BIOLOGICAL EVALUATION OF THE REVISED WASHINGTON WATER QUALITY STANDARDS

PREPARED FOR:
U.S. FISH AND WILDLIFE SERVICE
and
NATIONAL MARINE FISHERIES SERVICE

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1.0 Background/History

1.A. Project History

EPA received the State of Washington's July 2003 Water Quality Standards revisions on August 1, 2003. On January 12, 2005, EPA provided its CWA determination on some of the WQS revisions contained in the 2003 WQS package. EPA acted on the following provisions:

- Recreational uses and criteria, fresh water
- Water supply uses, fresh water
- Miscellaneous uses, fresh water
- Lake nutrient criteria
- Radioactive substances
- Toxics and aesthetics narrative
- Variance procedures
- Site specific criteria
- Use attainability analysis
- Water quality offsets
- Recreational, water supply, and miscellaneous uses for water bodies in Table 602

On February 10, 2005, EPA sent a letter to Washington explaining that EPA did not take action on Washington's new provision addressing compliance schedules for dams (WAC 173-201A-510(5)) because it is not a water quality standard under section 303 (c) of the Clean Water Act (CWA).

On March 22, 2006, EPA completed a review of specific aquatic life designated uses and associated temperature criteria contained in the State of Washington's July 2003 revised water quality standards (WAC 173-201 A-200(l)(c), WAC 173-201A-600(1) and 602). After reviewing the available fish distribution information, EPA determined that some streams had incorrect aquatic life use designations, and some streams had temperature criteria that are not protective of the appropriate fish uses in the streams. Based on its review, EPA disapproved the aquatic life designated use and associated temperature applied to specific waterbodies in Washington.

In June 2006, Washington proposed revised water quality standards to address EPA's March 2006 disapproval action. Washington adopted the revised water quality standards on November 20, 2006. The revised water quality standards were received by EPA on December 8, 2006.

EPA is proposing to approve those water quality standards provisions contained in Washington's 2003 water quality standards revisions for which EPA has not yet provided a determination. EPA is also proposing to approve the revised water quality standards contained in Washington's 2006 water quality standards revisions.

1.B. Organization of Biological Evaluation

This biological evaluation is organized to be consistent with the template outline provide by the National Oceanic and Atmospheric Association (NOAA) Fisheries Northwest Region (see *NOAA*

Fisheries Northwest Region Consultation Initiation Template and Users Guide, at: http://www.cit.noaa.gov/nosign/BATemplate.asp).

Recommended Content	Description
1. Background/History-- information on the Washington State water quality standards submittals, and EPA actions	A. Project History B. BE organization
2. Description of the Action and Action Area- describes Washington's revised water quality standards that EPA is proposing to approve.	A. Discussion of Federal Action and Legal Authority B. Project Description – Activities to be carried out C. Discussion of known, ongoing, and previous projects in the action area D. Project/Action Area Defined E. Maps of Project/Action Area
3. Status of Species and Critical Habitat-- ESA-listed species within the action area for the BE are identified and those that could be affected by the proposed action are listed. Life-history, critical habitat, ESA listing history, current known range, and status information for each species being considered.	A. Species List from the Services B. Species Assessed for Effects C. Description of Species including Biological Requirements, Factors of Decline and Local Empirical Information , and Critical Habitat Designations for each ESU
4. Environmental Baseline-- effects of past and ongoing human and natural factors leading to the current status of the ESA-listed species.	A. Description of Action Area B. Biological Requirements of the Action Area C. Description of Environmental Baseline D. Detailed Description of Habitat Features that may be Affected by the Proposed Action
5. Effects of the Action-- analysis of the direct and indirect effects of the proposed action on the species and/or critical habitat and its interrelated and interdependent activities.	A. Direct Effects B. Indirect Effects C. Effects from Interrelated Actions D. Effects from Ongoing Project Activities E. Description of how the Environmental Baseline would be Affected F. Discuss Effects of the Action on Essential Elements of Critical Habitat G. Use of Best Scientific an Commercially Available Data H. Effects Determinations for Listed Species and Designated Critical Habitats I. Summary of effects analysis
6. Cumulative Effects –includes interrelated and interdependent actions	Effects of future State, tribal, local and private actions which are reasonably certain to occur within the action area.
7. Conclusion	Summary of Determinations of effect of the project on the species (no effect, may affect, etc.)
8. References	Literature cited Copies of pertinent documents and maps List of personal communication contacts, contributors, preparers
9. Essential Fish Habitat	A. Description of Proposed Action B. Address EFH for appropriate Fish Management Plans C. Effects of Proposed Action D. Conclusions

2.0 Description of the Action and Action Area

2.A. Federal Action and Legal Authority

The subject of this Biological Evaluation will be limited to those provisions which EPA is proposing to approve and which can affect aquatic life. Additionally, the analysis of the effects of the proposed water quality standards provisions assumes that ESA-listed species and their habitat are exposed to waters meeting the proposed water quality standards. The following is a list of the provisions that EPA is proposing to approve, can affect aquatic life, and will be addressed specifically in this BE.

- Definitions - WAC-173-201A-020 (definitions will be consulted on in the context of the provisions in which they are used).
- Fresh water aquatic life designated uses, WAC 173-201A-200(1)(a)
- Fresh water aquatic life numeric temperature criteria, WAC 173-201A -200(1)(c), Table 200(1)(c)
- Fresh water aquatic life narrative temperature criteria, WAC 173-201A -200(1)(c)(i), (ii)(A), (iv), and (v)
- Fresh water aquatic life numeric dissolved oxygen criteria, WAC 173-201A-200(1)(d)
- Fresh water aquatic life dissolved oxygen criteria provision , WAC 173-201A -200(1)(d)(i) - (ii) (for specific waterbodies – See Note 2)
- Fresh water aquatic life total dissolved gas criteria provision, Special fish passage exemption for the Snake and Columbia Rivers, WAC 173-201A -200(1)(f)(ii)
- Marine water aquatic life temperature criteria provision, WAC 173-201A-210(1)(c)(i),(ii)
- Natural and irreversible human conditions , WAC-173-201A-260(1)(a)
- Procedures for applying criteria, WAC 173-201A-260(3)(b) and (c)
- Use designations in fresh waters, WAC 173-201A-600(1) and WAC 173-201A-602, including Table 602 (except for the special temperature criteria listed in the notes of Table 602 for portions of the Columbia, Snake, Yakima, Walla Walla, Skagit, Palouse, Pend Orielle, and Spokane Rivers; EPA is not taking action on these special temperature criteria because the State has not changed these criteria, and therefore they are not part of this action)
- Waters requiring supplemental spawning and incubation protection for salmonid species.

Notes:

(1) A complete copy of Washington's Water Quality Standards is included in Appendix A of this document. Appendix B of this document contains an abridged version of Washington's water quality standards (i.e., Part VI, WAC 173-201A-600 through 612 is not included in this version) which highlights the water quality standards provisions that are part of this ESA consultation. The GIS maps depicting the waters requiring supplemental spawning and incubation protection for salmonid species are provided in Appendix C.

(2) EPA is approving the dissolved oxygen (D.O.) criteria only for those waterbodies where the D.O. criterion has changed because the aquatic life use designation has changed. EPA is also including a conservation measure as part of the action to minimize the potential adverse effects associated with its approval of the D.O. criteria for these waterbodies. See 2.B.2.5 for discussion of D.O. conservation measure.

In addition to the above, Washington also revised the following provisions in their water quality standards:

- Purpose of water quality standards, WAC 173-201A-010(1)
- Fresh water narrative temperature criteria, WAC 173-201A -200(1)(iii)
- Fresh water dissolved oxygen narrative criteria, WAC 173-201A -200(1)(d)(iii)
- Marine water narrative temperature criteria, WAC 173-201A-210(1)(c)(iii)
- Marine water narrative dissolved oxygen criteria, WAC 173-201A-210(1)(d)(ii)
- Shellfish harvesting bacteria criteria, WAC 173-201A-210 (2)(b)
- Marine water primary contact bacteria criteria (new language only), WAC 173-201A-210(3)(b)
- Procedures for applying criteria, WAC 173-201A-260(3)(a)
- Analytic methods (new language only), WAC 173-201A-260(3)(h)
- Antidegradation policy, WAC 173-201A-300-330
- Short term modifications, WAC 173-201A-410

The above provisions are not part of EPA's consultation because they are either (1) a non-substantive change to the 1997 water quality standards that does not require EPA approval, (2) a provision for the protection of human health, which EPA has determined has no effect on ESA listed species, (3) not a water quality standard which does not require EPA approval, or (4) a water quality standard where EPA has determined it has no discretionary authority and therefore EPA approval is not an action under ESA Section 7(a)(2) (i.e., antidegradation).

The analysis of the effects of the proposed action assumes that ESA-listed species and their habitat are exposed to waters meeting the proposed water quality standards. There are many waters in the state of Washington that currently do not meet the standards for dissolved oxygen or temperature. Implementation of the standards is the key to changing the current condition; however, the only action under consideration at this time is whether the proposed standards themselves and EPA's approval of them will have an adverse effect on the species of interest.

As the state of Washington completes total maximum daily loads (TMDLs) designed to meet the revised standards, issues or reissues National Pollutant Discharge Elimination System (NPDES) permits in conjunction with those TMDLs, and incorporates nonpoint source controls to meet water quality standards, the condition of impaired waters, and thus the environmental baseline, will improve.

2.B. Project Description—Water Quality Standards

2.B.1. Overview of Water Quality Standards

A water quality standard defines the water quality goals for a water body by designating the use or uses to be made of the water, by setting criteria necessary to protect the uses, and by preventing or limiting degradation of water quality through antidegradation provisions. The Clean Water Act (CWA) provides the statutory basis for the water quality standards program and defines broad water quality goals. For example, Section 101(a) states, in part, that wherever attainable, waters achieve a level of quality that provides for the protection and propagation of fish, shellfish, and wildlife, and for recreation in and on the water ("fishable/swimmable").

Section 303(c) of the CWA requires that all states adopt water quality standards and that EPA review and approve these standards. In addition to adopting water quality standards, states are required to review and revise standards every 3 years. This public process, commonly referred to as the triennial review, allows for new technical and scientific data to be incorporated into the standards. The regulatory requirements governing water quality standards are established at 40 Code of Federal Regulations (CFR) Part 131.

The minimum requirements that must be included in the state standards are designated uses, criteria to protect the uses, and an antidegradation policy to protect existing uses, high-quality waters, waters designated as Outstanding National Resource Waters. In addition to these elements, the regulations allow for states to adopt discretionary policies such as allowances for mixing zones and variances from water quality standards. These policies are also subject to EPA review and approval.

Section 303(c)(2)(B) of the CWA requires the states to adopt numeric criteria for all toxic pollutants for which criteria have been published under Section 304(a). EPA publishes criteria documents as guidance to states. States consider these criteria documents, along with the most recent scientific information, when adopting regulatory criteria.

All standards officially adopted by each state are submitted to EPA for review, and approval or disapproval. EPA reviews the standards to determine whether the analyses performed are adequate and evaluates whether the designated uses are appropriate and the criteria are protective of those uses. EPA makes a determination whether the standards meet the requirements of the CWA and EPA's water quality standards regulations (40 CFR 131). EPA then formally notifies the state of these results. If EPA determines that any such revised or new water quality standard is not consistent with the applicable requirements of the CWA, EPA is required to specify the disapproved portions and the changes needed to meet the requirements. The state is then given an opportunity to make appropriate changes. If the state does not adopt the required changes, EPA must promulgate federal regulations to replace those disapproved portions.

Section 303 of the Clean Water Act (CWA) requires states and authorized Indian tribes to adopt water quality standards, including antidegradation provisions consistent with the regulations at 40 CFR 131.12. Under these rules, states and authorized Indian tribes are required to adopt antidegradation policies to provide three levels of water quality protection and identify implementation methods. The first level of protection (Tier 1) requires the maintenance and protection of existing instream water uses and the level of water quality necessary to protect those existing uses. Existing uses are "...those uses actually attained in the water body on or after November 28, 1975, whether or not they are included in the water quality standards." (40 CFR 131.3(e)). The second level of protection (Tier 2) is for high quality waters, which are waters where the quality is better than the levels necessary to support propagation of fish, shellfish, and wildlife, and recreation in and on the water ("fishable/swimmable" uses). This high quality is to be maintained and protected unless, through a public process, some lowering of water quality is deemed to be necessary to accommodate important economic or social development to occur in the area of the lowering. Activities such as new or increased discharges would presumably lower water quality and would not be permissible unless the State conducts a Tier 2 review. The third and highest level of protection (Tier 3) is for Outstanding National Resource Water (ONRWs). If a state or authorized tribe determines that the characteristics of a water body constitute an ONRW, such as waters of exceptional recreational or ecological significance, and designates a water body as such, then those characteristics must be maintained and protected.

In addition to requiring States and authorized Indian tribes to have an antidegradation policy, 40 CFR

131.12 requires that implementation methods be identified. Such methods are not required to be contained in the State's regulation, but are subject to EPA review. EPA's regulations provide a great deal of discretion to states and authorized Indian tribes regarding the amount of specificity required in antidegradation implementation methods. The regulations do not specify minimum elements for such methods, but do require that such methods are consistent with the intent of the antidegradation policy. The CWA only requires that antidegradation be applied to point sources because the CWA only gives EPA authority to regulate point sources. Thus, whether antidegradation applies to nonpoint sources is solely a question of state and tribal law. Therefore, EPA's approval of Washington's antidegradation implementation procedures only applies to point sources.

2.B.2. Description of Specific Water Quality Standards U.S. EPA Proposes to Approve

The following are the new or revised Washington water quality standards that EPA proposes to approve and that are the subject of this biological evaluation. EPA has included a complete copy of Washington's Water Quality Standards in Appendix A.

2.B.2.2. Definitions (WAC 173-201A-020)

"7-DADMax" or "**7-day average of the daily maximum temperatures**" is the arithmetic average of seven consecutive measures of daily maximum temperatures. The 7-DADMax for any individual day is calculated by averaging that day's daily maximum temperature with the daily maximum temperatures of the three days prior and the three days after that date.

2.B.2.3. Fresh water aquatic life designated uses (WAC 173-201A-200(1)(a))

WAC 173-201A-200 Fresh water designated uses and criteria. The following uses are designated for protection in fresh surface waters of the state. Use designations for water bodies are listed in WAC 173-201A-600 and 173-201A-602.

(1) **Aquatic life uses.** Aquatic life uses are designated based on the presence of, or the intent to provide protection for, the key uses identified in (a) of this subsection. It is required that all indigenous fish and nonfish aquatic species be protected in waters of the state in addition to the key species described below.

(a) The categories for aquatic life uses are:

(i) **Char spawning and rearing.** The key identifying characteristics of this use are spawning or early juvenile rearing by native char (bull trout and Dolly Varden), or use by other aquatic species similarly dependent on such cold water. Other common characteristic aquatic life uses for waters in this category include summer foraging and migration of native char; and spawning, rearing, and migration by other salmonid species.

(ii) **Core summer** s**almonid habitat.** The key identifying characteristics of this use are summer (June 15 – September 15) salmonid spawning or emergence, or adult holding; use as important summer rearing habitat by one or more salmonids; or foraging by adult and subadult native char. Other common characteristic aquatic life uses for waters in this category include spawning outside of the summer season, rearing, and migration by salmonids.

(iii) **Salmonid spawning, rearing, and migration.** The key identifying characteristic of this use is salmon or trout spawning and emergence that only occurs outside of the summer season (September 16 – June 14). Other common characteristic aquatic life uses for waters in this category include rearing and migration by salmonids.

(iv) **Salmonid rearing and migration only.** For the protection of rearing and migration of salmon and trout, and other associated aquatic life.

(v) **Non-anadromous interior redband trout.** For the protection of waters where the only trout species is a non-anadromous form of self-reproducing interior redband trout (*O. mykiss*), and other associated aquatic life.

(vi) **Indigenous warm water species.** For the protection of waters where the dominant species under natural conditions would be temperature tolerant indigenous nonsalmonid species. Examples include dace, redside shiner, chiselmouth, sucker, and northern pikeminnow.

2.B.2.4. Fresh water aquatic life temperature criteria (WAC 173-201A-200(1)(c))

(c) Aquatic life temperature criteria. Except where noted, water temperature is measured by the 7-day average of the daily maximum temperatures (7-DADMax). Table 200(1)(c) lists the temperature criteria for each of the aquatic life uses categories.

Table 200(1)(c)
Aquatic Life Temperature Criteria in Fresh Water

Category	**Highest 7-DADMax**
Char spawning	9°C (48.2°F)
Char spawning and rearing	12°C (53.6°F)
Salmon and trout spawning	13°C (55.4°F)
Core Summer salmonid habitat	16°C (60.8°F)
Salmonid spawning, rearing, and migration	17.5°C (63.5°F)
Salmonid Rearing and Migration **Only**	17.5°C (63.5°F)
Non-anadromous Interior Redband Trout	18°C (64.4°F)
Indigenous Warm Water Species	20°C (68°F)

(i) When a water body's temperature is warmer than the criteria in Table 200 (1)(c) (or within 0.3°C (0.54°F) of the criteria) and that condition is due to natural conditions, then human actions considered cumulatively may not cause the 7-DADMax temperature of that water body to increase more than 0.3°C (0.54°F).

(ii) When the background condition of the water is cooler than the criteria in Table 200 (1)(c), the allowable rate of warming up to, but not exceeding, the numeric criteria from human actions is restricted as follows:

(A) Incremental temperature increases resulting from individual point source activities must not, at any time, exceed 28/(T+7) as measured at the edge of a mixing zone boundary (where "T" represents the background temperature as measured at a point or points unaffected by the discharge and representative of the highest ambient water temperature in the vicinity of the discharge);

(iv) Spawning and incubation protection. The department has identified waterbodies, or portions thereof, which require special protection for spawning and incubation in ecology publication 06-10-038 (also available on ecology's web site at www.ecy.gov). This publication indicates where and when the following criteria are to be applied to protect the reproduction of native char, salmon and trout:

- Maximum 7-DADMax temperatures of 9°C (48.2°F) at the initiation of spawning and at fry emergence for char; and
- Maximum 7-DADMax temperatures of 13°C (55.4°F) at the initiation of spawning for salmon and at fry emergence for salmon and trout.

The two criteria above are protective of incubation as long as human actions do not significantly disrupt the normal patterns of fall cooling and spring warming that provide significantly colder temperatures over the majority of the incubation period.

(v) For lakes, human actions considered cumulatively may not increase the 7-DADMax temperature more than 0.3°C (0.54°F) above natural conditions.

2.B.2.5. Fresh water aquatic life dissolved oxygen criteria (WAC 173-201A-200(1)(d))

(d) Aquatic life dissolved oxygen (D.O.) criteria.

Use Category	lowest 1-day minimum
Char	9.5 mg/L
Core summer salmonid habitat	9.5 mg/L
Salmonid spawning, rearing and migration	8.0 mg/L

Note: EPA is proposing to approve the 9.5 mg/L DO criteria for two small waterbodies with a new Char use designation (Cedar Creek and Tacoma Creek in WRIA 62). EPA is proposing to approve the 9.5 mg/L DO criteria for waterbodies with a new Core summer habitat use designation that were previously designated Class A. EPA is proposing to approve the 8.0 mg/L for two small waterbodies with a new Salmon spawning, rearing and migration use designation (Palouse River in WRIA 34 and Mill Creek in WRIA 32). See EPA GIS maps depicting EPA disapproval action for location of specific rivers at www.epa.gov/r10earth/washington-wqs.htm.

(i) When a water body's D.O. is lower than the criteria in Table 200(1)(d) (or within 0.2 mg/L of the criteria) and that condition is due to natural conditions, then human actions considered cumulatively may not cause the D.O. of that water body to decrease more than 0.2 mg/L.

(ii) For lakes, human actions considered cumulatively may not decrease the dissolved oxygen concentration more than 0.2 mg/L below natural conditions.

Dissolved Oxygen Conservation Measure
A conservation measure as defined in the Services' Consultation Handbook is an action included by the Federal agency as an integral part of the proposed action that serves to minimize project effects. EPA has concluded that its approval of the D.O. criteria for the specific waterbodies where the D.O. criteria has changed from 8.0 mg/L to 9.5 mg/L is likely to cause adverse effects even though it is a more stringent criteria (i.e., adverse effects are possible even at the new more stringent criteria level). See section 5.H.12. To minimize these potential effects, the Department of Ecology has committed to review their D.O. criteria and initiate rulemaking to revise the D.O. criteria by July 2008, unless Ecology can demonstrate that the current 9.5 mg/L criteria will not lead to adverse effects to incubating salmonid eggs. Ecology's has a formal written commitment on this measure, which is in Appendix G.

2.B.2.6. Fresh water aquatic life total dissolved gas criteria (WAC 173-201A-200(1)(f))

(f) Aquatic life total dissolved gas (TDG) criteria.

(ii) …. The following special fish passage exemptions for the Snake and Columbia rivers apply when spilling water at dams is necessary to aid fish passage:

•TDG must not exceed an average of one hundred fifteen percent as measured in the forebays of the next downstream dams and must not exceed an average of one hundred twenty percent as measured in the tailraces of each dam (these averages are measured as an average of the twelve highest consecutive hourly readings in any one day, relative to atmospheric pressure); and

•A maximum TDG one hour average of one hundred twenty-five percent must not be exceeded during spillage for fish passage.

2.B.2.7. Marine water aquatic life temperature criteria (WAC 173-201A-210(1)(c))

(i) When a water body's temperature is warmer than the criteria in Table 210 (1)(c) (or within 0.3°C (0.54°F) of the criteria) and that condition is due to natural conditions, then human actions considered cumulatively may not cause the 7-DADMax temperature of that water body to increase more than 0.3°C (0.54°F).

(ii) When the natural condition of the water is cooler than the criteria in Table 210 (1)(c), the allowable rate of warming up to, but not exceeding, the numeric criteria from human actions is restricted as follows:

(A) Incremental temperature increases resulting from individual point source activities must not, at any time, exceed 12/(T-2) as measured at the edge of a mixing zone boundary (where "T" represents the background temperature as measured at a point or points unaffected by the discharge and representative of the highest ambient water temperature in the vicinity of the discharge);

2.B.2.8. Natural conditions and other water quality criteria and applications (WAC 173- 201A-260)

(1) Natural and irreversible human conditions.
(a) It is recognized that portions of many water bodies cannot meet the assigned criteria due to the natural conditions of the water body. When a water body does not meet its assigned criteria due to natural climatic or landscape attributes, the natural conditions constitute the water quality criteria.

(3) Procedures for applying water quality criteria. In applying the appropriate water quality criteria for a water, the Department will use the following procedure:

(b) Upstream actions must be conducted in manners that meet downstream water body criteria. Except where and to the extent described otherwise in this chapter, the criteria associated with the most upstream uses designated for a water body are to be applied to headwaters to protect nonfish aquatic species and the designated downstream uses.

(c) Where multiple criteria for the same water quality parameter are assigned to a water body to protect different uses, the most stringent criterion for each parameter is to be applied.

2.B.2.9. Use designations in fresh water, WAC 173-201A-600(1)

(1) All surface waters of the state not named in Table 602 are to be protected for the designated uses of: Salmon and trout spawning, Salmonid spawning, rearing, and migration, and migration; primary contact recreation; domestic, industrial, and agricultural water supply; stock watering; wildlife habitat; harvesting; commerce and navigation; boating; and aesthetic values.
(a) Additionally, the following waters are also to be protected for the designated uses of salmon and trout spawning, core rearing, and migration; and extraordinary primary contact recreation:
(i) All surface waters lying within national parks, national forests, and/or wilderness areas;
(ii) All lakes and all feeder streams to lakes (reservoirs with a mean detention time greater than fifteen days are to be treated as a lake for use designation);
(iii) All surface waters that are tributaries to waters designated salmon and trout spawning, core rearing, and migration; or extraordinary primary contact recreation; and
(iv) All fresh surface waters that are tributaries to extraordinary quality marine waters (WAC 173-201A-610 through 173-201A-612).

2.B.2.10. Aquatic life use in Table 602

Table 602 contains the aquatic life use designations applied to water bodies in Washington, and can be viewed in Appendix A.

2.C. Discussion of Known, Ongoing, and Previous Projects in the Action Area

The water quality standards that EPA is proposing to approve apply throughout the State, therefore the action area encompasses all State water bodies. Because the action area is so broad the known, ongoing and previous projects in the action area are diverse and numerous. Projects include such actions as municipal, industrial and agricultural point source discharges; municipal and industrial stormwater discharges; hydrologic modifications (e.g., hydropower dams, irrigation projects); forestry practices; and urban development. These projects are discussed in more detail in Section 5.B. and 5.E.2. in this document. Additional information on activities that affect fish can be found in the U.S. Fish and Wildlife Service and the National Marine Fisheries Services status reviews, critical habitat designations, and recovery plans for ESA listed species.

2.D. Action Area Description

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). USEPA's action, for the Water Quality Standards approval for the State of Washington affects all waters within the state boundaries that are used by ESA-listed species. Water Quality Standards apply to all surface waters of the state, which includes all lakes, bays, ponds, impounding reservoirs, springs, rivers, streams, creeks, estuaries, marshes, inlets, canals, the Pacific Ocean within the territorial limits of the State of Washington, and all other bodies of surface water, natural or artificial, inland or coastal, fresh or salt, public or private (except those private waters which do not combine or affect a junction with natural surface or underground waters), which are wholly or partially within or bordering the state or within its jurisdiction. EPA's approval action does not apply to, and thus the action area does not include, any waters within Native American Country (reservations).

The action area of this consultation consists of all surface waters of the state of Washington for which:
(1) the numeric and narrative temperature criteria have been proposed;
(2) the numeric dissolved oxygen criterion has changed as a result of the aquatic life use designation change (e.g.., those waters that Washington is re-designating to address EPA's March 2006 disapproval letter); and
(3) the Snake and Columbia River for total dissolved gas.

The waterbodies to which each criterion is applied are identified in the State's water quality standards (Appendix A) and are discussed further in Section 5 (Effects Determination).

2.E. Waterbodies in the Action Area

Washington's Water Quality Standards contain Table 602 which lists the aquatic life use applicable to state waters. A copy of the Washington Water Quality Standards is contained in Appendix A. Additionally, maps showing waterbodies that require additional protection for spawning and incubation are in Appendix C.

3.0 Status of Species and Critical Habitat

3.A. Species List from Services

The complete list of the federally listed, threatened and endangered species that are known or suspected to occur in Washington State are listed in **Table 3-1** and **Table 3-2**. This list was obtained from the USFWS Threatened and Endangered Species System (TESS) on 10/16/06. TESS is available at: http://ecos.fws.gov/tess_public/StateListingAndOccurrence.do?state=WA.

Table 3- 1. Federally listed fish species that are known or suspected to occur in Washington State.

Status	Salmonid Species-- Evolutionarily Significant Units
	Chinook Salmon (Oncorhynchus tshawytscha)
T	Snake River Fall Run
T	Snake River Spring/Summer Run
E	Upper Columbia River Spring Run
T	Lower Columbia River
T	Puget Sound
	Chum Salmon (Oncorhynchus keta)
T	Columbia River
T	Hood Canal-summer run
	Coho, Salmon (Oncorhynchus kisutch)
T	Lower Columbia River*
	Sockeye Salmon (Oncorhynchus nerka)
E	Snake River
T	Ozette Lake
	Steelhead (Oncorhynchus mykiss)
T (Proposed)	Puget Sound
T	Snake River Basin
E	Upper Columbia River
T	Middle Columbian River*
T	Lower Columbian River*
	Bull Trout (Salvelinus confluentus)
T	Coastal/Puget Sound
T	Columbia River Basin

*(According to the USFWS TESS website this species listed in state but does not occur in state. This appears to be an error as the ESU as described by NOAA shows this species to be distributed in WA.).

Table 3-2. Federally listed non-fish species that are known or suspected to occur in Washington State.

Status	Non-fish species
Marine Mammals	
T	Southern Sea Otter (Enhydra lutris neries)*
T	Steller Sea Lion—eastern population (Eumetpoias jubatus)**
E	Humpback Whale (Megaptera novaeagliae)
E	Killer Whale (Orcinus orca)
Marine Turtles	
E	Leatherback Sea Turtle (Dermochelys coriacea)
T	Green Sea Turtle (Chelonia mydas)
Mammals	
T	Grizzly Bear (Ursus arctos horribilis)
E	Woodland Carribou (Rangifer tarandus caribou)
T	Canada Lynx (Lynx Canadensis)
E	Pygmy Rabbit (Brachylagus idahoehsis)
E	Gray Wolf (Canis lupus)
E	Columbian white tailed deer (Odocoileus virginianus leucurus)
Birds	
T	Bald Eagle (Haliaeetus leucocephalus)
E	Brown Pelican (Pelecanus occidentalis)
T	Marbled Murrelet (Brachyramphus marmoratus)
T	Northern Spotted Owl (Strix occidentalis caurina)
T	Western Snowy Plover (Charadrius alexandrinus nivosus)
E	Short Tailed Albatross (Phoebastria albatrus)
E	Eskimo Curlew (numenius borealis)***
Butterflies	
T	Oregon Silverspot Butterfly (Speyeria zerene hippolyta)
Plants	
T	Golden Paintbrush (Castilleja levisecta)
E	Showy Stickseed (Hackelia venusta)
T	Water Howellia (Howellia aquatillis)
E	Bradshaw’s Desert-parsley (Lomatium bradshawii)
T	Kincaid’s Lupine (Lupinus sulphureus kincaidii)
T	Nelson’s Checker-mallow (Sidalcea nelsoniana)
E	Wenatchee Mountains Checkermallow (Sidalcea oregano)
T	Spalding’s Catchfly (Silene spaldingii)
T	Ute Ladies’-tresses (Spiranthes diluvialis)

*(According to the USFWS TESS website this species is listed in state but does not occur in state. Possible error as the ESU described by NOAA shows species to be distributed in WA.)
**(western population is also listed but does not occur in WA State)
***(listed in state but does not occur in state)

3.B. Species Assessed for Effects

The primary actions that are evaluated in this BE are the changes to the provisions of the Washington Water Quality, that if applied, have the potential to influence water temperature and dissolve oxygen levels in Washington waterbodies. These include: 1) the freshwater temperature criteria; 2) the freshwater narrative temperature provision (i.e., a temperature increase of 0.3 °C is allowed when the natural conditions is less than the established temperature criterion); 3) the freshwater dissolved oxygen criteria; and 4) the freshwater narrative dissolved oxygen criterion (i.e., a dissolved oxygen decrease of 0.2 mg/L is allowed when the natural conditions is less than the established dissolved oxygen criterion). Thus, the species that could be affected by these actions, either directly or indirectly, would have to have at least some portion of their range within the aquatic system or would have to have some portion of their life history wholly or in part connected to the aquatic community (e.g. food web interactions). For this reason the following species are considered to not be affected by the actions that will be evaluated in this BE.

