all the way down to the last cell in that column. The whole column should have the moving line around all the cells. Click on the little red arrow in the Edit Series window. That will expand out the window and you will do the same for the Series Y values. Click on the red arrow next to that, then left click and hold and select all the cells in the column under Sussol (mg/L), and then click on the red arrow again. When the Edit Series window expands, click on OK, and then click on OK.

v. The equation that you want to use for your conversion from NTUs to suspended solids is now on the graph. Hopefully, your R-squared value is also high. This gives you an indication of how well your data fits the line. A one (1) is perfect. If this number is low (and a ballpark figure is less than 0.60) then you may want to consider using the ratio method to determine your conversion from NTUs to suspended solids.

    1. Outliers – sometimes there will be data that will be far outside the norm. These values can be deleted and that will help increase your R-squared value. If you are good at statistics there are ways of

determining outliers. If not, you will probably just use the data as is, unless you think something is really not right, then you may want to delete those data points.

vi. Using the equation for the regression analysis, convert the sediment concentrations found for when adverse effects occur to bull trout and their habitat (number 3 above) to NTUs. For our example, let's say our NTU to suspended solid equation is: $y = 1.6632x - 0.5789$. Adverse effects would then occur at (solve for x):

For impacts to the species adverse effect would occur in the following situations:

a. Any time sediment concentrations exceed 89 NTU over background.
b. When sediment concentrations exceed 60 NTU over background for more than one hour continuously.
c. When sediment concentrations exceed 24 NTU over background for more than three hours cumulatively.
d. When sediment concentrations exceeded 12 NTU over background for over seven hours cumulatively.

For impacts to habitat

a. Any time sediment concentrations exceed 660 NTU over background.
b. When sediment concentrations exceed 532 NTU over background for more than one hour continuously.
c. When sediment concentrations exceed 208 NTU over background for more than three hours cumulatively.
d. When sediment concentrations exceeded 101 NTU over background for over seven hours cumulatively.

c. Turbidity:suspended solid ratio: To calculate the turbidity to suspended solid ratio you need to download the same data off the Ecology website as described above. Sometimes the monitoring stations have limited amount of data and by running the regression analysis it is possible to get a negative slope (an increase in turbidity results in a decrease in suspended solids). This is very unlikely to occur in a stream. Other times you have so few data points that the R^2 value shows that the correlation between suspended solid and turbidity is not very good. When R^2 values are below 0.60, determine the turbidity to suspended solid ratio. The following are the steps needed to calculate the turbidity to suspended solid ratio.

i. After you deleted all the columns and rows of data you do not need, you should have 3 columns of data. The first being the date, the second column contains the suspended solid data (mg/L) and the third column the turbidity (NTU) data.

ii. Calculate the average turbidity and suspended solid value for all data. Average the turbidity column and average the suspended solid column.

iii. Calculate the turbidity to suspended solid value for the average turbidity and average suspended solid value obtained in ii. Divide the average suspended solid value by the average turbidity value.

iv. If any outliers are identified, they should be deleted. Recalculate the turbidity:suspended solid ratio if outliers have been removed (should automatically be done when values are deleted).

vii. Using the turbidity to suspended solid ratio, convert the sediment concentrations found for when adverse effects occur to bull trout and their habitat (number 3 above) to NTUs. For our example, let's say our NTU to suspended solid ratio is 2.1. Adverse effects to the species would then occur in the following situations:

a. Any time sediment concentrations exceed 70 NTU over background.
b. When sediment concentrations exceed 47 NTU over background for more than one hour continuously.
c. When sediment concentrations exceed 19 NTU over background for more than three hours cumulatively.
d. When sediment concentrations exceeded 10 NTU over background for over seven hours cumulatively.