Vegetation will not be affect by this action as the only water quality parameters that could change are water temperature and dissolved oxygen. All of the **nine plant species** listed in Washington State (see above) are not be affected by alterations of the temperature and DO water quality standards and approval of the changes in these criteria would not have any effect on these species. Additionally, the proposed fresh water temperature criteria are intended to restore thermal regimes to protect sensitive native salmonids. If these alterations of the Washington Water Quality Standards are not limiting to salmonid populations, other listed species will likely not be limited by this action. These plant species are assigned a **NO EFFECT** determination and will not be addressed further in this BE.

Terrestrial animal species will not be exposed to the affects of altered water temperature and dissolved oxygen. The **six terrestrial mammal species** listed in Washington State: grizzly bear (Ursus arctos horribilis), woodland caribou (Rangifer tarandus caribou), Canada lynx (Lynx canadensis), pygmy rabbit (Brachylagus idahoehsis), gray wolf (Canis lupus), and Columbian white tailed deer (Odocoileus virginianus leucurus) will not be affected by the alterations of the water quality standards as these species do not inhabit the aquatic system and would therefore not be exposed to any possible effects from these actions. The only possibility for exposure to the effects of these standard changes would be alterations to the prey base that would be exploited by carnivores (grizzly bear, Canada lynx, and gray wolf). As stated above, the proposed fresh water temperature criteria are intended to restore thermal regimes to protect sensitive native salmonids. If these alterations of the Washington Water Quality Standards are not limiting to salmonid populations, then the prey base available to these carnivores would be unchanged thus resulting in **NO EFFECT** determination for these listed species.

As with the terrestrial mammals, the only possibility for effects from the water quality standards provision changes to the listed **bird species** is through a reduction in the prey base. Two species, the bald eagle (Haliaeetus leucocephalus) and the marbled murrelet (Brachyramphus marmoratus)are significant piscivores that could be affected by a reduction in their prey base (primarily salmonids) as an effect of implementation of these water quality standards to the freshwater environment. These species will be thoroughly addressed in this BE. There is **NO EFFECT** to the following bird species: brown pelican (Pelecanus occidentalis), northern spotted owl (Strix occidentalis caurina), western snowy plover (Charadrius alexandrinus nivosus), short tailed albatross (Phoebastria albatrus).

The **butterfly species,** Oregon Silverspot Butterfly (Speyeria zerene hippolyta), does not use aquatic habitats during any portion of its life history and therefore receives a **NO EFFECT** determination and will not be addressed further.

The **southern sea otter** (Enhydra lutris neries) is distributed in marine waters and preys on benthic invertebrates including sea urchins, clams, crabs, and mussels. Because this species is not exposed to the freshwaters and does not consume the prey species that are most effected by the changes to these water quality provisions (salmonid fish species) these actions will have **NO EFFECT** to southern sea otters.

The **Eskimo curlew** does not actually occur in the State of Washington during any portion of their life history. This species will have no exposure to the actions described in this BE and therefore receive a **NO EFFECT** determination and will not be addressed further.

The **two turtle species**, leatherback sea turtles (Dermochelys coriacea) and green sea turtles (Chelonia mydas) are distributed in marine waters (NMFS 2004). They are rarely found off of the Washington's coast, and neither species nests on the Washington coast. The Leatherback preys on invertebrates, algae and seaweed and fish. Green sea turtles hatchlings green turtles eat a variety of plants and animals, but adults feed almost exclusively on seagrasses and marine algae. Because these species are not exposed to the freshwaters and do not consume the prey species that are most effected by the changes to these water quality provisions (salmonid fish species) these actions will have **NO EFFECT** the turtle species.

In consultation with the National Marine Fisheries Service and the U.S. Fish and Wildlife Service, this BE will assess effects to the two bird species, all 16 salmonid ESUs, and three marine mammal species, that occur on the Federal Threatened and Endangered species list for the State of Washington. **Table 3-3** lists these species, their current status, and the Federal Register (FR) final rule notice for each species. **Table 3-4** provides the Federal Register final rule notice for critical habitat designation for each of these species.

Table 3-3. Status of species Listed Under the ESA within the State of Washington**.**

Species	ESU[a]/ DPS[b]/Population	Present Status	Federal Register Notice of listing	
Bald Eagle (Haliaeetus Leucocephalus)	North America	Threatened	60 FR 35999	7/12/95
Marbled Murrelet (Brachyramphus marmoratus)	Pacific Coast	Threatened	57 FR 45328	10/01/92
Chinook Salmon (Oncorhynchus tshawytscha)	Snake River Fall Run[a]	Threatened	57 FR 14653	04/22/92
	Snake River Spring/Summer Run[a]	Threatened	57 FR 14653	04/22/92
	upper Columbia River Spring Run[a]	Endangered	64 FR 14308	03/24/99
	Lower Columbia River[a]	Threatened	64 FR 14308	03/24/99
	Puget Sound[a]	Threatened	64 FR 14308	03/24/99
Chum Salmon (Oncorhynchus keta)	Columbia River[a]	Threatened	64 FR 14508	03/25/99
	Summer run -Hood Canal[a]	Threatened	64 FR 14528	03/25/99
Coho Salmon (Oncorhynchus kisutch)	Lower Columbia River	Theatened	70 FR 37160	06/28/05
Sockeye Salmon (Oncorhynchus nerka)	Snake River[a]	Endangered	56 FR 58619	11/20/91
	Ozette Lake[a]	Threatened	64 FR 14528	03/25/99
Steelhead (Oncorhynchus mykiss)	Snake River[a]	Threatened	62 FR 43937	08/18/97
	Upper Columbia River[a]	Endangered	62 FR 43937	08/18/97
	Middle Columbia River[a]	Threatened	64 FR 14517	03/25/99
	Lower Columbia River[a]	Threatened	63 FR 13347	03/19/98
	Puget Sound	Proposed	71FR 15666	03/29/06
Bull Trout (Salvelinus confluentus)	Coastal/ Puget Sound[b]	Threatened	63 FR31693	06/10/98
	Columbia River Basin[b]	Threatened	62 FR 32268	06/10/98
Steller Sea Lion (Eumetpoias jubatus)	Pacific Coast	Threatened in WA	N/A	N/A
Humpback Whale (Megaptera novaeangliae)	Pacific Coast	Endangered	35 FR 8491	06/02/70
Killer Whale (Orinus orca)	Southern Resident (DPS)	Endangered	70 FR 69903	11/18/05

[a] Evolutionarily Significant Unit
[b] Distinct Population Segment
ND Not Determined

Table 3-4. Summary of Critical Habitat Designations for Species Listed Under the ESA in Washington**.**

Species	ESU[a]/ DPS[b]/Population	Present Status	Federal Register Notice of Critical habitat	
Bald Eagle (Haliaeetus leucocephalus)	North America	Threatened	not Designated	N/A
Marbled Murrelet (Brachyramphus marmoratus)	Pacific Coast	Threatened	61 FR 26255	05/24/96
Chinook Salmon (Oncorhynchus tshawytscha)	Snake River Fall Run[a]	Final Rule	58 FR 68543	12/28/93
	Snake River Spring/Summer Run[a]	Final Rule	58 FR 68543	12/28/93 (revised 10/25/99)
	Upper Columbia River Spring Run[a]	Final Rule	70 FR 52630	09/02/05
	Lower Columbia River[a]	Final Rule	70 FR 52630	09/02/05
	Puget Sound[a]	Final Rule	70 FR 52630	09/02/05
Coho Salmon (Oncorhynchus kisutch)	Lower Columbia River	Under Review-Not currently designated	70 FR56212	09/26/05
Chum Salmon (Oncorhynchus keta)	Columbia River[a]	Final Rule	70 FR 52630	09/02/05
	Hood Canal Summer Run[a]	Final Rule	70 FR 52630	09/02/05
Sockeye Salmon (Oncorhynchus nerka)	Snake River[a]	Final Rule	58 FR 68543	12/28/93
	Ozette Lake[a]	Final Rule	70 FR 52630	09/02/05
Steelhead (Oncorhynchus mykiss)	Snake River Basin[a]	Final Rule	70 FR 52630	09/02/05
	Upper Columbia River[a]	Final Rule	70 FR 52630	09/02/05
	Puget Sound	Proposed species, no critical habitat	----	---
	Middle Columbia River[a]	Final Rule	70 FR 52630	09/02/05
	Lower Columbia River[a]	Final Rule	70 FR 52630	09/02/05
Bull Trout (Salvelinus confluentus)	Columbia River Basin[b]	Final Rule	50 FR 56212	10/26/05
	Coastal /Puget Sound[b]	Final Rule	50 FR 56212	10/26/05
Steller Sea Lion (Eumetpoias jubatus)	Pacific Coast		N/A	N/A
Killer Whale (Orinus orca)	Southern Resident	Final Rule	50 CFR 226	11/29/06
Humpback Whale (Megaptera novaeangliae)	Pacific Coast		N/A	N/A

[a] Evolutionarily Significant Unit
[b] Distinct Population Segment
ND Not determined

3.C. Description of Species (biological requirements, factors of decline,

local empirical information, Critical Habitat Designation for each ESU)

3.C.1. Birds

This section describes the status and life history of two listed avian species, the bald eagle and the marbled murrelet.

3.C.1.1. Bald eagle

Status

The bald eagle is listed federally as endangered species under the endangered species act on February 1978 (43 FR 6230). In July 1995, the bald eagle was down-listed to threatened in the lower 48 states (60 FR 35999). In the state of Washington, the bald eagle is listed as threatened. The bald eagle remains protected under the Bald and Golden Eagle Protection Act of 1940 (amended in 1962).

Geographic Range and Spatial Distribution

The bald eagle is a species endemic to North America. The state of Washington hosts both resident and migratory populations of bald eagles. Bald eagles can be found in all forested parts of Washington State, with greater abundance west of the Cascade Mountains (Stinson et al. 2001). Bald eagle nesting locations are most common along marine shorelines, but may also be found along lakes, reservoirs, and rivers. In eastern Washington, nesting pairs are less common, and are scattered near the boarder of British Columbia (Stinson et al.2001). The winter distribution of bald eagles in Washington State is much like the breeding distribution, with a higher concentration along salmon spawning streams (Stinson et al. 2001).

Critical Habitat

Critical habitat has not been designated for the bald eagle.

Life History

Bald eagles reach maturity at five years of age following the fourth molt to adult plumage. While little information is known about their longevity in the wild, captive eagle longevity ranges between 15 to 47 years. Bald eagles frequently nest near marine shorelines, as well as along lakes, rivers and reservoirs (Stinson et al. 2001).

Typically, bald eagles begin breeding at age 6, but may begin as early as age 3 or 4 where food is abundant, territories are vacant, or potential mates are limited. In Washington courtship and breeding usually begin during January and February. Nesting sites are located in large trees near open water, the majority of which are located with in 1 mile of lake, river, or marine shoreline. In March eagles begin to incubate their eggs, and the young hatch in late April. During early to mid-July, the young fledge at about 11 to 13 weeks of age (Stinson et al. 2001).

Bald eagles can reside year-round where food is available; otherwise they will migrate or wander to find food. When not breeding, may congregate where food is abundant, even [away from water (Stalmaster 1987). Washington's breeding eagles are on their territories until early fall when they migrate north to coastal British Columbia and southeast Alaska coinciding with early salmon runs. They return to Washington in January to begin nesting. Wintering eagles arrive in Washington in October through December, with juvenile arrive in January (Stinson et al. 2001). Eagles frequently concentrate along salmon spawning streams and water fowl wintering areas, as well as along the Columbia River (Stinson et al. 2001).

Bald eagles are generally associated with large bodies of water, but can occur in any habitat with available prey (Isaacs and Anthony 2003). Bald eagles nests in forested areas near the ocean, along rivers, and at estuaries, lakes, and reservoirs (Isaacs and Anthony 2001). Consequently, shoreline is an important component of nesting habitat. Live trees are usually used for nest trees, although nests will continue to be used if the tree dies. Nest trees are usually large and prominent (Anthony et al. 1982). Large old trees have large limbs and open structure required for eagle access and nest territory.

Wintering eagles in the Pacific Northwest perch on a variety of substrates; proximity to a food source is probably the most important factor influencing perch selection by bald eagles (Steenhof et al. 2002). Eagles use a variety of tree species as perch sites, depending on regional forest types and stand structures. Dead trees are used by eagles in some areas because they provide unobstructed view and are often taller than surrounding vegetation (Stalmaster 1987). Along the Columbia River in Washington, where perch trees are not available, eagles regularly use artificial perches, (USFWS 1986).

Habitat requirements for communal night roosting are different form those for diurnal perching. Communal roosts are invariably near a rich food resource and in forest stands that are uneven-aged and have at least a remnant of the old-growth forest component (Anthony et al. 1982). Close proximity to a feeding area is not the only requirement for night roosting sites, as there are minimum requirements for forest stand structure. In open areas, bald eagles also use cottonwoods and willows for night roosting (Isaacs and Anthony 1983). Most communal winter roosts used by bald eagles offer considerably more protection from the weather than diurnal habitat. Roost tree species and stand characteristics vary considerably throughout the Pacific Northwest (Anthony et al. 1982) (USFWS 1986)].

Isolation is an important feature of bald eagle wintering habitat. In Washington, 98% of wintering bald eagles tolerated human activities at a distance of 300 m (328 yards) (Stalmaster and Newman 1978). However, only 50% of eagles tolerated disturbances of 150 m (164 yards) (USFWS 1986)].

Population Trends and Risks

Bald eagles were abundant in Washington through out the 19th century. Eagles were commonly seen along rivers and coasts, with less of a presence in eastern Washington. Between the1940s and 1970's the extensive use of DDT is credited as the main cause for the decline of bald eagles in Washington and through out the lower 48 states (Stinson et al. 2001).

State wide surveys conducted in 1998 show an increase in nesting bald eagle populations through out the U.S. and in Washington State (Stinson et al. 2001). July 6, 1999, the USFWS proposed to remove the bald eagle from the threatened species list in the lower 48 states (64 FR 36453 36464), although the eagle would be afforded protection under the provisions of The Bald and Golden Eagle Protection Act (16 USC 668) and Migratory Bird Treaty Act (16 USC 703).

Habitat loss is identified as the most significant threat to bald eagle populations. It is expected that the available nesting and suitable foraging habitat in bald eagle territories will decline as the population and land development in Washington State continues to increase, especially along shorelines (Stinson et al. 2001).

3.C.1.2. Marbled murrelet

Status
The marbled murrelet was federally listed under the Endangered species act October 1, 1992 (57 FR 45328).

Geographic Range and Spatial Distribution
The marbled murrelet, a small sea bird that nests in the coastal old-growth forests of the Pacific Northwest, inhabits the Pacific coasts of North America from the Bearing Sea to central California. In contrast to other seabirds, murrelets do not form dense colonies, and may fly 70km or more inland to nest, generally in older coniferous forests. They are more commonly found inland during the summer breeding season, but make daily trips to the ocean to gather food, primarily fish and invertebrates, and have been detected in forests throughout the year. When not nesting, the birds live at sea, spending their days feeding and then moving several kilometers offshore at night (SEI 1999).

Critical Habitat
Critical habitat was designated for marbled murrelets 5/24/96 (61 FR 26251). The final rule identified 32 critical habitat units encompassing approx. 1,582,600 hectares.

On 9/12/2006 the U.S. Fish and Wildlife Service today issued a revised proposal to designate 221,692 acres of critical habitat for the marbled murrelet, a threatened species protected under the Endangered Species Act. Areas proposed for critical habitat include portions of California, Oregon and Washington. This proposal identifies 3,590,642 acres in the three states as critical habitat, but is proposing to exclude 3,368,950 acres as they content these are already protected under other existing regulations or plans, such as the Northwest Forest Plan, state and tribal management plans and habitat conservation plans. An additional 1,574,201 acres were considered but not included in the proposal because they already are managed in ways that meet the needs of the marbled murrelet. These include federal wilderness areas, tribal conservation easements and Redwood state and national parks. If the proposed exclusions are finalized, the final critical habitat designation will include 112,037 acres in California, 82,747 acres in Oregon and 26,908 acres in Washington.

Life History
The breeding season of the marbled murrelet generally begins in April, with most egg laying occurring in late May and early June. Peak hatching occurs in July after a 27- to 30-day incubation. Chicks remain in the nest and are fed by both parents. By the end of August, chicks have fledged and dispersed from nesting areas (Marks and Bishop 1999). The marbled murrelet differs from other seabirds in that its primary nesting habitat is old-growth coniferous forest within 50 to 75 miles of the coast. The nest typically consists of a depression on a moss-covered branch where a single egg is laid. Marbled murrelets appear to exhibit high fidelity to their nesting areas, and have been observed in forest stands for up to 20 years (Marks and Bishop 1999). Marbled murrelets have not been known to nest in other habitats including alpine forests, bog forests, scrub vegetation, or scree slopes (Marks and Bishop 1999).

Marbled murrelets are presumably long-lived species but are characterized by low fecundity (one egg per nest) and low nesting and fledging success. Fledging success has been estimated at 45 percent. Nest predation on both eggs and chicks appears to be higher for marbled murrelets than for other alcids, and may be cause for concern. Principal predators are birds, primarily corvids (jays, ravens, and crows) (Marks and Bishop 1999).

At sea, foraging murrelets are usually found as widely spaced pairs. In some instances murrelets form or join flocks that are often associated with river plumes and currents. These flocks may contain sizable portions of local populations (Ralph and Miller 1999).

Population Trends and Risks

The total North American population of marbled murrelets is estimated to be 360,000 individuals. Approximately 85 percent of this population breeds along the coast of Alaska. Estimates for Washington, Oregon, and California vary between 16,500 and 35,000 murrelets (Ralph and Miller 1999). In British Columbia, the population was estimated at 45,000 birds in 1990 (Environment Canada 1999). In recent decades the murrelet population in Alaska and British Columbia has apparently suffered a marked decline, by as much as 50 percent. Between 1973 and 1989, the Prince William Sound, Alaska, murrelet population declined 67 percent. Trends in Washington, Oregon, and California are also down, but the extent of the decrease in unknown. Current data suggest an annual decline of at least 3 to 6 percent throughout the species' range (Ralph and Miller 1999).

The most serious limiting factor for marbled murrelets is the loss of habitat through the removal of old-growth forests and fragmentation of forests. Forest fragmentation may be making nests near forest edges vulnerable to predation by other birds such as jays, crows, ravens, and great-homed owls (USFWS 1996). Entanglement in fishing nets is also a limiting factor in coastal areas due to the fact that the areas of salmon fishing and the breeding areas of marbled murrelets overlap. The marbled murrelet is especially vulnerable to oil pollution; in both Alaska and British Columbia, it is considered the seabird most at risk from oil pollution. In 1989, an estimated 8,400 marbled murrelets were killed as a result of the *Exxon Valdez* oil spill (Marks and Bishop 1999). Marbled murrelets forage in nearshore waters where recreational boats are most often found. Disturbance by boats may cause them to abandon the best feeding areas (Environment Canada 1999).

3.C.2. Salmonids

This section provides status and life history information on 16 salmon ESUs listed under the ESA that occur in Washington State.

3.C.2.1. Chinook salmon

Chinook salmon are easily distinguished from other *Oncorhynchus* species by their large size. Adults weighing over 120 pounds have been caught in North American waters. Chinook salmon are very similar to coho salmon in appearance while at sea (blue-green back with silver flanks), except for their large size, small black spots on both lobes of the tail, and black pigment along the base of the teeth. Chinook salmon are anadromous and semelparous. This means that as adults, they migrate from a marine environment into the freshwater streams and rivers of their birth (anadromous) where they spawn and die (semelparous). Adult female Chinook will prepare a spawning bed, called a redd, in a stream area with suitable gravel composition, water depth and velocity. Redds will vary widely in size and in location within the stream or river. The adult female Chinook may deposit eggs in four to five “nesting pockets” within a single redd. After laying eggs in a redd, adult Chinook will guard the redd from four to 25 days before dying. Chinook salmon eggs will hatch, depending upon water temperatures, between 90 to 150 days after deposition. Sufficient intergravel dissolved oxygen levels during the incubation period are critical to development of salmon eggs. Stream flow, gravel quality, and silt load all significantly influence the survival of developing Chinook salmon eggs as they influence intergravel dissolved oxygen levels. Juvenile Chinook may spend from three months to two years in freshwater after emergence and before migrating to estuarine areas as smolts, and then into the ocean to feed and mature.

Among Chinook salmon two distinct races have evolved. One race, described as a "stream-type" Chinook, is found most commonly in headwater streams. Steam-type Chinook salmon have a longer freshwater residency, and undergo extensive offshore migrations before returning to their natal streams in the spring or summer months. The second race is called the "ocean-type" Chinook, which is commonly found in coastal steams in North America. Ocean-type Chinook typically migrate to sea within the first three months of emergence, but they may spend up to a year in freshwater prior to emigration. They also spend their ocean life in coastal waters. Ocean-type Chinook salmon return to their natal streams or rivers as spring, winter, fall, summer, and late-fall runs, but summer and fall runs predominate. The difference between these life history types is also physical, with both genetic and morphological foundations.

Juvenile steam- and ocean-type Chinook salmon have adapted to different ecological niches. Ocean-type Chinook salmon tend to utilize estuaries and coastal areas more extensively for juvenile rearing. The brackish water areas in estuaries also moderate physiological stress during parr-smolt transition. The development of the ocean-type life history strategy may have been a response to the limited carrying capacity of smaller stream systems and glacially scoured, unproductive, watersheds, or a means of avoiding the impact of seasonal floods in the lower portion of may watersheds.

Stream-type juveniles are much more dependent on freshwater stream ecosystems because of their extended residence in these areas. A stream-type life history may be adapted to those watersheds, or parts of watersheds, that are more consistently productive and less susceptible to dramatic changes in water flow, or which have environmental conditions that would severely limit the success of subyearling smolts (FR 63 11482, Montgomery et al. 1999). At the time of saltwater entry, stream-type (yearling) smolts are much larger, averaging 73-134 mm depending on the river system, than their ocean-type (subyearling) counterparts and are, therefore, able to move offshore relatively quickly.

Coast-wide, Chinook salmon remain at sea for one to six years (more common, two to four years), with the exception of a small proportion of yearling males, called jack salmon, which mature in freshwater or return after two or three months in salt water. Ocean- and steam-type Chinook salmon are recovered differentially in coastal and mid-ocean fisheries, indicating divergent migratory routes. Ocean-type Chinook salmon tend to migrate along the coast, while stream-type Chinook salmon are found far from the coast in the central North Pacific. Differences in the ocean distribution of specific stocks may be indicative of resource partitioning and may be important to the success of the species as a whole.

There is a significant genetic influence to the freshwater component of the returning adult migratory process. A number of studies show that Chinook salmon return to their natal streams with a high degree of fidelity. Salmon may have evolved this trait as a method of ensuring an adequate incubation and rearing habitat. It also provides a mechanism for reproductive isolation and local adaptation. Conversely, returning to a stream other than that of one's origin is important in colonizing new areas and responding to unfavorable or perturbed conditions at the natal steam.

Chinook salmon stocks exhibit considerable variability in size and age of maturation, and at least some portion of this variation is genetically determined. The relationship between size and length of migration may also reflect the earlier timing of river entry and the cessation of feeding for Chinook salmon stocks that migrate to the upper reaches of river systems. Body size, which is correlated with age, may be an important factor in migration and redd construction success. Under high density conditions on the spawning ground, natural selection may produce stocks with exceptionally large-sized returning adults.

Temporal "runs" or modes in the migration of Chinook salmon from the ocean to freshwater are well known (Wydoski and Whitney 2003). Freshwater entry and spawning timing are believed to be related to local temperature and water flow regimes. Seasonal "runs" (i.e., spring, summer, fall, or winter) have been identified on the basis of when adult Chinook salmon enter freshwater to begin their spawning migration. However, distinct runs also differ in the degree of maturation at the time of river entry, the thermal regime and flow characteristics of their spawning site, and their actual time of spawning. Egg deposition must occur at a time to ensure that fry emerge during the following spring when the river or estuary productivity is sufficient for juvenile survival and growth.

Pathogen resistance is another locally adapted trait. Chinook salmon from the Columbia River drainage were less susceptible to *Ceratomyxa shasta*, an endemic pathogen, then stocks from coastal rivers where the disease is not know to occur (FR 63 11482). Alaskan and Columbia River stocks of Chinook salmon exhibit different levels of susceptibility to the infectious hematopoietic necrosis virus (IHNV).

The preferred temperature range for Chinook salmon has been variously described as 12.2-13.9 degrees C. (Brett 1952), 10-15.6 degrees C. (Burrows, 1963), or 13-18 degrees C. Temperatures for optimal egg incubation are 5.0-14.4 degrees C. (Bell, 1984). The upper lethal temperature limit is 25.1 degrees C. (Brett, 1952), but may be lower depending on other water quality factors (Ebel et al. 1971). Variability in temperature tolerance between populations is likely due to selection for local conditions; however, there is little information on the genetic basis of this trait.

Successful egg development in redds requires adequate intergravel dissolved oxygen levels over the incubation period. The EPA (1986) recommends 8.0 mg/L intergravel DO for successful salmonid egg incubation. Freshwater juveniles avoid water with dissolved oxygen concentrations below 4.5 mg/l at 20 degrees C. (Whitmore et al. 1960). Migrating adults will pass through water with dissolved oxygen levels as low as 3.5-4.0 mg/l (Alabaster 1988, 1989).

3.C.2.1.1. Snake River Fall Chinook Salmon

This ESU was listed as threatened on April 22, 1992. The 11/2/94 Emergency Rule (59 FR 54840), reclassifying Snake River Chinook from threatened to endangered, expired on May 26, 1995.

Geographic Boundaries and Spatial Distribution

The Snake River Basin drains an area of approximately 280,000 km2 and incorporates a range of vegetative life zones, climatic regions, and geological formations. The Snake River ESU includes the mainstem river and all tributaries, from their confluence with the Columbia River to the Hells Canyon Dam complex. Because genetic analyses indicate that fall-run Chinook salmon in the Snake River are distinct from the spring-summer-run in the Snake River Basin (Waples et al. 1991, as cited in Meyers et al., 1998), Snake River fall-run Chinook salmon are considered separately from the other two forms. They are also considered separately from those assigned to the Upper Columbia River summer- and fall-run ESU because of considerable differences in habitat characteristics and adult ocean distribution, and less definitive, but still significant, genetic differences. There is, however, some concern that recent introgression from Columbia River hatchery strays is causing the Snake River population to lose the qualities that made it distinct for ESA purposes.

Critical Habitat

The critical habitat for the Snake River fall Chinook salmon was listed on December 28, 1993 (58 FR 68543) and modified on March 9, 1998 (63 FR 11515) to include the Deschutes River. A 1995 status review found that the Deschutes River fall-run Chinook salmon population should be considered part of the Snake River fall-run ESU. Populations from Deschutes River and the Marion Drain (tributary of the Yakima River) show a greater genetic affinity to Snake River ESU fall Chinook than to the Upper Columbia River summer-fall-run Chinook (March 9, 1998, 63 FR 11490). The designated critical habitat (63 FR 11515, March 9, 1998) includes all river reaches accessible to Chinook salmon in the Columbia River from The Dalles Dam upstream to the confluence with the Snake River in Washington (inclusive). Critical habitat in the Snake River includes its tributaries in Idaho, Oregon, and Washington (exclusive of the upper Grande Ronde River and the Wallowa River in Oregon, the Clearwater River above its confluence with Lolo Creek in Idaho, and the Salmon River upstream of its confluence with French Creek in Idaho). Also included are river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to The Dalles Dam. Excluded are areas above specific dams identified in Table 17 (see March 9, 1998, 63 FR 11519) or above longstanding, naturally impassable barriers (e.g., natural waterfalls in existence for at least several hundred years).

Historical Information

Snake River fall-run Chinook salmon remained stable at high levels of abundance through the first part of the 20th century, but then declined substantially. Although the historical abundance of fall-run Chinook salmon in the Snake River is difficult to estimate, adult returns appear to have declined by three orders of magnitude since the 1940s, and perhaps by another order of magnitude from pristine levels. Irving and Bjornn (1981) estimated that the mean number of fall-run Chinook salmon returning to the Snake River declined from 72,000 during the period 1938 to 1949, to 29,000 during the 1950s. Further declines occurred upon completion of the Hells Canyon Dam complex, which blocked access to primary production areas in the late 1950s. Estimated returns of naturally produced adults from 1985 through 1993 range from 114 to 742 fish (USEPA 1998).