Adverse effects to the species through habitat impacts would occur in the following situations:

a. Any time sediment concentrations exceed 522 NTU over background.
b. When sediment concentrations exceed 421 NTU over background for more than one hour continuously.
c. When sediment concentrations exceed 164 NTU over background for more than three hours cumulatively.
d. When sediment concentrations exceeded 80 NTU over background for over seven hours cumulatively.

5) Determine how far downstream adverse effects and take will occur. There is no easy answer for determining this. Table 4 provides some sediment monitoring data for a variety of projects. These data can be used to determine the downstream extent of sediment impacts for a project. Note that in Table 4 there is not a single downstream

point that can always be used because sediment conveyance and mixing characteristics are different for each stream. **An explanation of how the distance downstream was determined needs to be included in each BO.**

Figure 1 – Severity of ill effect scores for juvenile and adult salmonids. The individual boxes provide the maximum concentration for that SEV. The concentration between 4 and 5 represents the threshold for harassment, and the concentration between 7 and 8 represents the threshold for harm.

Juvenile and Adult Salmonids
Average severity of ill effect scores

Concentration (mg/L)	1	3	7	1	2	6	2	7	4	11	30
	Hours			Days			Weeks		Months		
162755	10	11	11	12	12	13	14	14	-	-	-
59874	9	10	10	11	12	12	13	13	14	-	-
22026	8	9	10	10	11	11	12	13	13	14	-
8103	8	8	9	10	10	11	11	12	13	13	14
2981	5760 7	8	8	9	9	10	11	11	12	12	13
1097	6	2335 7	1164 7	8	9	9	10	10	11	12	12
403	5	6	7	491 7	8	9	9	10	10	11	12
148	5	5	6	7	214 7	8	8	9	10	10	11
55	99 4	5	5	6	6	95 7	8	8	9	9	10
20	3	40 4	20 4	5	6	6	42 7	8	8	9	9
7	3	3	4	8 4	5	6	6	18 7	8 7	8	9
3	2	2	3	4	4 4	5	5	6	7	4 7	8
1	1	2	2	3	3	2 4	5	5	6	7	2 7

Figure 2 - Severity of ill effect scores for adult salmonids. The individual boxes provide the maximum concentration for that SEV. The concentration between 5 and 6 represents the threshold for harassment, and the concentration between 7 and 8 represents the threshold for harm.

Adult Salmonids
Average severity of ill effect scores

Concentration (mg/L)											
162755	11	11	12	12	13	13	14	14	-	-	-
59874	10	10	11	11	12	12	13	13	14	14	-
22026	9	10	10	11	11	12	12	13	13	14	14
8103	8	9	9	10	10	11	11	12	12	13	13
2981	8	8	9	9	10	10	11	11	12	12	13
1097	2190 7	8	8	8	9	9	10	10	11	11	12
403	6	1095 7	642 7	8	8	9	9	10	10	11	11
148	156 5	6	6	331 7	175 7	8	8	9	9	10	10
55	5	78 5	6	6	7	94 7	8	8	9	9	9
20	4	4	46 5	24 5	6	6	50 7	27 7	8	8	9
7	3	4	4	5	12 5	6	6	7	14 7	8 7	8
3	2	3	3	4	4	7 5	4 5	6	6	7	4 7
1	2	2	3	3	4	4	5	2 5	1 5	6	6
	1	3	7	1	2	6	2	7	4	11	30
	Hours			Days			Weeks		Months		

Figure 3 - Severity of ill effect scores for juvenile salmonids. The individual boxes provide the maximum concentration for that SEV. The concentration between 4 and 5 represents the threshold for harassment, and the concentration between 7 and 8 represents the threshold for harm.