Life History

Fall-run Chinook salmon in this ESU are ocean-type. Ocean-type Chinook typically migrate to sea within 3 months of emergence, but may spend up to a year in freshwater prior to emigration. Adults return to the Snake River at ages 2 through 5, with age 4 most common at spawning (Chapman et al. 1991, as cited in Meyers 1998). Spawning, which takes place in late fall, occurs in the mainstem and in the lower parts of major tributaries (NWPPC 1989, Bugert et al. 1990). Juvenile fall-run Chinook salmon move seaward slowly as subyearlings, typically within several weeks of emergence (Chapman et al. 1991, as cited in Meyers 1998). Based on modeling by the Chinook Technical Committee, the Pacific Salmon Commission estimates that a significant proportion of the Snake River fall-run Chinook (about 36 percent) are taken in Alaska and Canada, indicating a far-ranging ocean distribution. In recent years, only 19 percent were caught off Washington, Oregon, and California, with the balance (45 percent) taken in the Columbia River (Simmons 2000).

Habitat and Hydrology

With hydrosystem development, the most productive areas of the Snake River Basin are now inaccessible or inundated. The upper reaches of the mainstem Snake River were the primary areas used by fall-run Chinook salmon, with only limited spawning activity reported downstream from river kilometer (Rkm) 439. The construction of Brownlee Dam (1958; Rkm 459), Oxbow Dam (1961; Rkm 439), and Hells Canyon Dam (1967; Rkm 397) eliminated the primary production areas of Snake River fall-run Chinook salmon. There are now 12 dams on the mainstem Snake River, and they have substantially reduced the distribution and abundance of fall-run Chinook salmon (Irving and Bjornn 1981).

Hatchery Influence

The Snake River has contained hatchery-reared fall-run Chinook salmon since 1981 (Busack 1991). The hatchery contribution to Snake River escapement has been estimated at greater than 47 percent (Meyers et al. 1998). Artificial propagation is recent, so cumulative genetic changes associated with it may be limited. Wild fish are incorporated into the brood stock each year, which should reduce divergence from the wild population. Release of subyearling fish may also help minimize the differences in mortality patterns between hatchery and wild populations that can lead to genetic change (Waples 1999).

Population Trends and Risks

Almost all historical Snake River fall-run Chinook salmon spawning habitat in the Snake River Basin was blocked by the Hells Canyon Dam complex; other habitat blockages have also occurred in Columbia River tributaries. The ESU's range has also been affected by agricultural water withdrawals, grazing, and vegetation management. The continued straying by nonnative hatchery fish into natural production areas is an additional source of risk. Assessing extinction risk to the newly configured ESU is difficult because of the geographic discontinuity and the disparity in the status of the two remaining populations. The relatively recent extirpation of fall-run Chinook in the John Day, Umatilla, and Walla Walla Rivers is also a factor in assessing the risk to the overall ESU. Long-term trends in abundance for specific tributary systems are mixed. For the Snake River fall-run Chinook salmon ESU, NOAA Fisheries estimates that the median population growth rate (lambda) over a base period from 1980 through 1998 ranges from 0.94 to 0.86, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared with that of fish of wild origin (McClure et al. 2000). The Snake River component of the fall Chinook run has been increasing during the past few years as a result of hatchery and supplementation efforts in the Snake and Clearwater River Basins. In 2002, more than 15,200 fall Chinook were counted past the two lower dams on the Snake River, with about 12,400 counted above Lower Granite Dam. These adult returns are about triple the 10-year average at these Snake River projects (FPC 2003).

3.C.2.1.2. Snake River Spring and Summer Chinook Salmon

This ESU was listed as threatened on April 22, 1992, and was "downgraded" to a proposed endangered status on December 28, 1994. The November 2, 1994 Emergency Rule (59 FR 54840), reclassifying Snake River Chinook from threatened to endangered, expired on May 26, 1995.

Geographic Boundaries and Spatial Distribution

Snake River spring-run and/or summer-run Chinook salmon are found in several subbasins of the Snake River (CBFWA 1990). Of these, the Grande Ronde and Salmon Rivers are large, complex systems composed of several smaller tributaries that are further composed of many small streams. In contrast, the Tucannon and Imnaha Rivers are small systems with most salmon production in the main river. In addition to these major subbasins, three small streams, Asotin, Granite, and Sheep Creeks, which enter the Snake River between Lower Granite and Hells Canyon Dams, provide small spawning and rearing areas (CBFWA 1990). Although there are some indications that multiple ESUs may exist within the Snake River Basin, the available data do not clearly demonstrate their existence or define their boundaries.

Critical Habitat

The critical habitat for the Snake River spring/summer Chinook salmon was listed on December 28, 1993 (58 FR 68543). The designated habitat consists of river reaches of the Columbia, Snake, and Salmon Rivers, and all tributaries of the Snake and Salmon Rivers (except the Clearwater River) presently or historically accessible to Snake River spring/summer Chinook salmon (except reaches above impassable natural falls and Hells Canyon Dam).

Historical Information

Historically, Snake River spring- and/or summer-run Chinook salmon spawned in virtually all accessible and suitable habitats in the Snake River system (Evermann 1895, Fulton 1968). During the late 1800s, the Snake River produced a substantial fraction of all Columbia Basin spring and summer Chinook salmon, with total production probably exceeding 1.5 million in some years. By the mid-1900s, the abundance of adult spring and summer Chinook salmon had greatly declined. Fulton (1968) estimated that an average of 125,000 adults per year entered the Snake River tributaries from 1950 through 1960. As evidenced by adult counts at dams, however, spring and summer Chinook salmon have declined considerably since the 1960s.

Life History

In the Snake River, spring and summer Chinook are both stream-type fish, with juveniles that migrate to sea as yearling smolts. Depending primarily on location within the basin (and not on run type), adults tend to return after either 2 or 3 years in the ocean. Most Snake River spring/summer Chinook salmon enter individual subbasins from May through September. Juvenile Snake River spring/summer Chinook salmon emerge from spawning gravels from February through June (Bjornn and Peery 1992). Typically, after rearing in their nursery streams for about 1 year, smolts begin migrating seaward in the period from April through May (Bugert et al. 1990, Cannamela 1992). After reaching the mouth of the Columbia River, spring/summer Chinook salmon probably inhabit near-shore areas before beginning their northeast Pacific Ocean migration. For detailed information on the life history and stock status of Snake River spring/summer Chinook salmon, NMFS (1991a), and 56 FR 29542 (June 27, 1991).

Habitat and Hydrology

In general, the habitats used for spawning and early juvenile rearing are different among the three Chinook salmon forms (spring, summer, and fall) (Chapman et al. 1991, as cited in Meyers 1998). In both the Columbia and Snake Rivers, spring Chinook salmon tend to use small, higher elevation streams (headwaters), and fall Chinook salmon tend to use large, lower elevation streams or mainstem areas. Summer Chinook are more variable in their spawning habitats; in the Snake River, they inhabit small, high elevation tributaries typical of spring Chinook salmon habitat, whereas in the upper Columbia River they spawn in the larger lower elevation streams characteristic of fall Chinook salmon habitat. Differences are also evident in juvenile out-migration behavior. In both rivers, spring Chinook salmon migrate swiftly to sea as yearling smolts, and fall Chinook salmon move seaward slowly as subyearlings. Summer Chinook salmon in the Snake River resemble spring-run fish in migrating as yearlings, but migrate as subyearlings in the upper Columbia River. Early researchers categorized the two behavioral types as "ocean-type" Chinook for seaward migrating subyearlings and as "stream-type" Chinook for the yearling migrants (Gilbert 1912).

Hatchery Influence

There is a long history of human efforts to enhance production of Chinook salmon in the Snake River Basin through supplementation and stock transfers. The evidence is mixed as to whether these efforts have altered the genetic makeup of indigenous populations. Straying rates appear to be low.

Population Trends and Risks

Recent trends in redd counts in major tributaries of the Snake River indicate that many subpopulations could be at critically low levels. Subpopulations in the Grande Ronde River, Middle Fork Salmon River, and Upper Salmon River Basins are at particularly high risk. Both demographic and genetic risks would be of concern for such subpopulations, and in some cases, habitat may be so sparsely populated that adults have difficulty finding mates. NOAA Fisheries estimates that the median population growth rate (lambda) over a base period from 1980 through 1998 ranges from 0.96 to 0.80, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared with the effectiveness of fish of wild origin (Tables B-2a and B-2b in McClure et al. 2000b). In 2002, the fish count at Lower Granite Dam was 75,025, more than double the 10-year average. Estimated hatchery Chinook at Lower Granite Dam accounted for a minimum of 69.7 percent of the run. The spring Chinook count in the Snake River was at the all-time low of about 1,500 as recently as 1995, but in 2001 and 2002 both hatchery and wild/natural returns to the Snake River increased (FPC 2003).

3.C.2.1.3. Upper Columbia River Spring-run Chinook Salmon

The Upper Columbia River (UCR) spring-run Chinook salmon ESU was listed as endangered on March 24, 1999 (64 FR 14308).

Geographic Boundaries and Spatial Distribution

The UCR ESU includes spring-run Chinook populations found in Columbia River tributaries between Rock Island and Chief Joseph Dams, notably the Wenatchee, Entiat, and Methow River Basins. The populations are genetically and ecologically separate from the summer- and fall-run populations in the lower parts of many of the same river systems (Meyers et al. 1998). Although fish in this ESU are genetically similar to spring Chinook in adjacent ESUs, they are distinguished by ecological differences in spawning and rearing habitat preferences. For example, spring-run Chinook in upper Columbia River tributaries spawn at lower elevations (500 to 1,000 m) than in the Snake and John Day River systems.

Critical Habitat

The critical habitat for UCR Chinook salmon was initially designated on February 16, 2000 (65 FR 7764) but was withdrawn in April 2002. The initial designation included all river reaches accessible to listed Chinook salmon in Columbia River tributaries upstream of the Rock Island Dam and downstream of Chief Joseph Dam in Washington, excluding the Okanogan River. Also included were river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to Chief Joseph Dam in Washington. Excluded were the areas above Chief Joseph Dam and areas above longstanding, naturally impassable barriers (e.g., natural waterfalls in existence for at least several hundred years). The final rule (70 FR52630) was designated 09/09/05.

Historical Information

The upper Columbia River populations were intermixed during the Grand Coulee Fish Maintenance Project (1939 through 1943), resulting in loss of genetic diversity between populations in the ESU.

Homogenization remains an important feature of the ESU. Fish abundance has tended downward both recently and over the long term. At least six former populations from this ESU are now extinct, and nearly all extant populations have fewer than 100 wild spawners.

Life History
UCR spring-run Chinook are considered stream-type fish, with smolts migrating as yearlings. Most stream-type fish mature at 4 years of age. Few coded-wire tags are recovered in ocean fisheries, suggesting that the fish move quickly out of the north central Pacific and do not migrate along the coast.

Habitat and Hydrology
Spawning and rearing habitat in the Columbia River and its tributaries upstream of the Yakima River includes dry areas where conditions are less conducive to Chinook survival than in many other parts of the Columbia River Basin (Mullan et al. 1992). Salmon in this ESU must pass up to nine federal and private dams, and Chief Joseph Dam prevents access to historical spawning grounds farther upstream. Degradation of remaining spawning and rearing habitat continues to be a major concern associated with urbanization, irrigation projects, and livestock grazing along riparian corridors.

Hatchery Influence
Spring-run Chinook salmon from the Carson National Fish Hatchery (a large, composite, nonnative stock) were introduced into, and have been released from, local hatcheries (Leavenworth, Entiat, and Winthrop National Fish Hatcheries [NFH]). Little evidence suggests that these hatchery fish stray into wild areas or hybridize with naturally spawning populations. In addition to these national production hatcheries, two supplementation hatcheries are operated by the Washington Department of Fish and Wildlife (WDFW) in this ESU. The Methow Fish Hatchery Complex (where operations began in 1992) and the Rock Island Fish Hatchery Complex (where operations began in 1989) were both designed to implement supplementation programs for naturally spawning populations on the Methow and Wenatchee Rivers, respectively (Chapman et al. 1995).

Population Trends and Risks
Access to a substantial portion of historical habitat was blocked by Chief Joseph and Grand Coulee Dams. There are local habitat problems related to irrigation diversions and hydroelectric development, as well as degraded riparian and instream habitat from urbanization and livestock grazing. Mainstem Columbia River hydroelectric development has resulted in a major disruption of migration corridors and affected flow regimes and estuarine habitat. Some populations in this ESU must migrate through nine mainstem dams.

Artificial propagation efforts have had a significant impact on spring-run populations in this ESU, either through hatchery-based enhancement or extensive trapping and transportation. Previous assessments of stocks within this ESU have identified several as being at risk or of concern. Given the lack of information on Chinook salmon stocks that are presumed to be extinct, the relationship of these stocks to existing ESUs is uncertain. Recent total abundance of this ESU is quite low, and escapements in 1994-1996 were the lowest in at least 60 years. At least six populations of spring Chinook salmon in this ESU have become extinct, and almost all remaining naturally spawning populations have fewer than 100 spawners. Risk assessments conducted by NOAA Fisheries showed extinction risks for UCR spring Chinook salmon of 50 percent for the Methow, 98 percent for the Wenatchee, and 99 percent for the Entiat spawning populations (Cooney 2002). In 2002, the spring Chinook count at Priest Rapids Dam was 34,083 with 24,000 arriving at Rock Island Dam. The 2002 count was about 67.6 percent and 242 percent of the respective 2001 and 10-year average adult spring Chinook count at Priest Rapids Dam. Numbers of wild Chinook in tributaries located above Rock Island Dam were reported to still be at low levels (FPC 2003).

3.C.2.1.4. Lower Columbia River Chinook Salmon

This ESU was listed as threatened on March 9, 1998.

Geographic Boundaries and Spatial Distribution

The Lower Columbia River (LCR) is characterized by numerous short and medium-length rivers that drain the coast ranges and the west slope of the Cascade Mountains. The LCR Chinook salmon ESU includes all native populations from the mouth of the Columbia River to the crest of the Cascade Range, excluding populations above Willamette Falls. The former location of Celilo Falls (inundated by The Dalles reservoir in 1960) is the eastern boundary for this ESU. Stream-type, spring-run Chinook salmon found in the Klickitat River, or the introduced Carson spring-run Chinook salmon strain, are not included in this ESU. Spring-run Chinook salmon in the Sandy River have been influenced by spring-run Chinook salmon introduced from the Willamette River ESU. However, analyses suggest that considerable genetic resources still reside in the existing population (Meyers et al. 1998). Recent escapements above Marmot Dam on the Sandy River average 2,800 and have been increasing (ODFW 1998a). "Tule" (LCR fall Chinook) from the LCR Chinook ESU were observed spawning in the Ives Island area during October 1999. The Hardy/Hamilton Creeks/Ives Island complex is located along the Washington shoreline, approximately 2 miles below Bonneville Dam.

Critical Habitat

The critical habitat for LCR Chinook salmon was *initially* designated on February 16, 2000 (65 FR 7764), but was withdrawn in April 2002. The initial designation included all river reaches accessible to Chinook salmon in Columbia River tributaries between the Grays and White Salmon Rivers in Washington and the Willamette and Hood Rivers in Oregon, inclusive. Also included were river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to the Dalles Dam. Excluded were the areas above specific dams (Condit, Dalles, Bull Run Dam 2, and Merwin Dam) and areas above longstanding, naturally impassable barriers (e.g., natural waterfalls in existence for at least several hundred years). Critical habitat designation for this ESU was finalized 09/02/05 (70 FR 52630).

Historical Information

Historical records of Chinook salmon abundance are sparse, but cannery records suggest a peak run of 4.6 million fish in 1883. Although fall-run Chinook salmon are still present throughout much of their historical range, most of the fish spawning today are first-generation hatchery strays. Furthermore, spring-run populations have been severely depleted throughout the ESU and extirpated from several rivers.

Life History

Most fall-run fish in the LCR Chinook salmon ESU emigrate to the marine environment as subyearlings (Howell et al. 1985, WDF et al. 1993). Returning adults that emigrated as yearling smolts may have originated from the extensive hatchery programs in the ESU. It is also possible that modifications in the river environment have altered the duration of freshwater residence. Coded-wire tag (CWT) recoveries of LCR Chinook salmon ESU fish suggest a northerly migration route, but CWT recoveries indicate that the fish contribute more to fisheries off British Columbia and Washington than to the Alaskan fishery. Tule fall Chinook salmon return at adult ages 3 and 4, and "bright" fall Chinook return at ages 4 and 5, with significant numbers returning at age 6. Tule and bright Chinook salmon are distinct in their spawn timing.

Habitat and Hydrology

As in other ESUs, Chinook salmon have been affected by the alteration of freshwater habitat (WDF et al. 1993, Kostow 1995). Timber harvesting and associated road building peaked in the 1930s, but effects from the timber industry remain (Kostow 1995). Agriculture is widespread in this ESU and has affected riparian vegetation and stream hydrology. The ESU is also highly affected by urbanization, including river diking and channelization, wetland draining and filling, and pollution (Kostow 1995).

Hatchery Influence

The LCR Chinook salmon ESU has been subject to intensive hatchery influence. Hatchery programs to enhance Chinook salmon fisheries in the lower Columbia River began in the 1870s, releasing billions of fish over time. That equals the total hatchery releases for all other Chinook ESUs combined (Meyers et al. 1998). Although most of the stocks have come from inside the ESU, more than 200 million fish from outside the ESU have been released since 1930 (Meyers et al. 1998).

Population Trends and Risks

Apart from the relatively large and apparently healthy fall-run population in the Lewis River, production in this ESU appears to be predominantly hatchery-driven with few identifiable naturally spawned populations. All basins are affected (to varying degrees) by habitat degradation. Hatchery programs have had a negative effect on the native ESU. Efforts to enhance Chinook salmon fisheries abundance in the lower Columbia River began in the 1870s. Available evidence indicates a pervasive influence of hatchery fish on natural populations throughout this ESU, including both spring- and fall-run populations. The large number of hatchery fish in this ESU make it difficult to determine the proportion of naturally produced fish. The loss of fitness and diversity within the ESU is an important concern.

NOAA Fisheries estimates that the median population growth rate over a base period from 1980 through 1998 ranges from 0.98 to 0.88, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared with that of fish of wild origin (Tables B-2a and B-2b in McClure et al. 2000b). In 2002, the number of fall Chinook counted at Bonneville Dam was 474,738 with an additional 40,210 jack Chinook. Tule fall Chinook estimated from the fish counts at Bonneville Dam totaled nearly 164,000. This component of the fall Chinook run was a record high and bolstered the overall record fall Chinook count at Bonneville Dam (FPC 2003).

3.C.2.1.5. Puget Sound Chinook Salmon

Geographic Boundaries and Spatial Distribution

The boundaries of this salmon ESU correspond with the Puget Lowland Ecoregion. This ESU encompasses all runs of Chinook salmon in the Puget Sound region from the North Fork Nooksack River to the Elwha River on the Olympic Peninsula, including Hood Canal. Chinook salmon in this area all exhibit an ocean-type life history. Although some spring-run Chinook salmon populations in the Puget Sound ESU have a high proportion of yearling smolt emigrants, the proportion varies substantially from year to year and appears to be environmentally mediated rather than genetically determined. Puget Sound stocks all tend to mature at ages 3 and 4 and exhibit similar, coastally-oriented, ocean migration patterns (Meyers et al.1998).

Hatchery fish are known to spawn in the wild in the Elwha and Dungeness river basins and are not considered discrete stocks from the wild fish (WDFW and WWTIT 1994). Adult Chinook begin to enter the Elwha River in June and continue through early October. The timing for entry into the Dungeness is unknown. Spawning in both rivers takes place between August and October (WDFW and WWTIT 1994). Outmigration of Chinook smolts in the Elwha and Dungeness basins occurs between March and mid-July (Williams et al. 1975).

Critical Habitat

On April 30, 2002, the US District Court for the District of Columbia approved a NMFS consent decree withdrawing a February 2000 critical-habitat designation for this and 18 other evolutionary significant units (ESUs) (NMFS 2002). Critical habitat consists of the water, substrate, and the adjacent riparian zone of accessible estuarine and riverine reaches. The February 2000 critical-habitat designation included Puget Sound marine areas, including the south sound, Hood Canal, and north sound to the international boundary at the outer extent of the Strait of Georgia, Haro Strait, and the Strait of Juan de Fuca to a straight line extending north from the west end of Freshwater Bay, inclusive. Critical habitat designation for this ESU was finalized 09/02/05 (70 FR 52630).

Historical Information

Chinook salmon were abundant in Washington State near the turn of the century, when estimates based on peak cannery pack suggested peak runs of near one million fish in the Oregon Coast, Washington Coast, and Puget Sound ESUs. However, Chinook salmon in this region has been strongly affected by losses and alterations of freshwater habitat. Timber harvesting and associated road building have occurred throughout this region. Agriculture is also widespread in the lower portions of river basins and has resulted in widespread removal of riparian vegetation, rerouting of streams, degradation of streambanks, and summer water withdrawals. Urban development has substantially altered watershed hydrodynamics and affected stream channel structure in many parts of Puget Sound.

The peak recorded harvest landed in Puget Sound occurred in 1908, when 95,210 cases of canned Chinook salmon were packed. This corresponds to a run-size of approximately 690,000 Chinook salmon at a time when both ocean harvest and hatchery production were negligible. This estimate, as with other historical estimates, needs to be viewed cautiously; Puget Sound cannery pack probably included a portion of fish landed at Puget Sound ports but originating in adjacent areas, and the estimates of exploitation rates used in run-size expansions are not based on precise data. Recent mean spawning escapements totaling 71,000 correspond to a run entering Puget Sound of approximately 160,000 fish. Based on an exploitation rate of one-third in intercepting ocean fisheries, the recent average potential run-size would be 240,000 Chinook salmon (ACOE 2000a).

Life History

Chinook salmon prefer to spawn and rear in the mainstem of rivers and larger streams (Williams et al. 1975, Healey 1991). Although the incubation period is determined by water temperatures, fry typically hatch in about eight weeks (Wydoski and Whitney 1979, Healey 1991). After emergence, Puget Sound juvenile Chinook salmon migrate to the marine environment during their first year.

Rearing and development to adulthood occurs primarily in estuarine and coastal waters (NMFS 1998). The amount of time juvenile Chinook spend in estuarine areas depends upon their size at downstream migration and rate of growth. While residing in upper estuaries, juvenile prey mainly on benthic and epibenthic organisms such as amphipods, mysids, and cumaceans. Juveniles typically move into deeper waters when they reach approximately 65-75 mm in fork length. As the juveniles grow and move to deeper waters with higher salinities, their main prey changes to pelagic organisms such as decapod larvae, larval and juvenile fish, drift insects, and euphausids (Simenstad et al. 1977).

<u>Hatchery Influence</u>

By 1908 there were state-run and federally-run Chinook hatcheries operating in this ESU. Transfers of Chinook salmon eggs to Puget Sound from other regions especially the Lower Columbia River were common practices of early hatcheries (Meyers et al., 1998). By the 1920's several million Chinook salmon had been released into Puget Sound tributaries (Cobb, 1930). Recently, stock integrity and genetic diversity have become important objectives. New policies have been initiated to reduce the impact of hatchery fish on natural populations (WDF 1991, WDF et al.1993). The abundance of Chinook salmon in watersheds throughout this ESU has been closely related to hatchery efforts (Meyers et al. 1998).

WDFW classified 11 out of 29 stocks in this ESU as being sustained, in part, through artificial propagation. Nearly 2 billion fish have been released into Puget Sound tributaries since the 1950s. The vast majority of these have been derived from local returning fall-run adults. Returns to hatcheries have accounted for 57 percent of the total spawning escapement, although the hatchery contribution to spawner escapement is probably much higher than that, due to hatchery-derived strays on the spawning grounds (ACOE 2000a).

<u>Population Trends and Risks</u>

The abundance of Chinook salmon in this ESU has declined since historic levels. Widespread stream blockages have reduced available spawning habitat. Widespread release of hatchery fish from limited stocks, has increased the risks of loss of genetic diversity and fitness to natural populations. In addition the large numbers of hatchery releases masks natural population trends and making it difficult to determine their sustainability. Forestry practices, farming and urbanization have blocked or degraded fresh water habitat (Meyers et al., 1998).

3.C.2.2. Chum salmon

Chum salmon have the widest natural geographic distribution of all Pacific salmon species, ranging in Asia from Korea to the Russian Arctic coast and west to the Lena River, and in North America from Monterey, California, to the Arctic coast and east to the Mackenzie River (Beaufort Sea). Historically, they may have constituted up t 50 percent of the annual biomass of the seven species of Pacific salmon in the North Pacific Ocean (Salo 2003).

Chum salmon spawn successfully in streams of various sizes, and the fry migrate directly to the sea soon after emergence. The immature chum distribute themselves widely over the North Pacific Ocean, and maturing adults return to the home streams at various ages, usually at two through five years, and in some cases up to seven years (Salo 2003).

Common to virtually every region of the chum salmon’s area of distribution is the occurrence of early and late returning stocks to the natal stream. In North America the only true summer chum salmon may be in the Yukon River, where summer chum have the distinguishing characteristics of the Asian summer chum. From western Alaska south to British Columbia and Washington, there are runs referred to as “summer” chum, which spawn from June to early September; these chum are characterized by large body size, older age composition, and high fecundity, and are probably early autumn chum (Salo 2003).

In general, early-run chum spawn in mainstems of streams, while late spawners seek out spring water that has more favorable temperatures through the winter. The timing of the runs varies from north to south, as does age at maturity and absolute (and, probably, relative) fecundity (Salo 2003).

3.C.2.2.1. Hood Canal Summer Run Chum Salmon

The Hood Canal (HC) summer run chum salmon ESU was listed as threatened on August 2, 1999.

Geographic Boundaries and Spatial Distribution

This ESU includes summer-run chum salmon populations in Hood Canal in Puget Sound and in Discovery and Sequim Bays on the Strait of Juan de Fuca. It may also include summer-run fish in the Dungeness River, but the existence of that run is uncertain. Distinctive life-history and genetic traits were the most important factors in identifying this ESU. Hood Canal summer-run chum salmon are defined as fish that spawn from mid-September to mid-October in the mainstems of rivers (Johnson et al.1997).

Critical Habitat

Critical habitat for the HC chum salmon was first designated February 16, 2000. On April 30, 2002, the US District Court for the District of Columbia approved a NMFS consent decree withdrawing a February 2000 critical-habitat designation for this and 18 other evolutionary significant units (ESUs) (NMFS 2002). The final critical habitat was designated 09/02/05 (70 FR 52630).

Historical Information

Hood Canal summer-run chum salmon are defined in SASSI (WDF et al. 1993) as fish that spawn from mid-September to mid-October. Fall-run chum salmon are defined as fish that spawn from November through December or January. Run-timing data from as early as 1913 indicated temporal separation between summer and fall chum salmon in Hood Canal (Johnson et al.1997).

Life History

Chum salmon in Hood Canal have been classified as summer- and fall- returning stocks. Most Hood Canal summer-run chum spawn in early September to mid-October. The Union River summer chum run is an exception as they have an earlier spawning timing (September – early October). Fry emerge from February to June. In Washington, chum may reside in freshwater for as long as a month before migration to estuarine habitats where they remain for about a month before migrating to deeper water (Johnson et al.1997).

Hatchery Influence

Very few summer-run chum salmon have been artificially propagated in Hood Canal, and the only releases in recent years have been from newly established restoration programs. These recent releases totaled about 241,000 chum salmon fry into Hood Canal in 1993 and 1994 and about 85,000 fry into Discovery Bay on the Strait of Juan de Fuca in 1992. There has been little artificial propagation of summer chum salmon from the Strait of Juan de Fuca east of the Elwha River. Since 1992 a restoration egg box program has produced about 85,000 fry annually in Salmon Creek, a tributary to Discovery Bay. There are no records of summer-run chum salmon fry plants into other streams that enter the Strait of Juan de Fuca, including Jimmycomelately and Snow Creeks, or the Dungeness River (Johnson et al.1997).

Population Trends and Risks

This ESU is in danger of extinction. Of 12 streams in Hood Canal identified as recently supporting spawning populations of summer chum salmon, 5 may already have become extinct, 6 of the remaining 7 showed strong downward trends in abundance, and all were at low levels of abundance. The populations in Discovery Bay and Sequim Bay were also at low levels of abundance with declining trends. Threats to the continued existence of these populations include degradation of spawning habitat, low water flows, and incidental harvest in salmon fisheries in the Strait of Juan de Fuca and coho salmon fisheries in Hood Canal (Johnson et al. 1997).

3.C.2.2.2. Columbia River Chum Salmon

The Columbia River (CR) chum salmon ESU was listed as threatened on March 25, 1999 (64FR14508).

Geographic Boundaries and Spatial Distribution

Chum salmon of the CR ESU spawn in tributaries and in mainstem areas below Bonneville Dam. Most fish spawn on the Washington side of the Columbia River (Johnson et al. 1997). Previously, chum salmon were reported in almost every river in the lower Columbia River basin, but most runs disappeared by the 1950s (Johnson et al. 1997). Currently, WDFW regularly monitors only a few natural populations in the basin, one in Grays River, two in small streams near Bonneville Dam, and the mainstem area next to one of the latter two streams. Recently, spawning has occurred in the mainstem Columbia River at two spots near Vancouver, Washington, and in Duncan Creek below Bonneville Dam.

Critical Habitat

The critical habitat for CR chum salmon was initially designated on February 16, 2000 (65FR7764), but was withdrawn in April 2002 and is currently under development. The initial designation included all river reaches accessible to listed chum salmon (including estuarine areas and tributaries) in the Columbia River downstream of Bonneville Dam, excluding Oregon tributaries upstream of Milton Creek at Rkm 144 near the town of St. Helens. Excluded were the areas above Bonneville and Merwin Dams and areas above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years). The final critical habitat was designated 09/02/05 (70 FR 52630).

Historical Information

Historically, the CR chum salmon ESU supported a large commercial fishery in the first half of this century, landing more than 500,000 fish per year as recently as 1942. Commercial catches declined beginning in the mid-1950s and in later years rarely exceeded 2,000 per year. There are now no recreational or directed commercial fisheries for chum salmon in the Columbia River, although chum salmon are taken incidentally in the gill-net fisheries for coho and Chinook salmon, and some tributaries have a minor recreational harvest (WDF et al. 1993). Observations of chum salmon still occur in most of the thirteen basins/areas that were identified in 1951 as hosting chum salmon. However, there are usually less than 10 fish observed in these areas. In 1999, the Washington State

Department of Fish and Wildlife located another Columbia River mainstem spawning area for chum salmon located near the I-205 bridge (WDFW 2000).

Life History

Chum salmon enter the Columbia River from mid-October through early December and spawn from early November to late December. Recent genetic analysis of fish from Hardy and Hamilton Creeks, and from the Grays River indicate that these fish are genetically distinct from other chum salmon populations in Washington. Genetic variability within and between populations in several geographic areas is similar, and populations in Washington show levels of genetic subdivision typical of those seen between summer- and fall-run populations in other areas, and are typical of populations within run types (Salo 1991, WDF et al. 1993, Johnson et al. 1997).

Hatchery Influence

For the last 100 years hatcheries have produced chum salmon for the purpose of increasing stocks. Movement of eggs and fry from one geographical region to another has occurred. Most of the stock transfers in Washington have occurred from chum salmon hatcheries in Hood Canal to streams and hatcheries in south and north Puget Sound, and the Strait of Juan de Fuca. Although these transfers ceased in the early 1980's, hatchery strains (with the Hood Canal chum salmon gene pools) are still being used at some hatcheries and wild populations may have been mixed with hatchery strains at the hatchery and through straying. Recently, the hatching of chum salmon in small stream-side incubators has become popular with volunteer groups. When eggs are provided from hatchery sources, these projects have the potential to disrupt historic patterns of genetic diversity (Johnson et al.1997).

Population Trends and Risks

Current abundance is probably less than 1% of historic levels, and the ESU has undoubtedly lost some (perhaps much) of its original genetic diversity. Presently, only three chum salmon populations, all relatively small and all in Washington, are recognized and monitored in the Columbia River (Grays River, Hardy and Hamilton Creeks). Each of these populations may have been influenced by hatchery programs and/or introduced stocks, but information on hatchery-wild interactions is unavailable (Johnson et al. 1997).

3.C.2.3. Coho salmon—lower Columbia River ESU

The Lower Columbia River Coho salmon ESU was listed as threatened on March 25, 1999 (64FR14508). Information describing this ESU is from the NOAA Technical Memorandum on the Updated Status of Federally listed ESUs of West Coast Salmon and Steelhead (Good et al. 2005) and the Lower Columbia River Coho Salmon Status Review conducted in 1991 (Johnson et al. 1991).

Geographic Boundaries and Spatial Distribution

Originally part of a larger Lower Columbia River/Southwest Washington ESU, Lower Columbia River coho (Oncorhynchus kisutch) were identified as a separate ESU and listed as threatened on 06/28/05 (70 FR37160). The ESU includes all naturally spawned populations of coho salmon in the Columbia River and its tributaries in Washington and Oregon, from the mouth of the Columbia up to and including the Big White Salmon and Hood Rivers, and includes the Willamette River to Willamette Falls, Oregon, as well as twenty-five artificial propagation programs: the Grays River, Sea Resources Hatchery, Peterson Coho Project, Big Creek Hatchery, Astoria High School (STEP) Coho Program, Warrenton High School (STEP) Coho Program, Elochoman Type-S Coho Program, Elochoman Type-N Coho Program, Cathlamet High School FFA Type-N Coho Program, Cowlitz Type-N Coho Program in the Upper and Lower Cowlitz Rivers, Cowlitz Game and Anglers Coho Program, Friends of the

Cowlitz Coho Program, North Fork Toutle River Hatchery, Kalama River Type-N Coho Program, Kalama River Type-S Coho Program, Lewis River Type-N Coho Program, Lewis River Type-S Coho Program, Fish First Wild Coho Program, Fish First Type-N Coho Program, Syverson Project Type-N Coho Program, Eagle Creek National Fish Hatchery, Sandy Hatchery, and the Bonneville/Cascade/Oxbow complex coho hatchery programs.

Some populations (e.g. North Fork Lewis River) spawned above now impassible barriers: they are completely extirpated. Most other populations, except for the Clackamas and Sandy River populations , are believed to have very little, if any, natural production. Sampling of the Oregon populations to obtain abundance estimates of the LCR coho indicate that hatchery-origin spawners dominate the population, but there are potential pockets of natural reproduction (e.g. Scappoose Creek).

Washington Populations: Hatchery production also dominates the Washington side of this ESU, and no populations are known to be naturally self-sustaining. There are no estimates of spawner abundance for Washington LCR coho ESU populations. However, recently conducted outmigrant information indicate that some natural production is occurring in the Lewis River and Mill-Germany-Abernathy creek populations. However, there is no direct way to determine whether these populations would be naturally self-sustaining in the absence of hatchery-origin spawners. WDFW suggest that juvenile outmigrant production seen in the monitored streams is typical of other Washington LCR ESU streams and that a fairly substantial number of natural-origin spawners may return to the LCAR each year. Preliminary WDFW calculations suggest that the natural pre-harvest recruitment from the monitored streams alone may be 27,000 adults.

The population above Cowlitz Falls is also capable of natural outmigrant production. However, these populations are not considered currently self-sustaining. Three dams block anadromous passage to the upper Cowlitz River and this population is maintained by trap and haul operations and hatchery production.

Critical Habitat

Currently the Critical habitat designation for LCR coho salmon is in review status and has not been finalized (9/26/05, 70 FR56212)

Historical Information

Prior to the 1900s, naturally produced coho salmon were widespread in the Columbia River Basin, with the historical center of abundance in the LCR. Columbia and Snake River runs were drastically reduced by or destroyed by various factors prior to the 1950s including overharvest, habitat destruction or barriers to habitat. The drastic decline in populations initiated the widespread hatchery enhancement program after 1960. This program increased coho salmon populations in the Columbia River to historic levels. The causes of the original declines to coho were not eliminated by this extensive hatchery production.

Overharvest, habitat blockages and destruction, and other detrimental activities continued. This resulted in a continued decline in naturally spawning runs while exploitation of hatchery fish continued at increased levels.

In the early 1980s it was estimated that less than 25,000 coho were spawning naturally in the Columbia River Basin. These fish were thought to have been mainly feral hatchery fish and returns from hatchery outplants in streams away from hatcheries, although some were naturally produced fish.

Life History

Native adult coho salmon populations return to their natal streams to spawn from early fall to late spring. Fry emerge from redds between early March and July. Juveniles rear in fresh water for a year before migrating to the marine environment. Coho mature in the ocean for 5-20 months before returning to spawn. Fidelity of homing in coho salmon under natural conditions is similar to that demonstrated for other species of Pacific salmon and appears sufficient to maintain populations with a similar level of distinctiveness. Different coho salmon populations show timing differences from fry emergence to time of adult spawner returns. Coho salmon show freshwater, estuarine, and ocean migratory patterns, which are apparently determined by the geographic area of their natal streams. Homing and spawning behavior is complex and would suggest a selection mechanism that appears sufficient to reduce gene flow from nonnative populations. However, available evidence indicates that massive and extensive disruptions documented in coho salmon population in the LCR have depleted native populations enough that population differences have been largely eliminated.

Hatchery Influence

Hatchery release to the Columbia River basin over the years 2000-2002 were 29,902.,509, 25,730,650, and 20,011,742 coho. Hatchery production dominates the LCR coho salmon ESU. The total expected return of hatchery coho salmon to the Columbia River basin in 2002 was over a million adults.

Population Trends and Risks

Currently, NOAA has identified only 2 populations of LCR coho, the Clackamas and Sandy Rivers that demonstrate appreciable levels of natural production. There is only limited information on the remainder of the 21 putative populations, but most were considered extirpated, or nearly so, during the low marine survival period of the 1990s. Recently initiated spawner surveys by ODFW and juvenile outmigrant data by WDFW indicate there is some natural coho salmon production in the LCR. However, hatchery-origin spawners dominate the majority of populations, and little data indicates they would naturally persist in the long-term. Of the two populations where natural production can be evaluated, both have experienced recruitment failure over the last decade. Recent abundances of the two populations are relatively low, placing them in a range where environmental, demographic, and genetic stochasticity can be significant risk factors.

The most serious overall concern was the scarcity of naturally produced spawners throughout the ESU, with attendant risks associated with small population, loss of diversity, and fragmentation and isolation of the remaining naturally produced fish. In the only two populations with significant natural production (Sandy and Clackamas rivers), short- and long-term trends are negative and productivity is down sharply. On the positive side, adult returns in 2000 and 2001 were up noticeably in some areas, and evidence for limited natural production has been found in some areas outside the Sandy and Clackamas. The paucity of naturally produced spawners in this ESU can be contrasted with the very large number of hatchery produced adults. Although the scale of the hatchery programs, and the great disparity in the relative numbers of hatchery and wild fish, produce many genetic and ecological threats to the natural populations, collectively these hatchery populations contain a great deal of genetic resources that might be tapped to help promote restoration of more widespread naturally spawning populations.

The number of stream miles available as habitat for LCR coho is greatly reduced from the historical condition due to barriers to upstream passage.

3.C.2.4. Sockeye salmon

The sockeye salmon is the third most abundant of the seven species of Pacific salmon, after pink salmon (*O. gorbuscha*) and chum salmon. Sockeye contributed about 17 percent by weight and 14 percent in numbers to the total salmon catch in the North Pacific Ocean and adjacent waters during the period 1952 to 1976 (Burgner 2003).

Sockeye salmon exhibit a greater variety of life history patterns than other member of the genus *Oncorhynchus*, and characteristically make more use of lake rearing habitat in juvenile stages. Although sockeye are primarily anadromous, there are distinct populations called kokanee that mature, spawn, and die in fresh water without a period of sea life. Typically, but not universally, juvenile anadromous sockeye utilize lake rearing areas for one to three years after emergence from the gravel; however, some populations utilize stream areas for rearing and may migrate to sea soon after emergence. Anadromous sockeye may spend from one to four years in the ocean before returning to freshwater to spawn and die in late summer and autumn. The sockeye also shows a wide variety of racial adaptations to rather specialized spawning and rearing habitat combinations (Burgner 2003).

The primary spawning grounds of sockeye salmon in North America extend from tributaries of the Columbia River to the Kuskokwim River in western Alaska, and, on the Asian side, the spawning areas are found mainly on the Kamchatka Peninsula of Russia. During their feeding and maturation phase in the ocean, sockeye range throughout the North Pacific Ocean, Bering Sea, and eastern Sea of Okhotsk north of 40° N. There is considerable intermingling of Asian and North American populations from Bering Sea and Gulf of Alaska streams. Maturing sockeye return to their respective spawning rivers at different times, during the period of late spring to midsummer. Spawning time range from late July through January, but are primarily from midsummer until late autumn (Burgner 2003).

3.C.2.4.1. Sockeye Salmon- Snake River ESU

The Snake River (SR) sockeye salmon ESU was listed as endangered on November 20, 1991 (56FR58519).

<u>Geographic Boundaries and Spatial Distribution</u>

The only remaining anadromous sockeye in the Snake River system are found in Redfish Lake, on the Salmon River. The non-anadromous form (kokanee) found in Redfish Lake and elsewhere in the Snake River basin, is included in the ESU. SR sockeye were historically abundant in several lake systems of Idaho and Oregon. However, all populations have been extirpated in the past century, except fish returning to Redfish Lake.

<u>Critical Habitat</u>

The critical habitat for the Snake River sockeye salmon was designated on December 28, 1993 (58FR68543). The designated habitat consists of river reaches of the Columbia, Snake, and Salmon Rivers, Alturas Lake Creek, Valley Creek, and Stanley, Redfish, Yellow Belly, Pettit, and Alturas Lakes (including their inlet and outlet creeks).

<u>Historical Information</u>

In 1910, impassable Sunbeam Dam was constructed 20 miles downstream of Redfish Lake. Although several fish ladders and a diversion tunnel were installed during subsequent decades, it is unclear whether enough fish passed above the dam to sustain the run. The dam was partly removed in 1934, after which Redfish Lake runs partially rebounded. Evidence is mixed as to whether the restored runs constitute anadromous forms that managed to persist during the dam years, non-anadromous forms that became migratory, or fish that strayed in from outside the ESU.

Historically, the largest numbers of Snake River sockeye salmon returned to headwaters of the Payette River, where 75,000 were taken one year by a single fishing operation in Big Payette Lake. During the early 1880s, returns of Snake River sockeye salmon to the headwaters of the Grande Ronde river in Oregon (Walleye Lake) were estimated between 24,000 and 30,000 at a minimum (Cramer 1990). During the 1950s and 1960s, adult returns to Redfish Lake numbered more than 4,000 fish.

Life History

Snake River sockeye salmon enter the Columbia River primarily during June and July. Arrival at Redfish Lake, which now supports the only remaining run of Snake River sockeye salmon, peaks in August and spawning occurs primarily in October (Bjornn et al. 1968). Eggs hatch in the spring between 80 and 140 days after spawning. Fry remain in the gravel for three to five weeks, emerge in April through May, and move immediately into the lake where juveniles feed on plankton for one to three years before migrating to the ocean. Migrants leave Redfish Lake from late April through May (Bjornn et al. 1968), and smolts migrate almost 900 miles to the Pacific Ocean. Out migrating juveniles pass Lower Granite Dam (the first dam on the Snake River downstream from the Salmon River) from late April to July, with peak passage from May to late June. Once in the ocean, the smolts remain inshore or within the Columbia River influence during the early summer months. Later, they migrate through the northeast Pacific Ocean (Hart 1973). Snake River sockeye salmon usually spend two to three years in the Pacific Ocean and return in their fourth or fifth year of life. For detailed information on the Snake River sockeye salmon, see Waples and Johnson (1991) and November 20, 1991, 56 FR 58619.

Population Trends and Risks

Snake River sockeye salmon returns to Redfish Lake since at least 1985, when the Idaho Department of Fish and Game began operating a temporary weir below the lake, have been extremely small (one to 29 adults counted per year). Snake River sockeye salmon have a very limited distribution relative to critical spawning and rearing habitat. Redfish Lake represents only one of the five Stanley Basin lakes historically occupied by Snake River sockeye salmon and is designated as critical habitat for the species. NOAA Fisheries proposed an interim recovery level of 2,000 adult SR sockeye salmon in Redfish Lake and two other lakes in the Snake River basin (NMFS 1995). Because only 16 wild and 264 hatchery-produced adult sockeye returned to the Stanley River basin between 1990 and 2000, NOAA Fisheries considers the risk of extinction of this ESU to be very high. In 2002, 52 adult sockeye were counted at Lower Granite Dam (FPC 2003). As of September 23, 2003, 12 sockeye salmon were counted at Lower Granite Dam on the Snake River (ACOE 2003).

3.C.2.4.2. Sockeye Salmon-Ozette Lake ESU

This sockeye salmon ESU includes all naturally spawned sockeye salmon in Ozette Lake, and streams and tributaries flowing into Ozette Lake (Gustafson et al. 1997).

Geographic Boundaries and Spatial Distribution
This salmon ESU includes all the sockeye that spawn in the Ozette River drainage near Ozette Lake. This salmon stock is genetically different from all other salmon stocks in the Northwest (Gustafson et al., 1997).

Critical Habitat
The critical habitat for this sockeye ESU was finalized 09/02/05 (70 FR52630).

Historical Information
Historically, run sizes of Ozette Lake sockeye numbered in the thousands during the early 1900's. Commercial harvest of these sockeye declined during the latter half of the 20th century. A small ceremonial fishery continued until 1981, and no direct fishery on this stock since 1982 (Gustafson et al. 1997).

Life History
The majority of “lake-type” sockeye salmon spawn in streams near lakes, or in lakes where juveniles rear for 1 to 3 years before migrating to sea. After 1,2,3,or 4 years at sea sockeye return to their natal lake system to spawn. Most “lake-type”sockeye salmon spawn in inlet or outlet tributaries of lakes, or along beaches (Gustafson et al. 1997).

Habitat and Hydrology
Sedimentation of spawning habitat as a result of logging and road building, as well as truck traffic on weak roadbeds has led to degradation of spawning habitat and decreased hatching (Gustafson et al., 1997).

Hatchery Influence
Hatchery propagation of this ESU has not been widespread in this basin; with production in Ozette Lake primarily of local stock. Additionally releases of non-native stocks of kokanee/sockeye hybrids in 1991-1992, may have had harmful effects on Ozette sockeye genetic integrity due to the differences in genetic between species (Gustafson et al. 1997).

Population Trends and Risks
Over fishing and habitat degradation have reduced the Ozette Lake sockeye population to its current level of less than 1,000 fish per 5-year average. Ozette Lake sockeye salmon will likely be in danger of extinction due to siltation of spawning habitat, downward trend in abundance, and genetic effects of hatchery production and practices (Gustafson et al. 1997).

3.C.2.5. Steelhead

The steelhead is the anadromous form of the rainbow trout (*O. mykiss*), which occurs in two subspecies, *O. mykiss irideus* and *O. mykiss gaidneri*. Whereas stream-resident rainbow trout may complete their life cycle in a limited area of a small stream and attain a length of only 8 inches or so, steelhead may spend half their lives at sea, roaming for thousands of miles in the North Pacific Ocean. Steelhead return to spawn at sizes ranging from about 24 inches and 5 pounds to about 36 to 40 inches or more and 20 pounds or more (Behnke 2002).

Biologically, steelhead can be divided into two reproductive ecotypes, based on their state of sexual maturity at the time of river entry. These two ecotypes are termed “stream-maturing” and “ocean-maturing”. Stream-maturing steelhead enter fresh water in a sexually immature condition and require from several months to a year to mature and spawn. These fish are often referred to as "summer run" steelhead. Ocean-maturing steelhead enter fresh water with well-developed gonads and spawn shortly after river entry. These fish are commonly referred to as "winter-run" steelhead. In the Columbia River basin, essentially all steelhead that return to streams east of the Cascade Mountains are stream maturing. Ocean-maturing fish are the predominate ecotype in coastal streams and lower Columbia River tributaries (ACOE 2000b).

All but one of the *O. m. gairdneri* steelhead populations migrating east of the Cascade Range are characterized as summer-run steelhead (entering the Columbia River from May into the early fall in October); the one exception is a winter-run steelhead spawning in Fifteenmile Creek, which drains the eastern side of the Cascades in Oregon. The genetic traits of Fifteenmile Creel steelhead make it intermediate between the subspecies *irideus* and *gairdneri*. Steelhead of the subspecies *irideus* are mainly winter-run fish, but *irideus* also has summer runs. Considering the entire range of *irideus* from California to Alaska, steelhead can be found entering one river or another in every month of the year (Behnke 2002).

Native steelhead in California generally spawn earlier than those to the north with spawning beginning in December. Washington populations begin spawning in February or March. Native steelhead spawning in Oregon and Idaho is not well documented. In the Clackamas River in Oregon, winter-run steelhead spawning begins in April and continues into June. In the Washougal River, Washington, summer-run steelhead spawn from March into June whereas summer run fish in the Kalama River, Washington spawn from January through April. Among inland steelhead, Columbia River populations from tributaries upstream of the Yakima River spawn later than most downstream populations.

Depending on water temperature, fertilized steelhead eggs may incubate in redds for 1.5 to 4 months before hatching as "alevins". Following yolk sac absorption, young juveniles or "fry" emerge from the gravel and begin active feeding. Juveniles rear in fresh water for 1 to 4 years, then migrate to the ocean as smolts. Downstream migration of wild steelhead smolts in the lower Columbia River begins in April, peaks in mid-May and is essentially complete by the end of June (ACOE 2000b). Previous studies of the timing and duration of steelhead downstream migration indicate that they typically move quickly through the lower Columbia River estuary with an average daily movement of about 21 kilometers (ACOE 2000b).

Juvenile steelhead generally spend two years in freshwater before smolting and migrating to the ocean at lengths of about 6 to 8 inches. Most steelhead return to their natal rivers to spawn after spending 15 to 30 months in the ocean. Unlike Pacific salmon, steelhead do not all die soon after spawning, but the rate of survival to repeat spawning is generally low - about 10 percent (Behnke 2002).

3.C.2.5.1. Steelhead-Snake River ESU

The Snake River (SR) steelhead ESU was listed as threatened on August 18, 1997 (62FR43937).

Geographic Boundaries and Spatial Distribution

This inland steelhead ESU occupies the Snake River Basin of southeast Washington, northeast Oregon and Idaho. The Snake River flows through terrain that is warmer and drier on an annual basis than the upper Columbia Basin or other drainages to the north. Geologically, the land forms are older and much more eroded than most other steelhead habitat. Collectively, the environmental factors of the Snake River Basin result in a river that is warmer and more turbid, with higher pH and alkalinity, than is found elsewhere in the range of inland steelhead. In many Snake River tributaries, spawning occurs at a higher elevation (up to 2,000 m) than for steelhead in any other geographic region.

Critical Habitat
The critical habitat for SR steelhead was initially designated on February 16, 2000 (65FR7764), but was withdrawn in April 2002. The initial designated habitat consisted of all river reaches accessible to listed steelhead in the Snake River and its tributaries in Idaho, Oregon, and Washington. Also included were river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to the confluence with the Snake River. Excluded were areas above the Hells Canyon and Dworshak Dams and areas above longstanding, naturally impassable barriers (i.e., Napias Creek Falls and other natural waterfalls in existence for at least several hundred years). The final critical habitat was designated 09/02/05 (70 FR 52630).

Historical Information
The longest consistent indicator of steelhead abundance in the Snake River basin is derived from counts of natural-origin steelhead at the uppermost dam on the lower Snake River. According to these estimates, the abundance of summer steelhead has declined from a 4-year average of 58,300 in 1964 to a 4-year average of 8,300 ending in 1998 (NMFS 2000). In general, steelhead abundance declined sharply in the early 1970's, rebounded moderately from the mid 1970's through the 1980's, and declined again during the 1990's.

Life History
Fish in this ESU are summer steelhead. They enter freshwater from June to October and spawn during the following March to May. Two groups are identified, based on migration timing, ocean-age, and adult size. A-run steelhead, thought to be predominately age-1-ocean, enter freshwater during June through August. B-run steelhead, thought to be age-2-ocean, enter freshwater during August through October. B-run steelhead typically are 75 to 100 mm longer at the same age. Both groups usually smolt as 2- or 3-year-olds (Whitt 1954, BPA 1992, Hassemer 1992). Steelhead are iteroparous, capable of spawning more than once before death.

Habitat and Hydrology
Hydrosystem projects create substantial habitat blockages in this ESU; the major ones are the Hells Canyon Dam complex (mainstem Snake River) and Dworshak Dam (North Fork Clearwater River). Minor blockages are common throughout the region. Steelhead spawning areas have been degraded by overgrazing, as well as by historical gold dredging and sedimentation due to poor land management. Habitat in the Snake basin is warmer and drier and often more eroded than elsewhere in the Columbia River basin or in coastal areas.

Hatchery Influence
Hatchery fish are widespread and stray to spawn naturally throughout the region. In the 1990s, an average of 86 percent of adult steelhead passing Lower Granite Dam were of hatchery origin. Hatchery contribution to naturally spawning populations varies, however, across the region. Hatchery fish dominate some stocks, but do not contribute to others.

Population Trends and Risks
For the SR steelhead ESU as a whole, NMFS (2000) estimates that the median population growth rate (lambda) over a base period from 1990 through 1998 ranges from 0.91 to 0.70, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared to that of fish of wild origin (Tables B-2a and B-2b in McClure et al. 2000b). The main contributor of steelhead in the Columbia River basin is the Snake River. In 2002, the turnout into the Snake River was about 210,000 71 percent of the total counted at McNary Dam (286,805). The 2002 Snake River steelhead count was about twice the 10-year average. The numbers of wild steelhead (non-clipped adipose fin) increased to about an annual average of 55,000 in the Snake River in 2002 (FPC 2003).

3.C.2.5.2. Upper Columbia River Steelhead ESU

The Upper Columbia River (UCR) steelhead ESU was listed as threatened on August 18, 1997 (62FR43937).

Geographic Boundaries and Spatial Distribution
This inland steelhead ESU occupies the Columbia River basin upstream from the Yakima River to the U.S./Canada border. Rivers in the area primarily drain the east slope of the northern Cascade Mountains and include the Wenatchee, Entiat, Methow, and Okanogan River basins.

Critical Habitat
The critical habitat for UCR steelhead was initially designated on February 16, 2000 (65FR7764), but was withdrawn in April 2002. The initial designated habitat consisted of all river reaches accessible to listed steelhead in Columbia River tributaries upstream of the Yakima River, Washington, and downstream of Chief Joseph Dam. Also included were river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to the confluence with the Snake River. Excluded were areas above the Chief Joseph Dam and areas above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years). The final critical habitat was designated 09/02/05 (70 FR 52630).

Historical Information
Estimates of historical (pre-1960s) abundance specific to this ESU are available from fish counts at dams (NMFS 2000). Counts at Rock Island Dam from 1933 to 1959 averaged 2,600 to 3,700, suggesting a pre-fishery run size exceeding 5,000 adults for tributaries above Rock Island Dam (Chapman et al. 1994). Lower Columbia River harvests had already depressed fish stocks during the period these counts were taken, thus, the pre-fishery estimate should be viewed with caution.

Life History
Life history information for this ESU has been summarized by NMFS (2000). Steelhead in the UCR ESU remain in freshwater up to a year before spawning. Smolt age is dominated by 2-year-olds. Based on limited data, steelhead from the Wenatchee and Entiat rivers return to freshwater after 1 year in salt water, whereas Methow River steelhead are primarily age-2-ocean (Howell et al. 1985). Life history characteristics for UCR steelhead are similar to those of other inland steelhead ESUs; however, some of the oldest smolt ages for steelhead, up to 7 years, are reported from this ESU. The relationship between anadromous and non-anadromous forms in the geographic area is unclear.

Habitat and Hydrology

Construction of the Chief Joseph and Grand Coulee dams caused blockages of substantial habitat, as did that of smaller dams on tributary rivers (NMFS 2000). Habitat issues for this ESU relate mostly to irrigation diversions and hydroelectric dams, as well as to degraded riparian and instream habitat from urbanization and livestock grazing.

Hatchery Influence

In an effort to preserve fish runs affected by the construction of the Grand Coulee Dam, which blocked fish passage in 1939, all anadromous fish migrating upstream were trapped at Rock Island Dam (Rkm 729) from 1939 through 1943 and either released to spawn in tributaries between Rock Island and Grand Coulee Dams or spawned in hatcheries and the offspring released in that area (Mullan et al. 1992, Chapman et al. 1994 in: 50 CFR Parts 222 and 227). Through this process, stocks of all anadromous salmonids, including steelhead, which historically were native to several separate sub-basins above Rock Island Dam, were randomly redistributed among tributaries in the Rock Island-Grand Coulee reach. Exactly how this has affected stock composition of steelhead is unknown. Currently, hatchery fish are widespread and escape to spawn naturally throughout the region. Spawning escapement is dominated by hatchery-produced fish.

Population Trends and Risks

Habitat degradation, juvenile and adult mortality in the hydrosystem, and unfavorable environmental conditions in both marine and freshwater habitats have contributed to the declines and represent risk factors for the future. Harvest in lower river fisheries and genetic homogenization from composite broodstock collection are other factors that may contribute significant risk to the UCR steelhead ESU.

NMFS (2000) estimates that the median population growth rate (lambda) over a base period from 1990 through 1998 ranges from 0.94 to 0.66, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared to that of fish of wild origin (Tables B-2a and B-2b in McClure et al. 2000b). In 2002, 15,286 steelhead were counted at Rock Island Dam, compared to the 2001 count of 28,602 and the 10-year average return of 9,165. Of the total steelhead counted at Rock Island Dam in 2002, 10,353 were wild (non-clipped adipose fin) steelhead (FPC 2003).

3.C.2.5.3. Middle Columbia River Steelhead ESU

The Middle Columbia River (MCR) steelhead ESU was listed as threatened on March 25, 1999 (64FR14517).

Geographic Boundaries and Spatial Distribution

The following summary is taken from NMFS (2000). The MCR ESU occupies the Columbia River basin from above the Wind River in Washington and the Hood River in Oregon and continues upstream to include the Yakima River, Washington. The region includes some of the driest areas of the Pacific Northwest, generally receiving less than 40 cm of precipitation annually (Jackson 1993). Summer steelhead are widespread throughout the ESU; winter steelhead occur in Mosier, Chenowith, Mill, and Fifteenmile Creeks, Oregon, and in the Klickitat and White Salmon rivers, Washington. The John Day River probably represents the largest native, natural spawning stock of steelhead in the region.

Critical Habitat

The critical habitat for MCR steelhead was initially designated on February 16, 2000 (65FR7764). The initial designated habitat consisted of all river reaches accessible to listed steelhead in Columbia

River tributaries except the Snake River between Mosier Creek in Oregon and the Yakima River in Washington (inclusive). Also included were river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to the confluence with the Snake River. Excluded were areas above the Condit and Pelton Dams and areas above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years). The final critical habitat was designated 09/02/05 (70 FR 52630).

Historical Information
The following summary is taken from NMFS (2000). Estimates of historical (pre-1960s) abundance specific to this ESU are available for the Yakima River, which has an estimated run size of 100,000 (WDF et al. 1993). Assuming comparable run sizes for other drainage areas in this ESU, the total historical run size may have exceeded 300,000 steelhead.

Life History
Life history information for this ESU has been summarized by NMFS (2000). Most fish in this ESU smolt at 2 years and spend 1 to 2 years in salt water before reentering freshwater, where they may remain up to a year before spawning (Howell et al. 1985, BPA 1992). All steelhead upstream of The Dalles Dam are summer-run (Schreck et al. 1986, Reisenbichler et al. 1992, Chapman et al. 1994). The Klickitat River, however, produces both summer and winter steelhead, and age-2-ocean steelhead dominate the summer steelhead, whereas most other rivers in the region produce about equal numbers of both age-1- and 2-ocean fish. A non-anadromous form co-occurs with the anadromous form in this ESU; information suggests that the two forms may not be isolated reproductively, except where barriers are involved.