Juvenile Salmonids
Average severity of ill effect scores

Concentration (mg/L)											
162755	9	10	11	11	12	13	14	14	-	-	-
59874	9	9	10	11	11	12	13	14	14	-	-
22026	8	9	9	10	11	11	12	13	13	14	-
8103	13119 7	8	9	9	10	11	11	12	13	13	14
2981	6	4448 7	8	9	9	10	11	11	12	13	13
1097	6	6	1931 7	8	9	9	10	11	11	12	13
403	5	6	6	687 7	8	9	9	10	11	11	12
148	197 4	5	6	6	254 7	8	9	9	10	11	11
55	4	67 4	5	6	6	96 7	8	8	9	10	11
20	3	4	29 4	5	6	6	36 7	8	8	9	10
7	2	3	4	10 4	5	6	6	13 7	8	8	9
3	1	2	3	4	4 4	5	6	6	5 7	8	8
1	1	1	2	3	4	1 4	5	6	6	8	8
	1	3	7	1	2	6	2	7	4	11	30
	Hours			Days			Weeks		Months		

Figure 4 - Severity of ill effect scores for eggs and alevins of salmonids. The individual boxes provide the maximum concentration for that SEV. The concentration between 4 and 5 represents the threshold for both harassment and harm to eggs and alevins.

Eggs and Alevins of Salmonids
Average severity of ill effect scores

Concentration (mg/L)											
162755	7	9	10	11	12	13	14	-	-	-	-
59874	7	8	9	10	12	13	14	-	-	-	-
22026	7	8	9	10	11	12	13	-	-	-	-
8103	7	8	9	10	11	12	13	14	-	-	-
2981	6	7	8	10	11	12	13	14	-	-	-
1097	6	7	8	9	10	11	12	14	-	-	-
403	6	7	8	9	10	11	12	13	14	-	-
148	5	6	7	9	10	11	12	13	14	-	-
55	5	6	7	8	9	10	12	13	14	-	-
20	5	6	7	8	9	10	11	12	13	-	-
7	11 4	5	7	8	9	10	11	12	13	14	-
3	4	5	6	7	8	10	11	12	13	14	-
1	4	5	6	7	8	9	10	11	13	14	-
	1	3	7	1	2	6	2	7	4	11	30
	Hours			Days			Weeks		Months		

Figure 5 - Severity of ill effect scores for salmonid habitat. The individual boxes provide the maximum concentration for that SEV. The concentration between 6 and 7 represents the threshold for anticipating adverse effects to bull trout through habitat modifications.

Salmonid Habitat
Average severity of ill effect scores

Concentration (mg/L)	1 Hours	3 Hours	7 Hours	1 Days	2 Days	6 Days	2 Weeks	7 Weeks	4 Months	11 Months	30 Months
162755	11	12	12	13	14	-	-	-	-	-	-
59874	10	11	12	12	13	14	-	-	-	-	-
22026	9	10	11	11	12	13	14	14	-	-	-
8103	8	9	10	11	11	12	13	14	14	-	-
2981	8	8	9	10	11	11	12	13	13	14	-
1097	7	7	8	9	10	10	11	12	13	13	14
403	885										
	6	7	7	8	9	10	10	11	12	12	13
148		345	167								
	5	6	6	7	8	9	9	10	11	12	12
55				68							
	4	5	6	6	7	8	9	9	10	11	11
20					29						
	3	4	5	5	6	7	8	8	9	10	11
7						12					
	2	3	4	5	5	6	7	7	8	9	10
3							5				
	2	2	3	4	5	5	6	7	8	8	9
1								2			
	1	1	2	3	4	4	5	6	7	7	8

Reference List

1. Anderson, P. G., B. R. Taylor, and G. C. Balch. 1996. Quantifying the effects of sediment release on fish and their habitats.Canadian Manuscript Report of Fisheries and Aquatic Sciences 2346.

2. Newcombe, C. P. and J. O. T. Jensen. 1996. Channel suspended sediment and fisheries: synthesis for quantitative assessment of risk and impact. North American Journal of Fisheries Management 16(4): 693-727.

3. Newcombe, C. P. 1994. Suspended sediment in aquatic ecosystems: ill effects as a function of concentration and duration of exposure. Victoria, British Columbia.