Habitat and Hydrology
Habitat degradation due to water diversions and impacts form live stock grazing are issues throughout this ESU.

Hatchery Influence

Total steelhead abundance in the ESU appears to have been increasing recently, but the majority of natural stocks for which we have data within this ESU have been declining, including those in the John Day River, which is the largest producer of wild, natural steelhead. There is concern about the pervasive opportunity for genetic introgression from hatchery stocks within the ESU. There is widespread production of hatchery steelhead within this ESU, but it is largely based on within-basin stocks (NMFS 1996). NMFS (2000) has summarized the influence of hatchery operations on the MCR steelhead ESU. Recent and continued increases in the proportion of stray hatchery steelhead in the Deschutes River basin is a major concern. The ODFW and the Confederated Tribes of the Warm Springs Reservation of Oregon estimate that 60 percent to 80 percent of the naturally spawning population consists of strays. Although the reproductive success of stray hatchery fish has not been evaluated, their numbers are so high that major genetic and ecological effects on natural populations are possible (Busby et al. 1999). The negative effects of any interbreeding between stray and native steelhead will be exacerbated if the stray steelhead originated in geographically distant river basins, especially if the river basins are in different ESUs.

Population Trends and Risks
Current population sizes are substantially lower than historic levels, especially in the rivers with the largest steelhead runs in the ESU, the John Day, Deschutes, and Yakima Rivers. At least two

extinctions of native steelhead runs in the ESU have occurred (the Crooked and Metolius Rivers, both in the Deschutes River Basin). For the MCR steelhead ESU as a whole, NMFS (2000) estimates that the median population growth rate (lambda) over the base period (1990-1998) ranges from 0.88 to 0.75, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared to that of fish of wild origin. In 2002, the count of Bonneville Dam steelhead totaled 481,036 and exceeded all counts recorded at Bonneville Dam since 1938, except the 2001 total which was 633,464. Of the total return in 2002, 143,032 were considered wild steelhead (FPC 2003).

3.C.2.5.4. Lower Columbia River Steelhead ESU

The Lower Columbia River (LCR) steelhead ESU was listed as threatened on March 19, 1998 (63FR13347).

Geographic Boundaries and Spatial Distribution

The following summary is taken from NMFS (2000). The LCR ESU encompasses all steelhead runs in tributaries between the Cowlitz and Wind rivers on the Washington side of the Columbia, and the Willamette and Hood rivers on the Oregon side. The populations of steelhead that make up the LCR steelhead ESU are distinguished from adjacent populations by genetic and habitat characteristics. The ESU consists of summer and winter coastal steelhead runs in the tributaries of the Columbia River as it cuts through the Cascades. These populations are genetically distinct from inland populations (east of the Cascades), as well as from steelhead populations in the upper Willamette basin and coastal runs north and south of the Columbia River mouth. This area has at least 36 distinct runs (Busby et al.1996). In addition, numerous small tributaries have historical reports of fish, but no current abundance data. The major runs in the ESU, for which there are estimates of run size, are the Cowlitz River winter runs, Toutle River winter runs, Kalama River winter and summer runs, Lewis River winter and summer runs, Washougal River winter and summer runs, Wind River summer runs, Clackamas River winter and summer runs, Sandy River winter and summer runs, and Hood River winter and summer runs.

Critical Habitat

The critical habitat for LCR steelhead was designated on February 16, 2000 (65FR7764). The initial designated habitat consisted of all river reaches accessible to listed steelhead in Columbia River tributaries between the Cowlitz and Wind Rivers in Washington and the Willamette and Hood Rivers ion Oregon, inclusive. Also included were river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to the Hood River. Excluded were areas above the Bull Run 2 and Merwin Dams and areas above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years). The final critical habitat was designated 09/02/05 (70 FR 52630).

Historical Information

All runs in the LCR steelhead ESU have declined over the past 20 years, with sharp declines in the last 5 years. Historic counts in some of the larger tributaries (Cowlitz, Kalama, and Sandy rivers) probably exceeded 20,000 fish; more recent counts have been in the range of one to 2,000 fish (NMFS 2000).

Habitat and Hydrology

This section is from NMFS (2000). Steelhead in this ESU are thought to use estuarine habitats extensively during outmigration, smoltification, and upstream spawning migrations. The lower reaches of the Columbia River are highly modified by urbanization and dredging for navigation. The upland areas covered by this ESU are extensively logged, affecting water quality in the smaller streams used primarily by summer runs. In addition, all major tributaries used by LCR steelhead have some form of hydraulic barrier that impedes fish passage. Barriers range from impassible structures in the Sandy River basin that block access to extensive, historically occupied, steelhead habitat, to passable but disruptive projects on the Cowlitz and Lewis rivers.

Hatchery Influence
NMFS (2000) has summarized the influence of hatchery operations on the LCR steelhead ESU. Many populations of steelhead in the Lower Columbia River ESU are dominated by hatchery escapement. Roughly 500,000 hatchery-raised steelhead are released into drainages within this ESU each year. As a result, first-generation hatchery fish are thought to make up 50 percent to 80 percent of the fish counted on natural spawning grounds. The effect of hatchery fish is not uniform, however. Several runs are mostly hatchery strays (e.g., the winter run in the Cowlitz River [92 percent] and the Kalama River [77 percent] and the summer run in the North Fork Washougal River [50 percent]), whereas others are almost free of hatchery influence (the summer run in the mainstem Washougal River [0 percent] and the winter runs in the North Fork Toutle and Wind rivers [0 percent to 1 percent]).

Population Trends and Risks
Habitat loss, hatchery steelhead introgression, and harvest are the major contributors to the decline of steelhead in this ESU. For the LCR steelhead ESU, NMFS (2000) estimates that the median population growth rate over the base period (1990-1998) ranges from 0.98 to 0.78, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared to that of fish of wild origin.

3.C.2.5.5. Puget Sound Steelhead ESU

The Puget Sound steelhead ESU was found to not warrant listing on August 9, 1996. On March 29, 2006 in response to a petition, NOAA Fisheries Service announced that it was proposing to list this Distinct Population Segment (DPS) as "threatened”. The following summary is taken from NMFS (2005).

Geographic Boundaries and Spatial Distribution
The Puget Sound steelhead DPS includes all naturally spawned anadromous winter-run and summer-run *O. mykiss* (steelhead) populations in streams of the Strait of Juan de Fuca, Puget Sound, and Hood Canal, basins. This area is bounded to the west by the Elwha River (inclusive) and to the north by the Nooksack River and Dakota Creek (inclusive), as well as the Green River natural and Hamma Hamma winter-run steelhead hatchery stocks.

Critical Habitat
The Puget Sound steelhead DPS is currently proposed for listing and no critical habitat has been proposed or assigned.

Historical Information
The analysis of catch records from 1889 indicate a catch peak of 163,796 steelhead in 1895. Using

estimates of harvest rate of 30-50%, the estimated peak run size ranged from 327,592-545,987 steelhead for the Puget Sound at that time. A survey of the Puget Sound in 1929 and 1930 identified steelhead in every major basin except the Deschutes River. By the late 1920s, steelhead abundance had already undergone significant declines and many marginal or ephemeral populations may have already disappeared. Steelhead were a target species for harvest as the winter run occurred during the months of the year when salmon fisheries were at seasonal lows. By 1898, the Washington State Fish Commissioner considered Puget Sound Steelhead to be "greatly depreciated" and catches continued to decline from 1900 through the 1920s. In 1925, steelhead were classified by Washington State as a sportfish and in 1932 the State prohibited the commercial catch of steelhead. All further run-size estimates were based on sportfish catch records and spawning surveys.

In the 1980s, the Puget Sound steelhead run size was estimated as 100,000 winter-run and 20,000 summer-run. In the 1990s, the total run size for major stocks in this ESU was greater than 45,000 with natural escapement estimates of 22,000 steelhead.

Habitat and Hydrology

Habitat utilization by steelhead has been most dramatically affected by a number of large dams in Puget Sound basins. Besides eliminating access to habitat, dams affect habitat quality by changing river hydrology, temperature profiles, gravel recruitment, and large woody debris movement and stability. Urban development and suburbanization have resulted in the loss of historical land cover, often replacing it with imperious surface. Combined with loss of wetland/riparian habitat, hydrology of many urban streams has changed dramatically. Flood frequency and peak flow during storm events has increased and groundwater derived summer flows have decreased. Land development for agriculture has also altered historical land cover. Because much of this type of development took place in river floodplains, direct impacts to river morphology have resulted. Diking, riprapping of banks, and channelization have resulted in river constriction which increases gravel scour, decreases habitat complexity, and alters amplitude of high flow events.

Hatchery Influence

Releases of hatchery propagated steelhead into Puget Sound waters began in the 1900s and by the 1940s, extensive hatchery rearing programs were developed. Hatchery fish were widespread, spawning naturally throughout the region, and were largely derived from a single stock (Chambers Creek). In the 1980s, the hatchery portion of the population based on ocean catches was 70%. Over the last two decades, release levels of hatchery steelhead have remained relatively constant. Hatchery –produced winter steelhead have been released in nearly every basin in the ESU, except for the Cedar River and some smaller tributaries.

The risk posed by artificial production programs to natural production in the Puget Sound steelhead ESU is not clear as definitive information is not available. However, the genetic and life-history relationships between the Chambers Creek Hatchery and Skamania Hatchery and the naturally-spawning populations indicate that these hatchery effects could be substantially detrimental.

Population Trends and Risks

NMFS concluded that the Puget Sound steelhead DPS is not presently in danger of extinction, nor is it likely to become endangered in the foreseeable future. Despite this conclusion, NMFS has several concerns about the overall health of this DPS and about the status of certain stocks within the DPS. Recent trends in stock abundance are predominantly downward, although this may be largely due to recent climate conditions. Trends in the two largest stocks (Skagit and Snohomish rivers) have been upward. The status of certain stocks within the DPS is also of concern, especially the depressed status of most stocks in the Hood Canal area and the steep declines of Lake Washington winter steelhead and Deer Creek summer steelhead. Habitat loss, hatchery steelhead introgression, and harvest are the major contributors to the decline of steelhead in this ESU.

3.C.2.6. Bull trout

The bull trout (Salvelinus confluentus)is a member of the char family (*Salvelinus*) and is represented by different life history forms, including river-resident populations, lacustrine populations, and sea-run populations. The latter appear to be relatively rare (Behnke 2002).

The stream-resident form is subdivided into two basic types: one lives its entire life in small headwater streams, often isolated above waterfalls; the other typically spawns in smaller tributary streams but spends most of its time foraging in larger rivers. This second form, often called “fluvial,” occurs only in relatively larger river basins that contain a network of headwater spawning tributaries connected to larger riverine habitat, allowing bull trout to undertake movements of more than 100 miles (Behnke 2002).

The northernmost distribution of bull trout occurs in the headwaters of the Yukon and Mackenzie River basins of Alaska and Canada. In Pacific Coast drainages, they occur in rivers of British Columbia southward to around Puget Sound. Bull trout are not native to Vancouver Island or other islands off the Pacific Coast of and Canada and southern Alaska. Native distribution includes the upper parts of the North and South Saskatchewan River drainages of Alberta, Canada (Behnke 2002).

To the south, a few bull trout populations persist in cold headwater tributary streams in the Upper Klamath Lake basin of Oregon. The southernmost population of bull trout once occurred in the McCloud River of California. However, those bull trout declined rapidly in the 1940s after construction of Shasta Dam (Behnke 2002).

Typically, species are listed throughout their entire range or, coterminously (i.e. in the lower 48 states). To allow more flexibility, especially for a wide-ranging species such as the bull trout, the Service has a policy which allows listing of a distinct population segment of that species' range, rather than its entire range**.** A distinct population segment is a discrete population that is identified as significant based on one or more of three criteria. The bull trout was initially listed as three separate Distinct Population Units (DPSs) (63 FR 31647, 64 FR 17110). Eventually, the FWS identified five distinct population segments: Coastal-Puget Sound; St. Mary-Belly River; Columbia River; Klamath River; and Jarbidge River. The listing of the St. Mary-Belly and Coastal-Puget Sound populations completes the listing of all five populations of bull trout in the United States, resulting in a coterminous listing. Now that all five population segments are listed, the FWS decided to list the species conterminously to avoid any possible confusion about which of these populations is listed. The final listing rule for the United States coterminous population of the bull trout discusses the consolidation of these DPSs, plus two other population segments, into one listed taxon and the application of the jeopardy standard under section 7 of the ESA relative to this species (64 FR 58930). However, they retain recognition of the population segments as **interim recovery units** to more effectively manage and recover this species. Because each population faces different challenges, the FWS will manage each separately based on the conservation needs of the individual population. The terminology of DPS has been retained for this discussion.

3.C.2.6.1. Bull Trout - Columbia Basin ESU

The Columbia River (CR) bull trout DPSs were listed as threatened on June 10, 1998 (62FR32268). The following information on bull trout was taken from 63 FR 31647-31674 and USFWS 2002a).

Geographic Boundaries and Spatial Distribution

The Columbia River population segment is from the northwestern United States and British Columbia, Canada. This population segment is comprised of 386 bull trout populations in Idaho, Montana, Oregon, and Washington with additional populations in British Columbia. The Columbia River population segment includes the entire Columbia River basin and all its tributaries, excluding the isolated bull trout populations found in the Jarbridge River in Nevada. Bull trout populations within the Columbia River population segment have declined from historic levels and are generally considered to be isolated and remnant.

Critical Habitat

Critical habitat has been designated for Columbia River Basin Population of bull trout effective 10/26/05 (70 FR56212).

Bull trout are seldom found in waters where temperatures are warmer than 15°C to 17.8°C. Besides very cold water, bull trout require stable stream channels, clean spawning gravel, complex and diverse cover, and unblocked migration routes (USFWS 2002a). Because bull trout life history patterns include migratory and resident forms, both adults and juveniles are present in the streams throughout the year. Bull trout adults may begin to migrate from feeding to spawning grounds in the spring and migrate slowly throughout the summer (Pratt 1992). Spawning usually begins in the fall. Bull trout eggs incubate from 100 to 145 days, after which the alevins require 65 to 90 days to absorb their yolk sacs (Pratt 1992). They remain within the interstices of the streambed as fry for up to three weeks before filling their air bladder, reaching lengths of 25-28 mm, and emerging from the streambed in late April (McPhail and Murray 1979, Pratt 1992).

3.C.2.6.2. Bull Trout - Coastal/Puget Sound ESU

The coastal Puget Sound (PS) bull trout DPS encompasses all Pacific coast drainages within Washington, including Puget Sound (50 FR Part 17).

Geographic Boundaries and Spatial Distribution

The coastal Puget Sound bull trout DPS encompasses all the Pacific coast drainages north of the Columbia River in Washington including those flowing into Puget Sound. This population is comprised of 34 populations which are segregated from other subpopulations by the Pacific Ocean and the Cascade Mountains. The Puget Sound DPS population segment is significant because it is thought to contain the only anadromous forms of bull trout in the coterminous United States (64 FR 58910). The Puget Sound bull trout DPS, occurs in the following river basins: Chehalis River, Grays Harbor, Quinault River, Queets River, Hoh River, and Quillayute River. While most of the northwest coast subpopulations occur within Olympic National Park with relatively undisturbed habitats, subpopulations in the southwestern coastal area are in relatively low abundance.

Another native char that co-occurs with bull trout in this ESU is the Dolly Varden (Salvelinus malma). Dolly Varden are a coastal species and are often anadromous. In Washington, Dolly Varden occur as far north as the Nooksack basin and as far south as the Quinault River. They occur in Lake

Washington and the Puget Sound as well (Wydoski and Whitney 2003). Dolly Varden are very similar in appearance to bull trout in both coloration and form. A count of the branchiostegal rays is the best morphometric to distinguishing between these two species. Because these species are virtually indistinguishable, USFW currently manages them together as "native char".

Critical Habitat

Critical habitat has been designated for coastal-Puget Sound bull trout population effective 10/26/05 (70 FR56212). The scope of the designation involved the Klamath River, Columbia River, Coastal-Puget Sound, and St. Mary-Belly River population segments (also considered as interim recovery units). Range-wide, the FWS designated 143,218 acres of reservoirs or lakes and 4,813 stream or shoreline as bull trout critical habitat.

In Washington State 33, 353 acres are included in this designation covering 1,519 miles of freshwater stream/shoreline and 985 miles of marine shoreline (FWS FP HCP BiOp). Although critical habitat has been designated across a wide area, some critical habitat segments were excluded in the final designation based on a careful balancing of the benefits of inclusion versus the benefits of exclusion (see Section 3(5)(A) and Exclusions under Section 4(b)(2) in the final rule). This balancing process resulted in all proposed critical habitat being excluded in 9 proposed critical habitat units: Unit 7 (Odell Lake), Unit 8 (John Day River Basin), Unit 15 (Clearwater River Basin), Unit 16 (Salmon River Basin), Unit 17 (Southwest Idaho River Basins), Unit 18 (Little Lost River), Unit 21 (Upper Columbia River), Unit 24 (Columbia River), and Unit 26 (Jarbidge River Basin). The remaining 20 proposed critical habitat units were designated in the final rule. It is important to note that the exclusion of waterbodies from designated critical habitat does not negate or diminish their importance for bull trout conservation.

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

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

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

The Olympic Peninsula and Puget Sound Critical Habitat Units are essential to the conservation of amphidromous bull trout, which are unique to the Coastal-Puget Sound bull trout population. These critical habitat units contain 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 sub-adult overwintering, migration, and foraging.

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, and sheltering. Note that only the PCEs described in paragraphs (1), (2), (3), and (4) apply to marine nearshore waters identified as critical habitat; and all except PCE (3) apply to foraging, migration, and overwintering habitat identified as critical habitat.

The PCEs are as follows:

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

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

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

4. A natural hydrograph, including peak, high, low, and base flows within historic ranges or, if regulated, currently operate under a biological opinion that addresses bull trout, or a hydrograph that demonstrates the ability to support bull trout populations by minimizing daily and day-to-day fluctuations and minimizing departures from the natural cycle of flow levels corresponding with seasonal variation. This rule finds that reservoirs currently operating under a biological opinion that addresses bull trout provides management for PCEs as currently operated;

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

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

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

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

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

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

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

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

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

Historical Information

Bull trout are native throughout the Pacific Northwest. In Washington, bull trout were historically found in the Willamette River and major tributaries on the west side of the Oregon Cascades, the Columbia and Snake Rivers and major tributaries east of the Cascades, and in streams of the Klamath basin. Currently, most bull trout populations are confined to headwater areas of tributaries to the Columbia, Snake, and Klamath rivers.

Historically, sport fishing regulations were liberal for bull trout. However, recent decline of fish abundance has led to more restrictive regulations (WDFW 2003).

Life History

Small bull trout eat terrestrial and aquatic insects but shift to preying on other fish as they grow larger. Large bull trout are primarily fish predators. Bull trout evolved with whitefish, sculpins, and other salmonid species and use all of them as food sources. Adult bull trout can grow to 36 inches in length and up to 32 pounds. Bull trout reach sexual maturity at between four and seven years of age and are known to live as long as 12 years. They spawn in the fall, after temperatures drop below 9°C, in streams with abundant cold, unpolluted water, clean gravel and cobble substrate, and gentle stream slopes. Many spawning areas are associated with cold water springs or areas where stream flow is influenced by groundwater. Bull trout eggs require a long incubation period compared to other salmon and trout, hatching in late winter or early spring. Fry may remain in the stream gravels for up to three weeks before emerging (USFWS 2002a).

Bull trout may be either resident or migratory. Resident fish live their entire life near areas where they were spawned. Bull trout with a fluvial/adfluvial life history are usually spawned in small headwater streams, and then migrate to larger streams, rivers, lakes, reservoirs or salt water where they grow to maturity. These larger, migratory fish will move considerable distances to spawn when habitat conditions allow. For instance, bull trout in Montana's Flathead Lake have been known to migrate up to 250 km to spawn (USFWS 2002a).

Habitat and Hydrology

Bull trout are seldom found in waters where temperatures are warmer than 15°C to 18°C. Besides very cold water, bull trout require stable stream channels, clean spawning gravel, complex and diverse cover, and unblocked migration routes (USFWS 2002a).

Hatchery Influence

No information was found on the direct influence of pressure from hatchery production on bull trout as is common with salmon. However, hatchery-stocked rainbow trout combined with large catch limits, use of bait, and easy public access to mainstem and tributaries has generated high angling pressures that have probably negatively affected bull trout in some areas.

Population Trends and Risks

Bull trout are vulnerable to many of the same threats that have reduced salmon populations. Due to their need for very cold waters and long incubation time, bull trout are more sensitive to increased water temperatures, poor water quality and degraded stream habitat than many other salmonids. Further threats to bull trout include hybridization and competition with non-native brook trout, brown trout and lake trout, over fishing, poaching, and man-made structures that block migration (USFWS 2002a).

Throughout its range, the bull trout is threatened by the combined effects of habitat degradation, fragmentation and alterations associated with: dewatering, road construction and maintenance, mining, and 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). Poaching and incidental mortality of bull trout during other targeted fisheries are additional threats.

In many areas, continued survival of the species is threatened by a combination of factors rather than one major problem. For example, past and continuing land management activities have degraded stream habitat, especially along larger river systems and streams located in valley bottoms. Degraded conditions have severely reduced or eliminated migratory bull trout as water temperature, stream flow and other water quality parameters fall below the range of conditions which these fish can tolerate. In many watersheds, remaining bull trout are smaller, resident fish isolated in headwater streams. Brook trout, introduced throughout much of the range of bull trout, easily hybridize with them, producing sterile offspring. Brook trout also reproduce earlier and at a higher rate than bull trout so bull trout populations are often supplanted by these non-natives. Dams and other in-stream structures also affect bull trout by blocking migration routes, altering water temperatures and killing fish as they pass through and over dams or are trapped in irrigation and other diversion structures (USFWS 2002a).

3.C.3. Marine mammals

Two marine mammal species, the Steller sea lion and humpback whale, could potentially occur in the marine waters of the State of Washington, although their frequency of occurrence in state waters is likely very low. Life history, status, and other pertinent information for these species is presented in this section.

3.C.3.1. Steller sea lion

Status

The Steller sea lion was listed as a threatened species under emergency role by NMFS in April 1990; final listing for the species became effective in December 1990.

Geographic Range and Spatial Distribution

Steller sea lions are polygamous and use traditional territorial sites for breeding and resting. Breeding sites, also known as rookeries, occur on both sides of the north Pacific, but the Gulf of Alaska and Aleutian Islands contain most of the large rookeries. Adults congregate for purposes other than breeding in areas known as haulouts (USEPA ,2002b). In 1997, NMFS classified Steller sea lions into two distinct population segments divided by the 144°W latitude. The eastern population segment occupies habitat including southeastern Alaska and Admiralty Island. Currently, NMFS has classified the western population segment as endangered, while classifying the eastern population segment as threatened (62FR24345). Although the Steller sea lion population has declined steadily for the last 30 years, scientists have yet to identify the cause of the decline (USEPA 2002b).

Steller sea lions may be observed in Puget Sound year-round, but they are most abundant during the fall and winter months. Three major haulout areas exist on the Washington outer coast and one major haulout area is located at the Columbia River south jetty.

No breeding rookeries have been identified in Washington waters (NMFS 1992).

Critical Habitat

Steller sea lion critical habitat has been designated in Alaska, California, and Oregon and includes a 20-nautical-mile buffer around all major haulouts and rookeries, as well as associated terrestrial, air, and aquatic zones, and three large offshore foraging areas. No critical habitat has been designated in Washington.

Life History

Steller sea lion habitat includes both marine and terrestrial areas that are used for a variety of purposes. Terrestrial areas (e.g., beaches) are used as rookeries for pupping and breeding. Rookeries usually occur on beaches with substrates that include sand, gravel, cobble, boulder, and bedrock (NMFS 1992). Haul-out areas are used other than during the breeding and pupping season. Sites used as rookeries may be used as haul-out areas during other times of the year. When Steller sea lions are not using rookery or haul-out areas, they occur in nearshore waters and out over the continental shelf. Some individuals may enter rivers in pursuit of prey (Jameson and Kenyon 1977).

Steller sea lions are opportunistic feeders and consume a variety of fishes such as flatfish cod, and rockfish; and invertebrates such as squid and octopus. Demersal and off-bottom schooling fishes predominate (Jones 1981). Steller sea lions along the coasts of Oregon and California have eaten rockfish, bake, flatfish, cusk-eel, squid, and octopus (Fiscus and Baines 1966, Jones 1981, Treacy 1985); rockfish and hake are considered to be consistently important prey items (NMFS 1992). Feeding on lamprey in estuaries and river mouths has also been documented at sites in Oregon and California (Jones 1981, Treacy 1985). Spalding (1964) and Otesiku et al. (1990) have documented Steller sea lions feeding on salmon, but they are not considered to be a major prey item (Osborne 1988).

The breeding range of Steller sea lions extends from southern California to the Bearing Sea (Osborne 1988). Breeding colonies consisting of small numbers of sea lions also exist on the outer coasts of Oregon and British Columbia. There are currently no breeding colonies in Washington state (NMFS 1992), although three major haul-out areas exist on the Washington outer coast and one major haul-out area is located at the Columbia River south jetty (NMFS 1992). Jagged Island and Spit Rock are used as summer haul-outs, and Umatilla Reef is used during the winter (National Marine Mammal Laboratory, unpublished data). Other rocks, reefs, and beaches as well as floating docks, navigational aids, jetties, and breakwaters are also used as haul-out areas (NMFS 1992).

Population Trends and Risks

The worldwide Steller sea lion population is estimated at just under 200,000, with the majority occurring in Alaska. The range of the Steller sea lion extends around the North Pacific Ocean rim from northern Japan, the Kuril Islands and Okhotsk Sea, through the Aleutian Islands and Bering Sea, along Alaska's southern coast, and south to California (Kenyon and Rice 1961, Loughlin et al. 1984).

Responses to various types of human-induced disturbances have not been specifically studied. Close approach by humans, boats, or aircraft will cause hauled-out sea lions to go into the water. Disturbances that cause stampeeds on rookeries may cause trampling and abandonment of pups (Lewis 1987). Areas subjected to repeated disturbance may be permanently abandoned (Kenyon 1962), and/or the repeated disturbance may negatively affect the condition or survival of pups through interruption of normal nursing cycles. Low levels of occasional disturbance may have little long-term effect (NMFS 1992).

3.C.3.2. Humpback whale

Status

Humpback whales are listed as endangered throughout their entire range under the Endangered Species act on June 2, 1970 (35 FR 8491).

Geographic Boundaries and Spatial Distribution

Surveys indicate that humpbacks occupy habitats around the world, with three major distinct populations: the north Atlantic, the north Pacific, and the southern oceans. These three populations do not interbreed. Humpbacks generally feed for 6-9 months of the year on their feeding grounds in Arctic and Antarctic waters. The animals then fast and live off their fat layer for the winter period while on the tropical breeding grounds (USEPA 2002b). The north Pacific herd of humpback whales that typically occupies southeastern Alaska waters also migrates to Hawaii and Mexico in the winter months for breeding. Humpback whales in the North Pacific are seasonal migrants feeding on zooplankton, and small schooling fish in coastal waters off he coastal waters of the western United States, Canada (NMFS 2002).

Humpback whales are not expected to be routinely present in Washington waters.

Critical Habitat
There is no designated critical habitat for the humpback whale.

Historical Information
Whaling took large numbers of humpbacks from the late 1800s through the early 20th century. Even though the International Whaling Commission provided protection to the species in the early 1960s, the Soviet Union has recently revealed massive illegal and unreported kills that occurred up until 1970 in the southern oceans.

Population Trends and Risks
The humpback whale population is listed as "depleted" under the Marine Mammal Protection Act. As a result, the Central North Pacific population of humpback whale is classified as a strategic stock. The Central North Pacific population has increased in abundance between the early 1980s and early 1990s; but the status of this population relative to its optimum sustainable population size is unknown (NMFS 2002).

The largest threats to their survival include entanglements in fishing gear, collisions with ship traffic, and pollution of their coastal habitat from human settlements (USEPA 2002b).

3.C.3.3. Killer whale

Status
NOAA Fisheries Service received a petition in 2001 to list Killer Whales under the Endangered Species Act. In May 2003 the species was determined to be depleted under the Marine Mammal Protection Act which began the process to identify site specific measures to address the potential factors for decline. The proposal to list the Southern Resident killer whale distinct population segment (DPS) as threatened was announced December 16, 2004. The final listing of this DPS as Endangered was November 18, 2005 (70 FR 69903).

Life History
Killer whales grow to considerable size. The males can reach lengths of 25 feet or more and weigh 5 tons, Females are typically a little smaller. This species ranges world wide including the Atlantic Ocean as far north as Iceland south to Antarctica.

Killer whales are primarily piscivores. Based on a study that included both Northern and Southern DPS whales, salmon were found to represent over 96 % of the prey during summer and fall. Chinook salmon were the preferred prey species comprising 70% of the species taken despite the relatively low abundance of Chinook in these areas compared to other species. Chum salmon were consumed extensively in the fall. Other prey species of Southern Resident killer whales include flatfish, lingcod, greenling, and squid.

Geographic Boundaries and Spatial Distribution

Resident killer whales in U.S. waters are distributed from Alaska to California, with four distinct communities recognized: Southern, Northern, Southern Alaska, and Western Alaska. The Southern Resident DPS consists of three pods named J, K, and L. These pods reside for part of the year in the inland waterways of Washington State and British Columbia (Strait of Georgia, Strait of Juan de Fuca, and Puget Sound), principally during late spring, summer, and fall. Pods visit coastal sites off Washington and Vancouver Island. Offshore movements and distribution are largely unknown for this DPS.

Critical Habitat

Critical habitat was proposed for the Southern Resident DPS of killer whales on 06/15/06 (50 FR 34571) and the final Critical habitat Rule was issued 11/29/06 (50 CFR Part 226). Three specific areas are designation: the summer core area in Haro Strait and waters around the San Juan Islands; Puget Sound; and the Strait of Juan de Fuca, spanning a total of 2560 sq. mi. Excluded are 18 military sites for national security purposes, comprising approx. 112 sq. mi.

Population Trends and Risks

Based on information collected mainly in summer seasons, the number of Southern Resident killer whales has never been large, numbering between 100 and 200 prior to 1960. Annual censuses of this DPS began in 1973. At that time live captures of these whales for the marine parks, reduced their numbers to fewer than 70 animals. All three of the pods were affected by this activity.

There are large differences in the survival rates of Southern Residents among different age and sex categories. Reproductive age females had the highest survival rate, followed by juveniles, post-reproductive age females, and young males. Calves and old males had the lowest survival rates.

The Southern Resident population has fluctuated considerably over the 30 years that it's been studied. In 1974 it comprised 71 whales, peaked at 97 animals in 1996, and then declined to 79 in 2001. The population now numbers in the high 80s. The most recent census in 2003 counted 83 whales, representing an overall annual increase of 0.4% per year. Based on the maximum recorded population size of 97 animals in 1996, the Southern Resident killer whale population declined by 2% per year between 1996 and 2003. NOAA has various models to estimate the extinction risk for this DPS (Krahn et al. 2004). Using the more pessimistic model based on population survival for the last 10 years there is a risk of quasi-extinction (the level of population size at which the population would be ‘doomed’ to extinction) of 39-67% in 100 years and 76-98% in 300 years.

The Southern Resident population is at risk for both incremental small-scale impacts over time (e.g. reduced fecundity or subadult survivorship) or to major catastrophe (e.g. oil spill or disease outbreak). The small size of this DPS makes it potentially vulnerable to allele effects (e.g. inbreeding depression) that could cause decline.

There are limited numbers of reproductive-age Southern Resident males and several females of reproductive age are not having calves. The factors causing the decline of Southern Residents are not well known. Some of the possible causes of decline are: reduced quantity and quality of prey; persistent pollutants that could cause immune or reproductive system dysfunction; oil spills; and noise and disturbance from vessels.

4.0 Environmental Baseline

The purpose of this section is to identify "the past and present effects of all Federal, State, or private activities in the Action Area, the anticipated effects of all proposed Federal projects in the Action Area that have already undergone formal or early section 7 consultation, and the effect of State or private actions which are contemporaneous with the consultation process"(50 CFR 402.02, definition of "effects of the action"). These factors affect the species' environment or critical habitat in the Action Area. The factors are described in relation to species' biological requirements in the Action Area.

4.A. 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). USEPA's action, for the Water Quality Standards approval for the State of Washington affects all waters within the state boundaries that are used by ESA-listed species. Water Quality Standards apply to all surface waters of the state, which includes all lakes, bays, ponds, impounding reservoirs, springs, rivers, streams, creeks, estuaries, marshes, inlets, canals, the Pacific Ocean within the territorial limits of the State of Washington, and all other bodies of surface water, natural or artificial, inland or coastal, fresh or salt, public or private (except those private waters which do not combine or affect a junction with natural surface or underground waters), which are wholly or partially within or bordering the state or within its jurisdiction. EPA's approval action does not apply to, and thus the Action Area does not include, any waters within Native American Country (reservations). The Washington State Department of Ecology (Ecology) reports that there are approximately 71,430 miles of streams in Washington and over 2,900 square miles of estuaries (Ecology 2002). No information was found on the total area of lakes or open ocean areas in Washington.

4.B. Biological Requirements in the Action Area

The biological requirements of the Action Area related to listed species are those physical or biological features that are essential to conservation of the species. An accurate description of these features is best derived from the NMFS-FWS regulations for listed species and designated critical habitat which states that the agencies must consider those physical and biological features that are essential to the conservation of a given species (FR vol.71, no.229, 69060). These features are called Primary Constituent Elements are described by NMFS-FWS for each listed fish species. The requirements related to PCEs include: 1) space for growth and normal behavior; 2) food, water, air, light necessary for physiological requirements; 3) cover/shelter; 4) sites for breeding, reproduction, and rearing; 5) habitats that are protected from disturbance or represent ecological distribution of species.

The PCEs for listed salmon species are similar among species and NMFS lists the same ones for the 12 ESU of west coast salmon and steelhead in Washington, Idaho, and Oregon (70 FR 52630 vol. 70 No. 170). The six PCEs for salmon are: 1) freshwater spawning sites with water quantity and quality conditions and substrate to support spawning, incubation, and larval development, 2) Freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions; water quality and forage, and natural cover such as shade, large wood, side channels all necessary for juveniles to forage, grow and develop behaviors for survival; 3) freshwater migration corridors free of obstruction with water quantity and quality conditions and natural cover to support juvenile and adult mobility and survival; 4) estuarine areas free of obstructions with water quantity and quality and salinity to support both adult and juvenile physiological transition between fresh and salt water environments, cover, and forage;5) nearshore marine areas free of obstruction with water quality and quantity conditions, forage, and cover; 6) Off shore marine areas with water quality conditions and forage.

The PCEs For bull trout are: those necessary for spawning and rearing life stages are permanently flowing, cold, upwelling groundwater with suitable spawning substrate and complex rearing habitat. Those necessary for migration are deep holding pools and a forage base to support large adult bull trout (FR vol. 70, no. 185 pg 56214).

For the listed bird species essential features include cover/shelter in proximity to food resources, food and water, space, adequate migration conditions, roosting and nesting habitat in the form of quality and quantity of tree canopy, multi-layered canopies and large diameter old-growth trees in low-elevation forest (marbled murrelet FR vol.61 no. 102 pg. 26256).

For the killer whale, the PCEs are: 1) water quality to support growth and development, 2) sufficient quality and quantity of prey species, 3) sound levels that do not exceed thresholds that inhibit communication, 4) passage conditions to support migration and foraging (FR vol.71,No. 115 pg 34573).

For Steller sea lion the habitat requirements are breeding rookeries, haulout sites, feeding areas, and nutritional requirements. Also terrestrial habitats adjacent to rookeries are important . FR (55 FR 49204).

4.C. Description of Habitat Features that may be Affected by the Proposed Action

The EPA actions that are addressed in this BE are relevant only to the water quality aspect of habitat of freshwater waterbodies, specifically, water temperature and dissolved oxygen. Although limited in scope, water temperature and dissolved oxygen are extremely important features of habitat for aquatic organisms. These water quality characteristics are important to physiology and behavior at all life history phases of fish including freshwater spawning, freshwater rearing, freshwater migration and staging and rearing in estuarine areas. Also, these water quality characteristics are also important to forage species. Alteration of water temperature and dissolved oxygen that may result from EPA's approval of the Washington State water quality standards will not directly affect other physical habitat features such as space or cover. However, restoration or management alterations that result from the implementation of these water quality standards could influence other aspects of habitat in a positive way. For example, a common restoration method to decrease stream temperatures is to increase shade to the channel by increasing the amount of riparian vegetation. Besides, shading the stream channel, riparian vegetation can provide cover and stabilize stream banks. Both of which can benefit physical habitat quality for fish. Likewise, increase in mature riparian vegetation through time would result in the recruitment of more large woody debris to stream channels, which would further increase habitat complexity for fish.

4.D. Description of Environmental Baseline

The environmental baseline is a description of the factors affecting the environment of the species or critical habitat in the action area. As stated previously, USEPA's proposed approval of Washington's Water Quality Standards affects all waters within the state boundaries that are used by ESA-listed species (see section 2.D. Action Area Description). Therefore, the baseline includes current condition for all listed endangered and threatened species. The status of each species and the factors affecting are described by the National Marine Fisheries Service in their ESU Status Review, ESA Critical Habitat Listing, and the Draft or Final Recovery Plans for each salmon species (http://www.nwr.noaa.gov/ESA-Salmon-Regulations-Permits/index.cfm). For bull trout the above information can be found at The U.S. Fish and Wildlife Service web site at http://www.fws.gov/pacific.

In general, endangered and threatened species have been listed because of their habitat has been significantly degraded from human activities. Human changes to the landscape have magnified the degree of river warming, which adversely affects salmonids and reduces the number of river segments that are thermally suitable for salmonids. Human activities can increase water temperatures by increasing the heat load into the river, by reducing the river's capacity to absorb heat, and by eliminating or reducing the amount of groundwater flow which moderates temperatures and provides cold water refugia. Specific ways in which human development has caused excess warming of rivers are summarized below:

1) Removal of streamside vegetation reduces the amount of shade that blocks solar radiation and increases solar heating of streams. Examples of human activities that reduce shade include forest harvesting, agricultural land clearing, livestock grazing, and urban development.

2) Removal of streamside vegetation also reduces bank stability, thereby causing bank erosion and increased sediment loading into the stream. Bank erosion and increased sedimentation results in wider and shallower streams, which increases the stream's heat load by increasing the surface area subject to solar radiation and heat exchange with the air.

3) Water withdrawals from rivers for purposes such as agricultural irrigation and urban/municipal and industrial use result in less river volume and generally remove cold water. The temperatures of rivers with smaller volumes equilibrate faster to surrounding air temperature, which leads to higher maximum water temperatures in the summer.

4) Water discharges from industrial facilities, wastewater treatment facilities and irrigation return flows can add heat to rivers.

5) Channeling, straightening, or diking rivers for flood control and urban and agricultural land development reduces or eliminates cool groundwater flow into a river that moderates summertime river temperatures. These human actions can reduce two forms of groundwater flow. One form is groundwater that is created during over-bank flooding and is slowly returned to the main river channel to cool the water in the summer. A 7 second form is water that is exchanged between the river and the riverbed (i.e. hyporheic flow). Hyporheic flow is plentiful in fully functioning alluvial rivers systems.

6) Removal of upland vegetation and the creation of impervious surfaces associated with urban development increases storm runoff and reduces the amount of groundwater that is stored in the watershed and slowly filters back to the stream in the summer to cool water temperatures.

7) Dams and their reservoirs can affect thermal patterns in a number of ways. They can increase maximum temperatures by holding waters in reservoirs to warm, especially in shallow areas near shore. Reservoirs, due to their increased volume of water, are more resistant to temperature change which results in reduced diurnal temperature variation and prolonged periods of warm water. For example, dams can delay the natural cooling that takes place in the late summer-early fall, thereby harming late summer-fall migration runs. Reservoirs also inundate alluvial river segments, thereby diminishing the groundwater exchange between the river and the riverbed (i.e., hyporheic flow) that cools the river and provides cold water refugia during the summer. Further, dams can significantly reduce the river flow rate, thereby causing juvenile migrants to be exposed to high temperatures for a much longer time than they would under a natural flow regime. It should also be noted that some human development can create water temperatures colder than an unaltered river. The most significant example of this occurs when cold water is released from the bottom of a thermally stratified reservoir behind a dam.

The remainder of this section will describe other water quality baseline conditions, but the primary focus will be on temperature baseline conditions as this is one of the factors contributing to the decline of salmonid species and it is the primary change in Washington's water quality standards.

4.D.1. Methods to Assess Environmental baseline

4.D.1.1. Temperature water quality assessment

Washington has collected 7DADMax temperature data for a number of major rivers since 2001. EPA has summarized this data in Table 4-1 below. The table gives a general overview of those water bodies that significantly exceed the temperature criterion, and those that are below the temperature criterion. The table contains the following four categories:

(1) **High –** a waterbody is included in this category if the aquatic life use is "Core summer salmonid habitat" and the waterbody has had at least one 7DADMax temperature greater than 20°C; or the aquatic life use is "Salmonid spawning, rearing, and migration" and the waterbody has had at least one 7DADMax temperature above 21.5°C; or the aquatic life use is "Salmonid rearing, and migration only" and the waterbody has had at least one 7DADMax temperature above 21.5°C.

(2) **Moderately High** - a waterbody is included in this category if the aquatic life use is "Core summer salmonid habitat" and the waterbody has had at least one 7DADMax temperature in the range of 17°C – 19.9°C; or the aquatic life use is "Salmonid spawning, rearing, and migration" and the waterbody has had at least one 7DADMax temperature in the range of 18.5°C – 21.4°C; or the aquatic life use is

“Salmonid rearing, and migration only” and the waterbody has had at least one 7DADMax temperature in the range of 18.5°C – 21.4°C.

(3) **At or below Criterion -** a waterbody is included in this category if the aquatic life use is “Core summer salmonid habitat” and the 7DADMax temperature is at or below 16°C; or the aquatic life use is “Salmonid spawning, rearing, and migration” and the 7DADMax temperature is at or below 17.5°C; or the aquatic life use is “Salmonid rearing, and migration only” and the 7DADMax temperature is at or below 17.5°C.

The information presented in Table 4-1 show several trends. The temperature data in the eastern Puget Sound Region indicates that the summer temperatures are high in the lower reaches of many rivers in this region with a few exceptions (e.g., Nisqually, Puyallup, Skagit). In the Olympic Peninsula area temperatures are generally at or below the water quality criterion, with the exception of the Dungeness, lower Elwah, and Hoh rivers. Eastern Washington rivers are fairly warm, however, some rivers may be warm due to the natural condition of the waters. In the eastern and western portions of the Cascade Mountains the river temperatures are generally below the water quality criterion, except where significant landscape changes have occurred (e.g., timber harvest).

Table 4-1. 7DADMax Temperature Data.

Category	WRIA	River	Aquatic Life Use	7 DADMax temperature range (°C)	Number of years with 7DADMax/ year/ Notes
High	5	S.F. Stillaguamish	Core summer salmonid habitat	19.9 – 22.1	N=5; 2001 -2005
	5	Mid - Stillaguamish	Core summer salmonid habitat	20.9 – 23.4	N=5; 2001 - 2005
	5	N.F. Stillaguamish	Core summer salmonid habitat	19.9 – 22.3	N=5; 2001-2005
	7	Lower Skykomish	Core summer salmonid habitat	18.3 – 21.3	N=3;2001-2003
	7	Mid - Snoqualmie	Core summer salmonid habitat	18.4 – 20.5	N=5;2001 - 2005
	8	Near mouth of Cedar	Core summer salmonid habitat	18.3 – 20.7	N=5; 2001-2005
	13	Lower Deschutes	Salmonid spawning, rearing, migration	19.1-20.5	N=5; 2001-2005
	22	Mid - Humptulips	Core summer salmonid habitat	20.6 – 21.9	N=4; 2002 - 2005
	23	Chehalis near Porter Creek	Salmonid spawning,rearing,migration	22.3 – 24.1	N=5; 2001 - 2005
	23	Chehalis at Dryad	Core summer salmonid habitat	21.7 – 24.3	N=5;2001-2005
	24	Mid Willipa	Salmonid spawning,rearing,migration	22 – 22.7	N=2; 2001 -2002
	24	Upper Naselle	Core summer salmonid habitat	18.7 – 21.7	N=4; 2001- 2004
	27	Mid E.F. Lewis	Core summer salmonid habitat	23.2 – 25.9	N=5;2001 - 2005
	27	Kalama River, near mouth	Core summer salmonid habitat	18.5 – 20.3	N=5; 2001-2005
	32	Walla Walla, near mouth	Salmonid rearing and migration	27.8 - 30	N=5;2001 – 2005
	34	S.F. Palouse, near Idaho border	Salmonid spawning,rearing,migration	20.4 – 23.8	N=5; 2001-2005
	34	Palouse, near Idaho border	Salmonid spawning,rearing,migration	26.6 – 29.1	N=5, 2001-2005
	35	Tucannon, near Snake	Salmonid spawning,rearing,migration	25.3 – 26.5	N=5;2001-2005
	37	Yakima, near Ahtanum Creek	Salmonid pawning,rearing,migration	15.1 – 22.9	N=3;2001 – 2003
	38	Cowiche Creek, near Naches river	Salmonid spawning,rearing,migration	22.4	N=1; 2005
	39	Yakima River, near Cle Elum	Core summer salmonid habitat	20.2 – 21.9	N=5; 2001 – 2005
	41	Crab Creek, near Columbia River	Salmonid rearing,migration	28 – 28.8	N=5; 2001-2005
	45	Wenatchee River, near Leavenworth	Core summer salmonid habitat	18.8 – 23.5	N=5; 2001, 2002, 2005
	45	Wenatchee River, near Columbia River	Salmonid spawning, rearing, migration	22.4	N=1; 2001
	46	Entiat River, near Columbia River	Salmonid spawning, rearing, migration	20.9 – 24.3	N=5; 2001 – 2005
	48	Methow River near Columbia River	Salmonid spawning, rearing, migration	23.4 – 24.6	N=5; 2001, 2003-2005
Moderately High	1	Lower Nooksack	Core summer salmonid habitat	17.4-19.2	N=5;2001-2005
	3	Skagit near Mount Vernon	Core summer salmonid habitat	17.6-18.3	N=2, 2004-2005
Category	WRIA	River	Aquatic Life Use	7 DADMax	Number of years with 7DADMax/

				temperature range (°C)	year/ Notes
	9	Green River, mid river	Core summer salmonid habitat	17.9 – 20	N=4, 2001, 2003-2005
	10	Lower Puyallup, on tribal reservation land	On tribal land, no state designation	17.5-18.4	N=2; 2002-2003
	11	Nisqually, near mouth of river	Core summer salmonid habitat	16.1 - 17.5	N=5;2001-2005
	15	Mission Creek	Core summer salmonid habitat	17.2	N=1; 2003
	18	Dungeness, near mouth	Core summer salmonid habitat	17.2 – 18.6	N=4, 2002 -2005
	18	Lower Elwha	Core summer salmonid habitat	16.3 – 18.9	N=5; 2001 – 2005
	20	Hoh River	Core summer salmonid habitat	16 – 17.8	N=4;2001-2003, 2005
	26	Cowlitz River, near Columbia River	Salmonid spawning, rearing, migration	17.8 – 19.1	N=4; 2001-2003, 2005
At or Below Criterion	4	Lower Skagit	Core summer salmonid habitat	13 – 14.9	N=5;2001 – 2005
	15	Union River, near mouth	Core summer salmonid habitat	15.1	N=1; 2003
	15	Little Mission Creek	Core summer salmonid habitat	12.8	N=1; 2003
	15	Stimson Creek	Core summer salmonid habitat	15	N=1; 2003
	15	Olalla Creek	Core summer salmonid habitat	14.9	N=1; 2003
	16	Skokomish River	Core summer salmonid habitat	14.7 – 15.2	N=5; 2001- 2005
	16	Duckabush	Core summer salmonid habitat	13.2 – 15	N=5; 2001- 2005

4.D.1.2. Washington State's 2002/2004 Water Quality Assessment [303(d) List]

The Clean Water Act establishes as a national goal "water quality which provides for the protection and propagation of fish, shellfish, and wildlife, and recreation in and on the water, wherever attainable." These are commonly referred to as "fishable/swimmable" goals of the Act. As stated previously, each state has its own water quality standards designed to protect water quality. Water quality standards consist of designated uses (e.g., drinking water, aquatic life, etc), numeric or narrative criteria to protect the designated use, and an antidegradation policy. When a lake, river, stream or other water body fails to meet water quality standards the Clean Water Act required the state to place the water body on a list of "impaired" water bodies called the 303(d) list. States are required to prepare a 303(d) list every two years.

The Department of Ecology has compiled and assessed available water quality data on a statewide basis in order to get a better picture of the overall status of water quality in Washington's waters. The results of the assessment were submitted to the Environmental Protection Agency (EPA) as an "integrated report" to satisfy federal Clean Water Act requirements of sections 303(d) and 305(b). The assessed waters are placed in "categories" which describe the status of the water quality. These categories are:

- ***Category 1*: Meets tested standards is for clean waters**. Placement in this category does not necessarily mean that a water body is free of all pollutants. Most water quality monitoring is designed to detect a specific array of pollutants, so placement in this category means that the water body met standards for all the pollutants for which it was tested. Specific information about the monitoring results may be found in the individual listings.

- ***Category 2*: Waters of concern** is for waters where there is some evidence of a water quality problem, but not enough to require production of a TMDL at this time. There are several reasons why a water body would be placed in this category. A water body might have pollution levels that are not quite high enough to violate the water quality standards, or there may not have been enough violations to categorize it as impaired according to Ecology's listing policy. There might be data showing water quality violations, but the data were not collected using proper scientific methods. In all of these situations, these are waters that we will want to continue to test.

- ***Category 3*: No data** is a category that will be largely empty. Water bodies that have not been tested will not be individually listed, but if they do not appear in one of the other categories, they are assumed to belong here.

- ***Category 4*: Polluted waters that do not require a TMDL** is for waters that have pollution problems that are being solved in one of three ways.

    - ***Category 4*a** has a TMDL is for water bodies that have an approved TMDL in place and are actively being implemented.
    - ***Category 4*b** has a pollution control plan is for water bodies that have a plan in place that is expected to solve the pollution problems. While pollution control plans are not TMDLs, they must have many of the same features and there must be some legal or

financial guarantee that they will be implemented.
  - ***Category 4c*** is impaired by a non-pollutant is for water bodies impaired by causes that cannot be addressed through a TMDL. These impairments include low water flow, stream channelization, and dams. These problems require complex solutions to help restore streams to more natural conditions.

- ***Category 5*: Polluted waters that require a TMDL**. The 303(d) list is the traditional list of "impaired" water bodies. Placement in this category means that Ecology has data showing that the water quality standards have been violated for one or more pollutants.

For each of the water bodies on the 303(d) list a "water cleanup plan," also known as a total maximum daily load (TMDL) will need to be developed. A TMDL identifies how much pollution needs to be reduced or eliminated to achieve clean water.

This latest comprehensive assessment included 32,165 assessed segments, the system used for this assessment defines segments of rivers, streams, and lakes of less than 1,500 acres as that portion of the water body lying within a given section of a township and range (about a one mile square). Water bodies larger than 1,500 acres in size are subdivided by grid cells sized to 2.25 seconds of latitude/longitude per side. The Columbia River and Snake River areas were also segmented in grids. Therefore, each listing for a water body and parameter represents a one-mile stretch of river, or approximately a 500-foot square grid (this varies depending on the latitude and longitude).

Of the total number of assessed water segments about two thirds of those assessed, appear to be compliant for the pollutant monitored, based on monitoring results. Of the one third that are showing evidence of problems for a specific pollutant, more than half are not yet polluted, but will require attention to prevent further degradation. Percentage results are as follows:

- 66 percent meet the parameters they were tested for;
- 13 percent are waters of concern, but not polluted;
- 2.5 percent have water cleanup plans to correct problems;
- 9 percent are impaired by a non-pollutant, such as fish passage barriers or habitat degradation; and
- 8 percent are on the polluted waters list (the 303(d) list)

Water segments listed on the 303(d) list in 1998 were re-assessed based on the updated policy for listing and new data that may have been submitted. As a result, many segments have moved off of the 303(d) list in this preliminary assessment. About 50 percent (882 listings) of the waters on the 1998 303(d) list remain on the current Category 5 list of polluted waters. About 50 percent (875 listings) of the waters on the 1998 303(d) list have moved to other categories (Ecology 2004), as described below:

- 8% of the 1998 listings (146 listings) have moved to Category 1 because more recent data demonstrate that the water is not impaired,
- 19% of the 1998 listings (473 listings) have moved to Category 2 because the water is not showing persistent pollution, quality assurance of the data is questionable, or verification of pollutant listing determined water is not impaired,

- 16% of the 1998 listings (289 listings) have moved to Category 4A or 4B because a clean up plan (TMDL) or pollution control plan has been approved.
- 6% of the 1998 listings (104 listings) have moved to category 4C because their impairment is not related to a pollutant (e.g. habitat impairment, flow, invasive species) (Ecology 2004).

Overall, the category 5 list, has increased from the 1998 list by about 725 water body segments. While over half of the 1998 303(d) listings moved off the list, new listings were added as the result of new monitoring data gathered since 1998 (Ecology 2004).

In the 1998 assessment, 642 streams and lakes were represented on the 303(d) list, many of them with numerous segments monitored for more than one pollutant parameter. In the 2002/2004 assessment, 800 rivers and lakes are represented on Category 5, the 303(d) list, many of them also with numerous segments monitored for more than one pollutant. This is an increase of 166 new waters on the 303(d) list (Ecology 2004).

The key elements that have affected water quality in Washington continue to appear in new listings. These include fecal coliform, temperature, dissolved oxygen, pH, and total phosphorus. Of the total list of polluted waters, about 70 percent are made up of these parameters. The other 30 percent include toxic chemicals, metals, and other pollutant criteria (Ecology 2004).

Of the main pollutant parameters causing 303(d) listings, the most significant increase in listings occurs with temperature. This increase is due to increased temperature monitoring efforts in the last several years, likely spurred by increased salmon habitat protection efforts. The breakout of the key pollutant parameters, based on a total of 2,682 listings in Category 5, is as follows:

- Temperature listings are 33 percent (876) of the total listings;
- Fecal coliform listings are 25 percent (672) of the total listings;
- Dissolved oxygen listings are 10 percent (280) of the total listings;
- Total phosphorus listings are 2 percent (50) of the total listings; and
- Other pollutants (toxics, metals, other) are 30 percent (804) of total listings (Ecology 2004).

The 2002/2004 303(d) list was reviewed and all waters within each of the pollution categories that were listed as not meeting standards for ammonia, marine cyanide, temperature, bacteria (marine), or turbidity were summarized in Table 4-25 (ammonia), 4-26 (fecal coliform), 4-27 (temperature) and 4-28 (turbidity). No state marine waters were listed as being out of compliance with the state's cyanide criterion. The water bodies listed in Tables 4-25 through 4-28 are listed by pollution category and Water Resource Inventory Areas (WRIA) (Figure 4-1). In many cases several segments of a water body were listed within the 303(d) list under a single WRIA and pollution category, with the 303(d) providing location information (e.g., township, range, and section numbers) for each listed segment. Tables 4-2 through 4-4 list a water body only once for each WRIA within a given pollution category (Category 1 waters are not included in the tables). For information about location of each of the listed water body segments, please refer to *Washington State's Water Quality Assessment [303(d)]* at http://www.ecy.wa.gov/programs/wq/303d/2002/2002-index.html.

Table 4- 2. Washington State Waters Impaired by Ammonia Listed by Category and Water Resource Inventory Areas (WRIA).

CATEGORY 2 – Waters of Concern			
WRIA 1			
Bertrand Ck.	Depot Road Ditch	Double Ditch Drain	Semiahmoo Bay
Kulshan Ck.			
WRIA 5			
Stillaguamish R.			
WRIA 7			
French Ck.			
WRIA 8			
Washington Lake			
WRIA 9			
Puget Sound (South Central) and East Passage	Soos Ck.		
WRIA 34			
Palouse R.	Palouse R., S.F.		
WRIA 37			
Sufur Ck.	Wasteway	Yakima R.	
WRIA 39			
Selah Ditch	Yakima R.		
WRIA 40			
Garrison Ck.			
CATEGORY 4a – Polluted Waters that do not require a TMDL because a TMDL already exists			
WRIA 9			
Duwamish Waterway and River	Green R.		
WRIA 22			
Wildcat Ck.			
WRIA 28			
Weaver (Woodin) Ck.			
WRIA 32			
Mill Ck.			
WRIA 34			
Palouse R., S.F.			
WRIA 35			
Pataha Ck.			
WRIA 39			
Crystal Ck.			

Table 4-2 (continued)

CATEGORY 4a (Continued)		
WRIA 55		
Dragoon Ck.		
WRIA 59		
Colville R.		
CATEGORY 4b - Polluted Waters that do not require a TMDL because a pollution control plan exists		
WRIA 3		
Skagit R.		
WRIA 7		
Ebey Slough	**Steamboat Slough**	
CATEGORY 4c - Polluted Waters that do not require a TMDL because its impaired by a non-pollutant		
No listings for ammonia under this category		
CATEGORY 5 - Polluted Waters that do require a TMDL (303(d) list)		
WRIA 1		
Bertrand Ck.	Deet Ck.	
WRIA 7		
Swan Trail Slough		
WRIA 8		
Sammamish Lake	Union Lake	Washington Lake
WRIA 10		
Fife Ditch		
WRIA 34		
Paradise Ck.		
WRIA 37		
Granger Drain		
WRIA 38		
Myron Lake		
WRIA 42		
Crescent Bay Lake		
WRIA 43		
West Medical Lake		

Table 4-3. Washington State Waters Impaired by Fecal Coliform Listed by Category and Water Resource Inventory Areas (WRIA)

MARINE WATERS
CATEGORY 2 - Waters of concern
WRIA 1
Bellingham Bay (outer) Lummi Bay and Hale Passage
WRIA 2
San Juan Channel
WRIA 7
Ebey Slough Port Gardner and Inner Everett Harbor Possession Sound (North) Possession Sound (South) Steamboat Slough Swan Trail Slough Union Slough
WRIA 8
Puget Sound (central)
WRIA 11
Nisqually Reach/Drayton Passage
WRIA 13
Nisqually Reach/Drayton Passage
WRIA 14
Oakland Bay
WRIA 15
Dyes Inlet Great Bend/Lynch Cove Liberty Bay Port Gamble Bay Port Orchard Bay Sinclair Inlet
WRIA 16
Hood Canal (south) Dungeness Bay
WRIA 22
Grays Harbor
WRIA 24
Potter Slough
CATEGORY 4a – Polluted waters that do not require a TMDL because a TMDL already exists
WRIA 22
Grays Harbor (inner and outer)
CATEGORY 4b – Polluted waters that do not require a TMDL because a pollution control plan exists
No listings under this category for marine fecal coliforms
CATEGORY 4c - Polluted waters that do not require a TMDL because it is impaired by a non-pollutant
No listings under this category for marine fecal coliforms

TABLE 4-3 (CONTINUED)

FRESH WATERS		
CATEGORY 2 - Waters of concern		
WRIA 1		
Bertrand Ck	Double Ditch Drain	Semiahmoo Bay
WRIA 3		
Kulshan Ck		
WRIA 5		
Stillaguamish R.		
WRIA 7		
French Ck		
WRIA 8		
Washington Lake		
WRIA 9		
Puget Sound	East Passage	Soos Ck
WRIA 34		
Palouse R	Palouse R, S.F.	
WRIA 37		
Sulfur Ck	Wasteway	Yakima R
WRIA 39		
Selah Ditch	Yakima R	
WRIA 40		
Garrison Ck		

Table 4- 4. Washington State Waters Temperature by Category and Water Resource Inventory Areas (WRIA)

CATEGORY 2 – Waters of Concern				
WRIA 1				
Anderson Ck.	Baker Ck.	Bertrand Ck.	Black Slough	Boulder Ck.
Bear Ck.	Chuckanut Ck.	Dakota (Rebel) Ck.	Fever Ck.	Fourmile Ck.
Gallup Ck.	Hardscrabble Cr.	Jones Ck.	Kamm Ck.	Keefe Lake O
Maple Ck.	McCarty Ck.	Nooksack R.	Nooksack R., S.F.	Padden Ck.
Toss Ck.	Silver Ck.	Squalicum Cr.	Standard Ck.	Tenmile Ck.
Unnamed Ck (WE#01.0148)				
WRIA 2				
Unnamed Ck.				
WRIA 3				
Carpenter Ck.	Coal Ck.	Cumberland Ck.	Day Ck.	Fisher Ck.
Hansen Ck.	Jones Ck.	Mud Lake Ck.	Noname Slough	Nookachamps
Nookachamps Ck., E.F.	Otter Pond Ck.	Samish R.	Unnamed Ck.	Unnamed Slough
Indian(Big) Slough	Wiseman Ck.	Joe Leary Slough		
WRIA 4				
Elliott Ck.	Finney Ck.	Grandy Ck.	Jackman Ck.	
WRIA 5				
Deer Ck.	Old Stilly Channel, West Pass		Pilchuck Ck..	
South Pass Slough	Stillaguamish R.		Stillaguamish R., S.F .	
WRIA 7				
Deadwater Slough	Ebbey Slough	French Ck.	Marshlands	Pilchuck R.
Snohomish R.	Snoqualmie R.	Snoqualmie R.,S.F.	Steamboat Slough	Swamp Ck.
Allen Ck	Swan Trail Slough	Tokul Ck.	Union Slough	
WRIA 8				
Cedar R.	Coal Ck.	Evans Ck.	Issaquah Ck.	Little Bear Ck.
Lyon Ck.	May Ck.	Normal Ck.	North Ck.	Swamp Ck.
Tibbetts Ck.	Union Lake	Idylwood Ck	Sammamish R	Unnamed Ck
Willows Ck				
WRIA 9				
Big Soos Ck.	Black R.	Des Moines Ck.	Duwamish Waterway & R.	
Green R.	Hill (Mill) Ck.	Little Soos Ck.	Little Soosette Ck.	Longfellow Ck.
Mill Ck.	Mullen Slough	Springbrook(mill) Ck	Unnamed Ck. (WDF #09.0046)	
WRIA 10				
Beaver Ck.	Boise Ck.	Bowman Ck.	Camp Ck.	Meeker Ditch
Puyallup R.	Voight Ck.	White (Stuck) R.	White R.	
Dalco Passage/Poverty Bay				
WRIA 11				
Catt Ck.	Hiawatha Ck.	Mashel Ck.		
WRIA 12				
Chambers Ck.	Clover Ck.	Ponce de Leon Ck.	Spanaway Ck.	

Table 4-4 (continued)

CATEGORY 2 – Waters of Concern (continued)				
WRIA 13				
Capitol Lake Outlet	Deschutes R.	Henderson Inlet.	McLane Ck.	Woodland Ck.
Budd Inlet	Case Inlet and Passage	Eld Inlet		
WRIA 14				
Deer Ck.	Goldsborough Ck.	Sherwood Ck.	Burns Ck	Oakland Bay
Great Bend/Lync Cove	Perry Ck	Totten Inlet		
WRIA 15				
Big Beef Ck.	Coulter Ck.	Grovers Ck.	Martha-John Ck.	Big Scandia
Bay Carr Inlet	Case Inlet/Dana Passage	Dyes Inlet	Eagle Harbor	Liberty Bay
Henderson Bay	Great Bend Lynch Cove	Miller Bay	Port Orchard Bay	Sinclair Inlet
Quartermaster Harbor				
WRIA 16				
McDonald Ck.	Skokomish R., S.F.			
WRIA 17				
Shine Ck.	Spencer Ck.	Thorndyke Ck., W.F.		
WRIA 18/19				
Bell Ck.	Elwha R.	Morse Ck.	Lyre R (19)	
WRIA 20				
Big R.	Calawah R., N.F.	Crooked Ck.	Devils Ck.	Dickey R.
Hoh R.	Kahkwa Ck.	Lake Ck.	Mosquito Ck.	Ozette R.
Quinn Ck.	Soleduck R.	Soleduck R., S.F.	Unnamed Ck.	Upper Cool Ck.
WRIA 21				
Coal Ck.	Matheny Ck.	Queets R.	Quinault R.	Salmon R.
Salmon R., M.F.	Ziegler Ck.			
WRIA 22				
Charley Ck.	Chehalis R.	Chenois Ck.	Dempsey Ck.	Grass Ck.
Johns R.	Newskah Ck.	Wishkah Ck.	Grays Harbor	
WRIA 23				
Beaver Ck.	Unnamed Ck.			
WRIA 24				
Fern Ck.	Fork Ck.	Lower Salmon Ck.	Mill Ck.	Naselle R.
Riverdale Ck.	Upper Salmon Ck.	Skidmore Slough	Willapa R.	Willapa R., S.F.
Willapa Bay	Wilson Ck.			
WRIA 25				
Abernathy Ck.	Beaver Ck.	Cameron Ck.	Columbia R.	Delameter Ck.
Elochoman R.	Grays R., E.F.	Grays R., W.F.	Jim Crow Ck.	Mill Ck.
Mill Ck., S.F.	Sission Ck.	Skamokawa Ck.	Wiest Ck.	Wilson Ck.

Table 4-4 (continued)

CATEGORY 2 – Waters of Concern (continued)				
WRIA 26				
Cispus R. & Cispus R, N.F.	Davis Ck.	Green R.	Lillian Ck.	Pinto Ck.
Quartz Ck.	Silver Ck.	Willame Ck.	Woods Ck.	Yellowjacket Ck.
WRIA 27				
Canyon Ck.	Cedar Ck.	Clear Ck.	Clearwater Ck.	Columbia R.
Gee Ck.	Green Fork Ck.	Hatchery (Fallert) Ck.	Lewis R.	Lewis R., E.F.
Lockwood Ck.	McCormick Cr.	Muddy Ck. Slide Ck.	Smith Ck.	
WRIA 28				
Burnt Bridge Ck.	Columbia R.	Dwyer Ck.	Fifth Plain Ck.	Matney Ck.
Round Lake	Salmon Ck.	Weaver Ck.	Whipple Ck.	
Gibbons Ck Remnant Channel				
WRIA 29				
Columbia R.	Cultus Ck.	Grand Meadows Ck.	Little White Salmon R.	
Lost Ck.	Mosquito Ck.	Trapper Ck.	Trout Lake Ck.	
WRIA 30				
Columbia R.				
WRIA 31				
Columbia R.				
WRIA 32				
Coates Ck.	Mill Ck.	Patit Ck.	Touchet R.	Coppei Ck
Touchet R., N.F. (E.F.)	Touchet R., S.F.	Dry Ck	Little Walla Walla R, West	
Walla Walla R				
WRIA 33				
Snake R.				
WRIA 34				
Palouse R.	Palouse R., S.F.	Paradise Ck.	Pine Ck.	Rebel Flat Ck.
Union Flat Ck.				
WRIA 35				
Alpowa Ck.	Cummings Ck.	Deadman Ck., N.F.	Little Tucannon Ck.	
WRIA 36				
East Potholes Canal	EL 68D Wasteway	EL 68T31 Wasteway	EL 74 Wasteway	EL 83 Wasteway
Eltopia Branch Canal	Esquatzel Coulee	Esquatzel Diversion Channel	Mattawa Drain	
Mattawa Wasteway	PE 16,4 Wasteway	Saddle Mountain Wasteway	Scootney Wasteway	
WB5 Lateral Drain				
WRIA 37				
Ahtanum Ck.	Moxee (Birchfield) Drain	Roza Canal	Sulphur Ck. Wasteway	
Tailwater Drain	Wide Hollow Ck.	Yakima R.		

Table 4-4 (continued)

CATEGORY 2 – Waters of Concern (continued)				
WRIA 38				
Naches R.	Bear Ck	Blowout Ck		
WRIA 39				
Blue Ck.	Caribou Ck.	Cascade Canal	Cherry Ck.	Cle Elum R.
Cooke Ck.	French Cabin Ck.	Naneum Ck.	North Branch Canal	
Parke Ck.	Thorp Ck.	Umtanum Ck.	Wenas Ck.	
Wilson Ck.	Wipple Wasteway	Yakima R.	Ellensburg Water Co. Canal	
WRIA 41				
Crab Ck.	Crab Ck. Lateral	DE55 Wasteway	EL 63.8 Wasteway	EL 31 Wasteway
Wasteway	W645 Fr	W645 West Canal	Winchester Wasteway	
Frenchman Hills wasteway	Lind Coulee	Lower Crab Ck Moses Lake Outlet		
PE16.4 M12 Wasteway	Potholes Canal	QD Wasteway	RBC Wasteway	RCD Wasteway
Red Rock Coulee	Rocky Coulee Wasteway	Rocky Ford Wasteway	Unnamed Ck	
W35.9B Wasteway	W645 Drain	W645 Wasteway		
WRIA 42				
Alkali-Lenore Ck.	Blue-Alkali Ck.	Lenore Lake Outlet Channel	Main Canal	Meadow Ck.
Park Lake Cr.				
WRIA 43				
Crab Ck.	Lake Ck.	Lords Ck.	Rock Ck.	
WRIA 45				
Mission Ck.	Chumstick Irr Ret	Gunn Ditch	Icicle Irr Ret	Indian Creek
Ingalls Ck	Jones Shotewell Ditch	Little Chumstick Ck	Mission Ck	No Name Ck
Panther Ck	Peshastin Irr Ret	Pioneer Irr Ret	Rainy Ck	Snow Ck
Wenatchee R	White River	Yaksum Ck		
WRIA 46				
Entiat R.				
WRIA 47				
Chelan R.	Columbia R.			
WRIA 48				
Lost R.	Methow R.	Twisp R.		
WRIA 49				
Okanogan R.	Similkmeen R.			
WRIA 52				
Granite Ck.	Ninemile Ck.	O'Brien Ck.	Sanpoil R.	
WRIA 54				
Spokane R.	Long Lake (Reservoir)			

Table 4-4 (continued)

CATEGORY 2 – Waters of Concern (continued)				
WRIA 55				
Deadman Ck.	Dragoon Ck.	Little Spokane R.		
WRIA 56				
Hangman Ck.				
WRIA 57				
Spokane R.				
WRIA 59				
Bayley Ck.	Chewelah Ck., N.F.	Chewelah Ck., S.F.	Colville R.	Cottonwook Ck.
Mill Ck., S.F.	Sherwood Ck.	Wilson Ck.		
WRIA 60				
Boulder Ck., S.F.	Catherine Ck., S.F.	Cummings Ck.	Lambert Ck.	Lone Ranch Ck.
St. Peter Ck., S.F.				
WRIA 61				
Columbia R.	Crown Ck., E.F.	Deep Ck.		
WRIA 62				
Calispell Ck.	Cedar (Ione) Ck.	Leclerc Ck., W. Branch	Lost Ck., S.F.	Outlet Ck.
Pend Orielle R.	Small Ck., E.F.			
CATEGORY 4a – Polluted waters that do not require a TMDL because a TMDL already exists				
WRIA 5				
Stillaguamish River, N.F.				
WRIA 10				
Brush Ck.	Greenwater R.	Pyramid Ck.	South Prairie Ck.	Straight Ck.
Whitler Ck.	Wilkeson Ck.			
WRIA 14				
Kennedy Ck				
WRIA 16				
Skokomish R, N.F.				
WRIA 22				
Humptulips R.	Humptullips R., E.F.	Humptullips R., W.F.	Chester Ck	Rabbit Ck
Wildcat Ck				
WRIA 23				
Black R.	Chehalis R.	Chehalis R., S.F.	Dillenbaugh Ck.	Lincoln Ck.
Lincoln Ck., N.F.	Newaukum R.	Salzer Ck.	Scatter Ck.	Skookumchuck R
Stearns Ck				

Table 4-4 (continued)

CATEGORY 4a – Polluted waters that do not require a TMDL because a TMDL already exists
WRIA 29
Bear Ck. Black Ck. Cedar Ck. Crater Ck. Eightmile Ck.
WRIA 30
Butler Ck. Little Klickitat R. Little Klickitat R., East Prong Little Klickitat
WRIA 39
Stafford Ck. Teanaway R. Teanaway R., M.F. Teanaway R., N.F. Teanaway R., W.F.
WRIA 58
Sherman Ck Sherman Ck, S.F.
WRIA 59
Chewelah Ck, N.F.
WRIA 60
Boulder Ck
WRIA 62
Browns Lake Outlet Ck Calispell Ck, M.F. Calispell Ck, N.F. Cedar (Ione)Ck Cusick Ck Leclerc Ck, East Branch Leclerc Ck, Middle Branch Leclerc Creek, West Branch Lime Ck Little Muddy Ck Lost Ck Ruby Ck Sullivan Ck
CATEGORY 4b - Polluted waters that do not require a TMDL because a pollution control plan exists
No Listings
CATEGORY 4c - Polluted waters that do not require a TMDL because it's impaired by a non pollutant
No Listings
CATEGORY 5 – Polluted waters that require a TMDL (303(d) list)
WRIA 1
Anderson Ck. Bells Ck. Canyon (Lake) Ck. Canyon Ck. Cavanaugh Ck. Cemetery Ck. Connelly Ck. Cornell Ck. Edfro Ck. Fever Ck. Fishtrap Ck. Gallop Ck. Hardscrabble Ck. Howard Ck. Kenney Ck. Lincoln Ck. Nooksack R. Nooksack R., M.F. Nooksack R., S.F. Padden Ck .Racehorse Ck. Roaring Ck. Porter Ck Squalicum Ck. Sygitowicz Ck Tennant Ck. Todd Ck. Whatcom Ck. Plumbago Ck Unnamed Ck (Peat Bog Ck)
WRIA 3
Carpenter Ck. Fisher Ck. Hansen Ck. Turner Ck Otter Ck Nookachamps Ck. Nookachamps Ck., E.F. Red Ck Unnamed Ck.
WRIA 5
Canyon Ck. Deer Ck. Higgins Ck. Jim Ck. Little Deer Ck. Old Stillaguamish R. Pilchuck R. Stillaguamish R. Stillaguamish R., N.F. Stillaguamish R., S.F.

Table 4-4 (continued)

CATEGORY 5 – Polluted waters that require a TMDL (303(d) list)				
WRIA 7				
Bear Ck.	Olney Ck.	Pekola Ck.	Pilchuck Ck.	Skykomish R.
Beaver Ck.	Snoqualmie R.	Swifty (Ferguson) Ck.	Wallace R.	French Ck
Catherine Ck				
WRIA 8				
Bear Ck.	Mercer Slough	Cedar R.	Cottage Lake Ck.	Evans Ck.
Fairweather Bay Ck.	Forbes Ck.	Juanita Ck.	Kelsey Ck.	Lewis Ck.
May Ck.	North Ck.	Sammamish R.	Swamp Ck.	Thornton Ck.
Tibbetts Ck.	Peters Ck	Willa Marine Ck		
WRIA 9				
Gale Ck.	Green R.	Little Soos Ck.	Ravendale Ck.	Smay Ck.
Hill (Mill) Ck				
WRIA 10				
Boise Ck.	Clearwater R.	Fox Ck.	Kings Ck.	Lyle Ck.
Milky Ck.	Scatter Ck.	White R.		
WRIA 11				
East Ck.	Little Nisqually R.	Little Nisqually R., W.F.	Mashel R.	
WRIA 12				
Clover Ck				
WRIA 13				
Deschutes R.	Woodland Ck.	Black R Ditch	Huckleberry Ck	Woodland Ck
WRIA 14				
Cranberry Ck.	Johns Ck.	Mill Ck.	Skookum Ck.	
WRIA 15				
Big Beef Ck.	Carpenter Ck.	Chico Ck.	Curley Ck.	Dickerson Ck.
Gamble Ck.	Kitsap Ck.	Mayo Ck.		
WRIA 16				
Dosewallips R.	Duckabush R.	Fulton Ck.	Lebar Ck.	Skokomish R., S.F.
WRIA 17				
Big Quilcene R.	Chimacum Ck.	Chimacum Ck., E.F.	Donavan Ck.	Howe Ck.
Leland Ck.	Little Quilcene R.	Ripley Ck.	Tarboo Ck.	Tarboo Ck., E.F.
Marple Ck.				
WRIA 18				
Dry Ck.	Elwha R.			
WRIA 19				
Clallam R.	Deep Ck.	Green Ck.	Little Hoko R.	Sekiu R.
Sekiu R., N.F.	Sekiu, S.F.			

Table 4-4 (continued)

CATEGORY 5 – Polluted waters that require a TMDL (303(d) list)				
WRIA 20				
Alder Ck.	Anderson Ck.	Beaver Ck.	Bogachiel R.	Calawah R., S.F.
Coal Ck.	Crooked Ck., N.F.	Dickey R., E.F.	Elk Ck.	Fisher Ck.
Lake Ck.	Line Ck.	Maple Ck.	Maxfield Ck.	Nolan Ck.
Owl Ck.	Sitkum R.	Soleduck R.	Split Ck.	Willoughby Ck.
Winfield Ck.	Dickey R., M.F.	Dickey R., W.F.		
WRIA 21				
Kalaloch Ck.	Mathney Ck.	Sams Ck.		
WRIA 22				
Black Ck.	Chester Ck.	Rabbit Ck.		
WRIA 23				
Mill Ck.	Stillman Ck.	Unnamed Ck.		
WRIA 24				
Elkhorn Ck.	Fern Ck.	Fork Ck.	Half Moon Ck.	Joe Ck.
WRIA 25				
Abernathy Ck.	Coal Ck.	Columbia R.	Delameter Ck	Elochoman R.
Germany Ck.	Grays R.	Grays R., S.F.	Monahan Ck.	Skamokawa Ck.
Unnamed Ck.	Wilson Ck.			
WRIA 26				
1918 Ck.	Arkansas Ck.	Baird Ck.	Cispus R.	Columbia R.
Coweeman R.	Cowlitz R.	East Canyon Ck.	Goble Ck.	Greenhorn Ck.
Herrington Ck.	Hoffstadt Ck.	Iron Ck.	Lake Ck.	Lynx Ck
Mulholland Ck.	Ostrander Ck.	Ostrander Ck., S.F.	Pumice Ck.	Schultz Ck.
Silver Ck.				
WRIA 27				
Clear Ck.	Clearwater Ck.	Copper Ck.	Kalama R.	Lewis R.
Lewis R., E.F.	Muddy R.	Quartz Ck.	Siouxon Ck.	
WRIA 28				
Burnt Bridge Ck.	China Ditch	Columbia R.	Fifth Plain Ck.	Lacamas Ck.
Lake R.	Matney Ck.	Salmon Ck.	Shanghai Ck.	China Lateral
WRIA 29				
Columbia R.	Indian Ck.	Little White Salmon R.	Major Ck.	Rattlesnake Ck.
WRIA 30				
Columbia R.	Swale Ck.			
WRIA 31				
Columbia R.				

Table 4-4 (continued)

CATEGORY 5 – Polluted waters that require a TMDL (303(d) list)				
WRIA 32				
Blue Ck.	Caldwell Ck.	Cold Ck.	Coppei Ck.	Coppei Ck, N.F.
Coppei Ck., S.F.	Cottonwood Ck.	Doan Ck.	Dry Ck., N.F.&S.F.	Garrison Ck.
Jim Ck.	Lewis Ck.	Little Walla Walla R., East	Little Walla Walla R.,West	
Mill Ck.	Pine Ck.	Robinson Ck. (Fork)	Russell Ck.	Touchet R.
Touchet R., N.F. (E.F.)	Touchet R., S.F.	Walla Walla R.	Whiskey Ck.	Wolf Ck. (Fork)
Yellowhawk Ck.				
WRIA 33				
Snake R.				
WRIA 34				
Cow Ck.	Palouse R.	Palouse R., S.F.		
WRIA 35				
Alkali Flat Ck.	Almota Ck.	Asotin Ck.	Asotin Ck., N.F.	Asotin Ck., S.F.
Charley Ck.	Couse Ck.	Cummings Ck.	Deadman Ck.	Deadman Ck.,
S.F. George Ck.	Lick Ck.	Little Almota Ck.	Meadow Ck.	Menatchee Ck.
Mill Ck.	Pataha Ck.	Penawawa Ck.	Pintler Ck.	Snake R.
Steptoe Ck.	Tenmile Ck.	Tucannon R.	Wawawai Ck.	
WRIA 36				
Columbia R.	Esquatzel Coulee	SCBID PE 16.4 Wasteway	WB5 Wasteway #1	
WRIA 37				
Wide Hollow Ck.	Yakima R.	Granger Drain	Snipes Ck	Yakima R
WRIA 38				
American R.	Bear Ck.	Blowout Ck.	Bumping R.	Cowiche Ck.
Cowiche Ck., N.F.	Cowiche Ck., S.F.	Crow Ck.	Gold Ck.	Little Naches R.
Little Rattlesnake Ck.	Mathew Ck.	Nile Ck., N.F.	Rattlesnake Ck.	Reynolds Ck.
Tieton R., S.F.	Little Naches R, N.F.			
WRIA 39				
Big Ck.	Cabin Ck.	Cle Elum R.	Cooke Ck.	Cooper R.
WRIA 40				
Columbia R.				
WRIA 41				
Columbia R.	Crab Ck.	Frenchman Hills Wasteway	Lind Coulee	Lower Crab Ck.
Red Rock Ck	Sand Hollow Ck.			
WRIA 42				
Columbia R.				

Table 4-4 (continued)

CATEGORY 5 – Polluted waters that require a TMDL (303(d) list)				
WRIA 43				
Crab Ck.				
WRIA 44				
Columbia R.				
WRIA 45				
Chiwaukum Ck.	Chiwawa R.	Icicle Ck.	Little Wenatchee R.	Mission Ck.
Nason Ck.	Peshastin Ck.	Rock Ck.	Sand Ck.	Tronsen Ck.
Second Ck	Wenatchee R.	Brender Ck	Chumstick Ck	Fish Lake Run
WRIA 47				
Chelan R.	Columbia R.			
WRIA 48				
Chewuch R.	Methow R.			
WRIA 49				
Okanogan R.	Similkameen R.			
WRIA 50				
Columbia R.				
WRIA 53				
Columbia R.	Franklin D. Roosevelt Lake			
WRIA 56				
Hangman Ck.				
WRIA 57				
Spokane R.				
WRIA 58				
Sherman Ck.				
WRIA 59				
Chewelah Ck.	Colville R.	Cottonwood Ck.	Little Pend Orielle R.	Mill
Ck. Stensgar Ck.	Stranger Ck.			
WRIA 60				
Kettle R.				
WRIA 61				
Deep Ck., S.F.	Franklin D. Roosevelt Lake			
WRIA 62				
Calispell Ck., S.F.	Cedar (Ione) Ck.	Leclerc Ck., East Branch	Little Muddy Ck.	
Pend Orielle R.	Ruby Ck.	Lost Ck.		

4.D.1.3. Washington State's Water Quality Assessment [305(b) Report]

The federal Clean Water Act establishes a process for states in developing information on the quality of its surface waters. Section 305(b) of the CWA requires that each state periodically prepare a water quality assessment report. The U.S Environmental Protection Agency (EPA) compiles the information in the state reports, summarizes them, and transmits the summaries to Congress along with an analysis of the status of water quality nationwide.

The *Washington State Water Quality Assessment, Year 2002 Section 305(b) Report* (Washington Department of Ecology, June 2002) was conducted based on published guidance on preparing the report (*Guidelines for Preparation of the Comprehensive State Water Quality Assessments (305(b))Reports) and Electronic Updates*, EPA, September 1997). The report presents an assessment of the support of uses designated for protection in Washington State's Water Quality Standards Chapter 173-201A Washington Administrative Code. The report also presents an assessment of the causes of use impairment.

EPA's guidance requests States to provide a comprehensive assessment of all surface waters in the state. It is not possible to monitor the quality of all waters statewide using a "census" approach (e.g., monitoring every surface water). To conduct a comprehensive statewide assessment, EPA recommends using a "sample survey" approach. A sample survey approach allows for the estimation of the conditions of waters statewide by making inferences from a defined set of monitoring locations. The level of certainty for these estimates can be described.

Sample surveys are intended to produce assessments of the condition of the entire resource when that resource cannot be subject to a complete census. Sample surveys rely on the selection of monitoring sites that are representative of the resource. EPA (1997) describes two different sample survey designs: probability-based and judgmental. Both designs use a stratified sampling method so that inferences can be made about other waters that the samples represent, with a known level of certainty. These two types of monitoring designs are described below.

The *probability-based design* uses monitoring stations that are selected in a statistically random method. Randomization in the site selection process is the way to assure that sites are selected without bias. This approach is used to select stations for EPA's Environmental Monitoring and Assessment Program (EMAP). The random selection of stations provides that:

- Every possible station (population) has a known probability of being selected for monitoring (sample).
- The set of stations monitored (sample) is drawn by some method of random selection, or a systematic selection with a random start.
- Estimates are made about the population from the sample.

The EMAP design uses a tiered grid approach for selection of stations and estimating probabilities. The sampling approach attempts to measure not only population variance, but also variance caused temporally or by the assessment indices. This type of design requires a large sampling network and a long-term commitment. However, use of a probability-based design has several drawbacks for use in the water quality assessment. The most significant is the need to establish a new sampling network based on random selection. With this design, one cannot use data collected by an existing sampling network. Also there are much higher costs associated with traveling to remote stations that may have limited access.

Judgmental design is the other sample survey approach recommended by USEPA (1997). Selection of monitoring locations is based on the best professional judgment that the sites are representative of the target resource (i.e., a subpopulation of surface waters). The method assumes that the stations selected represent all waters in a particular subpopulation (e.g., stratum). Monitoring station locations from an existing sampling network are reviewed individually to determine the reasons why the location was selected. Data for the assessment is used from stations which were located because they represent a type of water within an area. Since they represent an inherent bias, data from stations that were located based on the identification of specific problems (e.g., downstream of a specific wastewater discharge) are not used in the water quality assessment.

The judgmental design has several advantages for use in the water quality assessment:
• All stations selected are accessible.
• Allows the making of estimates with a known precision and confidence.
• Data collected by existing sampling network can be used -- will not have to wait for new sampling data to conduct assessments.
• Assessments can be made for any surface water type (i.e., streams or estuaries).

However, there are some deficiencies in the judgmental design:
• Assumes that stations selected by judgment represent all waters in the stratum.
• Statewide estimates may still be biased due to factors unknown to the monitoring agency who selected stations using best professional judgment.

Based on an assessment of the advantages and deficiencies of each design, Washington uses a judgmental sample survey design for assessment of most designated uses. However, the assessment of wildlife habitat was conducted from data collected from monitoring stations selected using a probability-based design from the EMAP program.

Assessment Methods
Data from stations in both Ecology's routine ambient monitoring program and the Environmental Monitoring and Assessment Program (EMAP) were selected for use in this assessment. The stations from the routine ambient monitoring program were selected by best professional judgment to represent the characteristics of similar waters in the geographic area (judgmental design). The stations from EMAP were selected by a spatially-balanced, random approach (probability-based design). Data used in this assessment from the routine ambient monitoring program were collected statewide from streams and estuaries from 1993 to 2001. Data used in this assessment from EMAP were collected statewide from streams during 2000.

Ecology eliminated its statewide lake monitoring program in 1999. As such, no new assessment of the water quality of lakes was conducted. The last assessment of lake water quality in Washington’s Section 305(b) Report for the year 2000 represents the most current data from lakes.

Selected stream stations were stratified into subpopulations according to size and ecoregion to represent subpopulations of the target resource. Subpopulations with no representative stations were not assessed. Ecoregions denote areas of general similarity in ecosystems and in the type, quality, and quantity of environmental resources. The following ecoregions were used to as subpopulations of

streams.
• Coast Range
• Puget Lowlands
• Willamette Valley (Clark County Area)
• Cascades (includes the Olympic Mountains)
• East Cascades and Foothills
• Columbia Basin
• Northern Rockies (Pend Oreille County Area)
• Blue Mountains (Asotin County Area)

Streams stations were also stratified by size into two subpopulations. “Large Streams” were defined as those reaches that are shown with double-banked cartographic features in the Washington Rivers Information System GIS coverage. “Small Streams” were defined as those reaches that are in the coverage as a single line.

Stations from estuary areas were stratified into three subpopulations: (1) Deep, well-mixed open water areas, (2) Somewhat protected channels and passages, and (3) Bays, inlets and harbors. Waters overlying shallower depths will be included in the stratum of water contiguous to it. For example, no separate stratum will be made for shallower shoreline areas adjacent to deep water with monitored stations.

The following specific uses designated (4.D.1.3.1. - 4.D.1.3.2) for protection in the Washington State Water Quality Standards (Chapter 173-201A Washington Administrative Code) were assessed. No evaluation was made to determine if natural conditions caused indicators to exceed the criteria. As such, it is important to note that many of the impairments identified may be due to natural conditions.

4.D.1.3.1. Aquatic Life Uses

The data collected as part of Washington’s 2002 305(b) report for indicators with numeric criteria in the water quality standards were used from sampling stations to assess the support or impairment of specific designated uses. The indicators assessed were temperature, dissolved oxygen, pH, ammonia, fecal coliform, and metals (arsenic, cadmium, copper, lead, mercury, nickel, and zinc). The specific designated uses assessed were fish migration, fish spawning, salmonid spawning, shellfish spawning, shellfish harvesting, primary contact recreation, and secondary contact recreation. This BE only provides the information for fish migration, fish spawning, and salmonid spawning that was in Washington’s 305(b) report (Tables 4-1and 4-2).

EPA guidance recommends using the specific frequency that data exceed numeric criteria to assess use support of aquatic life and recreational uses. If 25 percent or greater of the data exceed any one criterion, support of the specific use was considered “poor.” If more than 11 percent but less than 25 percent of the data exceed the criterion, support of the specific use was assessed as “fair.” If less than 10 percent of the data exceed the criterion, support of the use was considered “good”.

The overall “Aquatic Life” use support assessments were rolled up from assessments of the related individual designated uses analyzed. If one or more of the related individual uses assessed at a station are identified as fair or poor, the overall aquatic life use at the station were considered impaired. If all these uses assessed at a station are identified as good, then the overall aquatic life use at the station would be considered as good. The “Overall Use” support was developed in the same way as the

"Aquatic life" use (i.e., individual use support assessments from each station were rolled up from assessments of each individual use).

4.D.1.3.2. Wildlife Habitat Use

Habitat data collected by the Environmental Monitoring and Assessment Program (EMAP) program was used to assess the designated use of wildlife habitat. Wildlife habitat is defined in standards to include aquatic habitat. A riparian habitat quality index developed by the USEPA was used to assess support of the wildlife habitat use. The riparian habitat quality index combines several types of field measurements and observations of riparian vegetation and human disturbances collected by the EMAP program. The measures of riparian vegetation quality include a measure of stream bank canopy cover determined in the field with a densiometer and a measure of cover complexity and sustainability. The measure of riparian human disturbances is a proximity-weighted index of the extent and intensity of human activities within the channel, in the riparian zone, and in upland areas near the riparian zone. The index is calculated as the proximity-weighted sum of 11 categories of human disturbances, including buildings, roads, mining activities, lawns and parks, pastures and grazing, row crops, dams and bank revetments, influent and effluent pipes, trash and landfills, land clearing, and forest practices. The resulting integrated Riparian Condition Index (QR1) varies from 0 to 1. The USEPA has defined values less than 0.5 to be "poor," values between 0.5 to 0.63 to be "fair," and values greater than 0.63 as "good" riparian habitat (Ecology 2002).

4.D.1.3.3. Water Quality Assessment (305(b)) Results

Ecology conducted a statewide water quality assessment for over 70,000 miles of streams representing 98 percent of the total streams in Washington. The remaining 2 percent of streams not assessed were from subpopulations where samples were not collected. The assessment was also conducted for over 2,900 square miles of estuary areas representing 100 percent of the estuaries in Washington. No assessment of lakes or open ocean areas in Washington was conducted due to the lack of a monitoring program.

Overall, the designated uses were fully supported in 47 percent of all streams and 58 percent of estuaries assessed statewide. Use impairments were most prevalent on small streams and estuarine bays, inlets, and harbors. The Columbia Basin and the Puget Lowland Ecoregions show the highest rate of impaired uses. Aquatic life uses were mostly supported in streams (86 percent), but uses were impaired for most estuaries (71 percent). Fecal coliform indicates the most impairment of uses in streams and dissolved oxygen indicates the most impairment of uses in estuaries (Ecology 2002). The results of the statewide water quality assessment are summarized in Tables 4-5 through 4-29 below (Ecology 2002).

Table 4-5. Percent of Streams Assessed by Designated Use and Type (Ecology 2002)

Designated Use	Stream Type		
	Large	**Small**	**All Types**
Aquatic Life	98%	95%	98%
Fish Migration	98%	95%	98%
Fish Spawning	98%	95%	98%
Salmon Spawning	98%	95%	98%
Fish Consumption	58%	82%	59%
Wildlife Habitat	0%	62%	60%
Overall Use	98%	95%	98%

Table 4- 6. Percent of Estuaries Assessed by Designated Use and Type (Ecology 2002)

Designated Use	Estuary Type			
	Deep Open Water	**Channels & Passages**	**Bays, Inlets, & Harbors**	**Total All Types**
Aquatic Life	100%	100%	100%	100%
Fish Migration	100%	100%	100%	100%
Fish Spawning	100%	100%	100%	100%
Shellfish Spawning	100%	100%	100%	100%
Overall Use	100%	100%	100%	100%

Table 4- 7. Overall Use Support of Streams (Ecology 2002)**.**

Strata	Rating	Size (miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Large Stream	Good	1,483	68%	9%
	Fair	395	18%	8%
	Poor	297	14%	7%
Small Streams	Good	25,934	39%	6%
	Fair	17,156	26%	6%
	Poor	23,939	36%	6%
Coast Range Ecoregion	Good	3541	56%	19%
	Fair	1,417	22%	16%
	Poor	1,417	22%	16%
Puget Lowlands Ecoregion	Good	3,408	43%	8%
	Fair	1,785	22%	7%
	Poor	2,759	35%	8%
Willamette Valley Ecoregion	Good	284	50%	41%
	Fair	142	25%	36%
	Poor	142	25%	36%
Cascades Ecoregion	Good	14,217	80%	15%
	Fair	889	5%	8%
	Poor	2,666	15%	13%
East Cascades and Foothills Ecoregion	Good	2,030	63%	28%
	Fair	812	25%	25%
	Poor	406	13%	19%
Columbia Basin Ecoregion	Good	8,585	34%	10%
	Fair	7,767	31%	10%
	Poor	8,994	35%	10%
Northern Rockies Ecoregion	Good	4,463	57%	17%
	Fair	2,060	26%	15%
	Poor	1,373	17%	13%
Blue Mountains Ecoregion	Good	50	100%	0%
	Fair	0	0%	0%
	Poor	0	0%	0%
All Streams Statewide	Good	32,532	47%	5%
	Fair	16,266	24%	5%
	Poor	20,406	29%	5%

Table 4- 8. Aquatic Life Use Support of Streams (Ecology 2002)**.**

Strata	Rating	Size (miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Large Stream	Good	1,812	83%	14%
	Fair	198	6%	9%
	Poor	165	11%	12%
Small Streams	Good	58,499	91%	5%
	Fair	4,875	6%	4%
	Poor	3,656	3%	3%
Coast Range Ecoregion	Good	5,312	83%	14%
	Fair	354	6%	9%
	Poor	708	11%	12%
Puget Lowlands Ecoregion	Good	7,205	91%	5%
	Fair	497	6%	4%
	Poor	249	3%	3%
Willamette Valley Ecoregion	Good	568	100%	0%
	Fair	0	0%	0%
	Poor	0	0%	0%
Cascades Ecoregion	Good	17,771	100%	0%
	Fair	0	0%	0%
	Poor	0	0%	0%
East Cascades and Foothills Ecoregion	Good	3,249	100%	0%
	Fair	0	0%	0%
	Poor	0	0%	0%
Columbia Basin Ecoregion	Good	18,369	73%	9%
	Fair	3,270	13%	9%
	Poor	3,679	15%	7%
Northern Rockies Ecoregion	Good	6,866	87%	12%
	Fair	1,030	13%	12%
	Poor	0	0%	0%
Blue Mountains Ecoregion	Good	50	100%	0%
	Fair	0	0%	0%
	Poor	0	0%	0%
All Streams Statewide	Good	59,617	86%	4%
	Fair	5,392	8%	3%
	Poor	4,194	6%	3%

Table 4- 9. Fish Migration Use Support of Streams (Ecology 2002)

Strata	Rating	Size (miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Large Streams	Good	1,746	80%	8%
	Fair	214	10%	6%
	Poor	214	10%	6%
Small Streams	Good	64,203	96%	3%
	Fair	423	4%	2%
	Poor	404	1%	1%
Coast Range Ecoregion	Good	4,250	67%	16%
	Fair	266	4%	7%
	Poor	1,859	29%	15%
Puget Lowlands Ecoregion	Good	7,620	96%	3%
	Fair	249	3%	3%
	Poor	83	1%	2%
Willamette Valley Ecoregion	Good	568	100%	0%
	Fair	0	0%	0%
	Poor	0	0%	0%
Cascades Ecoregion	Good	17,771	100%	0%
	Fair	0	0%	0%
	Poor	0	0%	0%
East Cascades and Foothills Ecoregion	Good	2,843	88%	19%
	Fair	406	13%	19%
	Poor	0	0%	0%
Columbia Basin Ecoregion	Good	22,437	89%	7%
	Fair	2,909	1%	7%
	Poor	0	0%	0%
Northern Rockies Ecoregion	Good	7,553	96%	7%
	Fair	343	4%	7%
	Poor	0	0%	0%
Blue Mountains Ecoregion	Good	50	100%	0%
	Fair	0	0%	0%
	Poor	0	0%	0%
All Streams Statewide	Good	63,072	91%	3%
	Fair	3,796	5%	2%
	Poor	2,336	3%	2%

Table 4- 10. Fish Spawning Use Support of Streams (Ecology 2002).

Strata	Rating	Size (miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Large Streams	Good	1,911	88%	7%
	Fair	165	8%	5%
	Poor	99	5%	4%
Small Streams	Good	61,906	92%	3%
	Fair	2,989	4%	3%
	Poor	2,135	3%	2%
Coast Range Ecoregion	Good	5,312	83%	14%
	Fair	708	11%	12%
	Poor	354	6%	9%
Puget Lowlands Ecoregion	Good	7,494	94%	4%
	Fair	183	2%	3%
	Poor	274	3%	3%
Willamette Valley Ecoregion	Good	568	100%	0%
	Fair	0	0%	0%
	Poor	0	0%	0%
Cascades Ecoregion	Good	16,882	95%	8%
	Fair	889	5%	8%
	Poor	0	0%	0%
East Cascades and Foothills Ecoregion	Good	3,249	100%	0%
	Fair	0	0%	0%
	Poor	0	0%	0%
Columbia Basin Ecoregion	Good	21,257	84%	8%
	Fair	2,453	10%	6%
	Poor	1,635	6%	5%
Northern Rockies Ecoregion	Good	7,553	96%	7%
	Fair	343	4%	7%
	Poor	0	0%	0%
Blue Mountains Ecoregion	Good	50	100%	0%
	Fair	0	0%	0%
	Poor	0	0%	0%
All Streams Statewide	Good	62,997	91%	3%
	Fair	3,724	5%	2%
	Poor	2,482	4%	2%

Table 4- 11. Salmon Spawning Use Support of Streams (Ecology 2002).

Strata	Rating	Size (miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Large Streams	Good	1,933	89%	7%
	Fair	173	8%	6%
	Poor	69	3%	4%
Small Streams	Good	60,285	90%	4%
	Fair	3,794	6%	3%
	Poor	2,951	4%	3%
Coast Range Ecoregion	Good	6,374	100%	0%
	Fair	0	0%	0%
	Poor	0	0%	0%
Puget Lowlands Ecoregion	Good	7,288	92%	5%
	Fair	414	5%	4%
	Poor	249	3%	3%
Willamette Valley Ecoregion	Good	568	100%	0%
	Fair	0	0%	0%
	Poor	0	0%	0%
Cascades Ecoregion	Good	16,882	95%	8%
	Fair	889	5%	8%
	Poor	0	0%	0%
East Cascades and Foothills Ecoregion	Good	3,249	100%	0%
	Fair	0	0%	0%
	Poor	0	0%	0%
Columbia Basin Ecoregion	Good	19,713	78%	9%
	Fair	3,286	13%	8%
	Poor	2,347	9%	6%
Northern Rockies Ecoregion	Good	7,210	91%	10%
	Fair	343	4%	7%
	Poor	343	4%	7%
Blue Mountains Ecoregion	Good	50	100%	0%
	Fair	0	0%	0%
	Poor	0	0%	0%
All Streams Statewide	Good	69,034	90%	3%
	Fair	4,364	6%	3%
	Poor	2,806	4%	2%

Table 4- 12. Wildlife Habitat Use Support of Streams (Ecology 2002).

Strata	Rating	Size (miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Large Streams	Good	NA	NA	NA
	Fair	NA	NA	NA
	Poor	NA	NA	NA
Small Streams	Good	16,824	40%	21%
	Fair	16,824	40%	21%
	Poor	8,412	20%	17%
Coast Range Ecoregion	Good	4,592	75%	36%
	Fair	1,531	25%	36%
	Poor	0	0%	0%
Puget Lowlands Ecoregion	Good	0	0%	0%
	Fair	0	0%	0%
	Poor	7,553	100%	0%
Willamette Valley Ecoregion	Good	NA	NA	NA
	Fair	NA	NA	NA
	Poor	NA	NA	NA
Cascades Ecoregion	Good	4,370	25%	36%
	Fair	4,370	25%	35%
	Poor	8,741	50%	41%
East Cascades and Foothills Ecoregion	Good	1,611	50%	41%
	Fair	1,611	50%	41%
	Poor	0	0%	0%
Columbia Basin Ecoregion	Good	NA	NA	NA
	Fair	NA	NA	NA
	Poor	NA	NA	NA
Northern Rockies Ecoregion	Good	0	0%	0%
	Fair	7,681	100%	0%
	Poor	0	0%	0%
Blue Mountains Ecoregion	Good	NA	NA	NA
	Fair	NA	NA	NA
	Poor	NA	NA	NA
All Streams Statewide	Good	16,824	40%	21%
	Fair	16,824	40%	21%
	Poor	8,412	20%	17%

Table 4- 13. Overall Use Support of Estuaries (Ecology 2002).

Strata	Rating	Size (sq. miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Deep Open Water Areas	Good	1,415.1	75%	25%
	Fair	235.8	13%	19%
	Poor	235.8	13%	19%
Channels and Passages	Good	352.1	65%	18%
	Fair	108.3	20%	15%
	Poor	81.2	15%	13%
Bays, Inlets, and Harbors	Good	243.0	51%	12%
	Fair	116.2	24%	11%
	Poor	116.2	24%	11%
All Estuary Areas	Good	1,670.7	58%	10%
	Fair	636.5	22%	8%
	Poor	596.7	21%	8%

Table 4- 14. Aquatic Life Use Support of Estuaries (Ecology 2002).

Strata	Rating	Size (sq. miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Deep Open Water Areas	Good	628.9	33%	26%
	Fair	838.6	44%	27%
	Poor	419.3	22%	23%
Channels and Passages	Good	243.7	45%	18%
	Fair	216.7	40%	18%
	Poor	81.2	15%	13%
Bays, Inlets, and Harbors	Good	90.6	19%	10%
	Fair	181.1	38%	12%
	Poor	203.8	43%	13%
All Estuary Areas	Good	818.0	28%	9%
	Fair	1,145.2	39%	10%
	Poor	940.7	32%	9%

Table 4- 15. Fish Migration Use Support of Estuaries (Ecology 2002).

Strata	**Rating**	**Size (sq. miles)**	**Percent of Assessed Size**	**Precision of Estimate (+/- %)**
Deep Open Water Areas	Good	1,886.8	100%	0%
	Fair	0	0%	0%
	Poor	0	0%	0%
Channels and Passages	Good	514.6	95%	8%
	Fair	0	0%	0%
	Poor	27.1	5%	8%
Bays, Inlets, and Harbors	Good	444.5	93%	6%
	Fair	0	0%	0%
	Poor	31.0	7%	6%
All Estuary Areas	Good	2,746.9	95%	4%
	Fair	0	0%	0%
	Poor	157.0	5%	4%

Table 4- 16. Fish Spawning Use Support of Estuaries (Ecology 2002)

Strata	**Rating**	**Size (sq. miles)**	**Percent of Assessed Size**	**Precision of Estimate (+/- %)**
Deep Open Water Areas	Good	1,415.1	75%	25%
	Fair	235.8	13%	19%
	Poor	235.8	13%	19%
Channels and Passages	Good	487.5	90%	11%
	Fair	0	0%	0%
	Poor	54.2	10%	11%
Bays, Inlets, and Harbors	Good	380.4	80%	10%
	Fair	63.4	13%	8%
	Poor	31.7	7%	6%
All Estuary Areas	Good	2,386.7	82%	7%
	Fair	278.5	10%	6%
	Poor	238.7	8%	5%

Table 4- 17. Stream Use Impairments Caused by Temperature (Ecology 2002).

Strata	Assessed Size (miles)	Impaired Size (miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Large Streams	2,175	841	33%	10%
Small Streams	67,030	20,339	27%	6%
Coast Range Ecoregion	6,374	84	20%	17%
Puget Lowlands Ecoregion	7,951	1,449	16%	6%
Willamette Valley Ecoregion	568	284	50%	41%
Cascades Ecoregion	17,771	4,809	22%	16%
East Cascades and Foothills Ecoregion	3,249	0	0%	0%
Columbia Basin Ecoregion	25,345	12,067	55%	11%
Northern Rockies Ecoregion	7,896	2,486	33%	17%
Blue Mountains Ecoregion	50	0	0%	0%
All Streams Statewide	69,204	21,180	29%	5%

Table 4- 18. Estuary Use Impairments Caused by Temperature (Ecology 2002).

Strata	Assessed Size (miles)	Impaired Size (miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Deep Open Water Areas	1,886.8	1,617.2	86%	22%
Channels and Passages	541.6	379.1	70%	17%
Bays, Inlets, and Harbors	475.5	285.3	60%	12%
All Estuaries Areas	2,903.9	2,281.6	65%	9%

Table 4- 19. Stream Use Impairments Caused by Dissolved Oxygen (Ecology 2002).

Strata	Assessed Size (miles)	Impaired Size (miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Large Streams	2,287	157	6%	5%
Small Streams	67,030	12,732	18%	5%
Coast Range Ecoregion	6,374	28	7%	11%
Puget Lowlands Ecoregion	7,951	1,469	16%	6%
Willamette Valley Ecoregion	681	0	0%	0%
Cascades Ecoregion	17,771	4,786	17%	14%
East Cascades and Foothills	3,249	0	0%	0%
Columbia Basin Ecoregion	25,345	4,661	15%	8%
Northern Rockies Ecoregion	7,896	1,963	24%	15%
Blue Mountains Ecoregion	50	0	0%	0%
All Streams Statewide	69,317	12,889	15%	4%

Table 4- 20. Estuary Use Impairments Caused by Dissolved Oxygen (Ecology 2002).

Strata	Assessed Size (miles)	Impaired Size (miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Deep Open Water Areas	1,886.8	1,886.8	100%	0%
Channels and Passages	541.6	477.9	88%	13%
Bays, Inlets, and Harbors	475.5	289.4	61%	12%
All Estuary Areas	2,903.9	2,654.1	72%	9%

Table 4- 21. Stream Use Impairments Caused by pH (Ecology 2002).

Strata	Assessed Size (miles)	Impaired Size (miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Large Streams	2,287	343	14%	7%
Small Streams	67,030	19,653	18%	5%
Coast Range Ecoregion	6,374	28	7%	11%
Puget Lowlands Ecoregion	7,951	105	1%	2%
Willamette Valley Ecoregion	681	0	0%	0%
Cascades Ecoregion	17,771	3,178	11%	12%
East Cascades and Foothills	3,249	1,289	25%	25%
Columbia Basin Ecoregion	25,345	12,515	43%	11%
Northern Rockies Ecoregion	7,896	2,880	29%	16%
Blue Mountains Ecoregion	50	0	0%	0%
All Streams Statewide	69,317	19,996	17%	4%

Table 4- 22. Estuary Use Impairments Caused by pH (Ecology 2002).

Strata	Assessed Size (miles)	Impaired Size (miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Deep Open Water Areas	1,886.8	471.7	25%	25%
Channels and Passages	541.6	127.4	24%	17%
Bays Inlets and Harbors	475.5	79.2	17%	9%
All Estuary Areas	2,903.9	678.4	19%	8%

Table 4- 23. Stream Use Impairments Caused by Ammonia-Nitrogen (Ecology 2002).

Strata	Assessed Size (miles)	Impaired Size (miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Large Streams	2,287	0	0%	0%
Small Streams	67,030	111	1%	1%
Coast Range Ecoregion	6,374	0	0%	0%
Puget Lowlands Ecoregion	7,951	111	1%	2%
Willamette Valley Ecoregion	681	0	0%	0%
Cascades Ecoregion	17,771	0	0%	0%
East Cascades and Foothills Ecoregion	3,249	0	0%	0%
Columbia Basin Ecoregion	25,345	0	0%	0%
Northern Rockies Ecoregion	7,896	0	0%	0%
Blue Mountains Ecoregion	50	0	0%	0%
All Streams Statewide	69,317	111	0%	1%

Table 4- 24. Estuary Use Impairments Caused by Ammonia-Nitrogen (Ecology 2002).

Strata	Assessed Size (miles)	Impaired Size (miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Deep Open Water Areas	1,886.8	0	0%	0%
Channels and Passages	541.6	0	0%	0%
Bays, Inlets, and Harbors	475.5	0	0%	0%
All Estuary Areas	2,903.9	0	0%	0%

Table 4- 25. Stream Use Impairments Caused by Fecal Coliform (Ecology 2002).

Strata	Assessed Size (miles)	Impaired Size (miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Large Streams	2,287	532	24%	9%
Small Streams	67,030	35,790	59%	6%
Coast Range Ecoregion	6,374	2,833	44%	19%
Puget Lowlands Ecoregion	7,951	4,970	57%	8%
Willamette Valley Ecoregion	681	284	50%	41%
Cascades Ecoregion	17,771	6,806	35%	18%
East Cascades and Foothills Ecoregion	3,249	1,933	38%	28%
Columbia Basin Ecoregion	25,345	15,569	45%	10%
Northern Rockies Ecoregion	7,896	3,927	48%	17%
Blue Mountains Ecoregion	50	0	0%	0%
All Streams Statewide	69,317	36,322	49%	5%

Table 4- 26. Estuary Use Impairments Caused by Fecal Coliform (Ecology 2002).

Strata	Assessed Size (miles)	Impaired Size (miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Deep Open Water Areas	1,886.8	539.1	29%	28%
Channels and Passages	541.6	125.0	23%	19%
Bays Inlets and Harbors	475.5	147.6	31%	14%
All Estuary Areas	2,903.9	811.6	29%	11%

Table 4- 27. Stream Use Impairments Caused by Metals (Ecology 2002).

Strata	Assessed Size (miles)	Impaired Size (miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Large Streams	1,873	1,136	64%	21%
Small Streams	39,635	30,759	50%	26%
Coast Range Ecoregion	0	0	0%	0%
Puget Lowlands Ecoregion	7,951	2,783	50%	24%
Willamette Valley Ecoregion	0	0	0%	0%
Cascades Ecoregion	289	0	0%	0%
East Cascades and Foothills Ecoregion	26	26	100%	0%
Columbia Basin Ecoregion	25,345	25,031	80%	29%
Northern Rockies Ecoregion	7,896	4,056	75%	36%
Blue Mountains Ecoregion	0	0	0%	0%
All Streams Statewide	41,508	31,896	58%	17%

Table 4- 28. Indicators of Use Impairment in Streams (Ecology 2002).

Indicator	Impaired Size (miles)	Percent of Assessed Size
Fecal Coliform	36,322	49%
Metals	31,896	58%
Temperature	21,180	29%
pH	19,996	17%
Dissolved Oxygen	12,889	15%
Ammonia-Nitrogen	111	<1%

Table 4- 29. Indicators of Use Impairment in Estuaries (Ecology 2002).

Indicator	Impaired Size (sq. miles)	Percent of Assessed Size
Dissolved Oxygen	2,654	72%
Temperature	2,282	65%
Fecal Coliform	811	29%
pH	678	19%
Ammonia-Nitrogen	0	0%

5.0 ANALYSIS OF EFFECTS

The ESA Section 7 implementing regulations (50 CFR 402.02) 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 interrelated or interdependent with that action, that will be added to the environmental baseline. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur (50 CFR 402.02)."

5.A. Direct Effects

For the USEPA action there are no direct effects of consequence to ESA listed or proposed for listing anadromous fish because approving new water quality standards in and of its self will not change the environmental baseline or directly affect listed or proposed species.

5.B. Indirect Effects

Approving water quality standards may have indirect effects to listed species when Clean Water Act programs are implemented. These effects are indirect because they are likely to occur later in time when the programs are implemented. CWA programs that may lead to indirect effects include 303(d) listings, Total Maximum Daily Load (TMDL) management plans, National Pollutant Discharge Elimination System (NPDES) permits, CWA 401 certifications of federally licensed projects, and non-point source management plans designed to meet the water quality standards over time. Each of these programs is intended to control inputs of both point-source and nonpoint-source pollution to waterbodies such that the water quality standards are met in the receiving waters and aquatic life is protected. Effects to species described in Section 5.H. are indirect effects of EPA's approval action.

Note: The discussion below describes the various CWA and other programs where actual implementation occurs to attain water quality standards. Actual effects to listed species occur when on-the-ground implementation occurs. However, EPA is not assessing the adequacy of these programs to attain standards because EPA's action does not address approval of these various programs. EPA's action is approval of the standards. Therefore, the effect analysis in Section 5.H examines the effects to listed species of the standards themselves assuming they are attained. The discussion below is intended to provide context of how EPA's approval of standards relates to real on-the-ground actions that indirectly effect listed species.

Washington's surface water quality standards consist of three primary components: 1) designated uses (e.g., recreation, fish and wildlife habitat, water supply) that are assigned to the waters; 2) numeric and narrative criteria that designed to protect the specified designated uses; and 3) a water quality antidegradation program that provides special protection for existing uses and high quality waters.

The water quality standards establish the foundation for the state's water pollution control programs. Under state and federal laws and regulations human sources of pollution must not cause or contribute to an exceedance of the water quality standards. As such, regulated activities must be conditioned and designed to achieve the water quality standards. While the water quality standards of the state of Washington apply broadly to all categories and sources of pollution, there are jurisdictional and practical limitations that affect how well certain sources of pollution are brought into compliance. The following discussion is intended to provide a general overview on how the water quality standards are applied to protect water quality in the state of Washington.

1) Water Quality Assessments and TMDLs

Consistent with sections 303(d) and 305(b) of the federal Clean Water Act, every two years Ecology conducts an assessment of the health of its waters. Part of that assessment includes identifying any waters that do not meet the state water quality standards. Any waters where data shows the standards are not being met are placed on an impaired waters list. Waters on this list are then prioritized for water quality management plans (TMDLs) that identify the needed pollutant reductions from point and nonpoint sources that will be needed to bring the waters into compliance with the water quality standards. The water quality management plans are a primary mechanism for determining how much pollutant reduction will be required from each contributing source. The pollutant allocations placed in these plans are then used in the NPDES permits for point sources of pollutants, and serve to guide watershed restoration programs for nonpoint sources.

The temperature and dissolved oxygen water quality standards that EPA proposes to approve will set the benchmarks that will a) be the basis for listing waters on the 303(d) list of impaired waters in the future, and b) serve as the temperature and dissolved oxygen targets in future TMDLs. Section 5.H. discusses the effects to listed species that will occur after rivers have met the targets established in the TMDLs. As discussed previously, many waterbodies in the State of Washington are already exceeding the1997 temperature standards and are listed on the State's 303(d) list. As a result, Ecology has developed a number of temperature TMDLs. A summary of TMDLs completed to date can be viewed at http://www.ecy.wa.gov/programs/wq/tmdl/watershed/index.html.

A review of this website shows that eight temperature TMDLs have been completed and include a detailed implementation plan, the TMDLs are: Stilliguamish, Upper White, South Praire, Willapa, Chehalis, Wind, Little Klickatat, and Teanaway Rivers and the rivers in the Wenatchee Forest. Additionally, Ecology is in the process of developing about nine other TMDLs in the near term, including: Lower Skagit, Bear-Evans, Green, Deschutes, Lower Puyallup, upper Yakima, Wenatchee, and Naches Rivers and Henderson Inlet. Many of the rivers where temperatures TMDLs are completed or underway also have dissolved oxygen TMDLs that have been completed or are underway.

Implementation of TMDLs will generally be beneficial to listed salmonid species because it occurs through programs designed to reduce current harmful water temperatures (and DO levels) to levels that achieve the water quality standards. The assessment of any remaining effects to endangered species after TMDLs have been implemented and achieve water quality standards is discussed in Section 5.H. of this document.

A review of the temperature TMDL's implementation plans, completed to date, shows that these plans rely heavily on existing programs to meet the load reduction targets to attain water quality standards. For example, to improve water temperature on forest lands, the Federal Forest Plan is the implementation mechanism for federal lands and the State's Forest Practices Act is the implementation mechanism for state lands. For agricultural lands, the primary mechanism is grant/loan incentive programs through the State's Conservation Districts. For urban lands, local ordinances in accordance with the Shorelines Management Act, Growth Management Act, and Ecology's Municipal Stormwater general permit are the primary mechanisms. The NPDES program is the mechanism used to address point sources discharges. Endangered Species Act Habitat Conservation Plans and federal actions under Section 7 (e.g., operations of federal dams) may also be implementation mechanisms to attain water quality standards. Additionally, TMDLs help prioritize areas for restoration to aid in acquiring special project funding, such as CWA 319 grants and salmon recovery funds. Many of these programs are discussed further below.

2) Point Source Discharges of Pollutants (NPDES Program)

Point sources refer to pollutants that enter surface waters from a discrete location such as from a discharge pipe. Formal permit programs are established under state and federal laws and regulations for point source discharges. These regulations include the requirement that permits be established to achieve compliance with the water quality standards.

The temperature and dissolved oxygen standards that EPA proposed to approve will be the basis for establishing temperature and BOD/COD, and ammonia effluent limits, and BMPs to meet these standards, in future NPDES permits. For existing NPDES permits where the water quality standards are becoming more stringent, EPA's approval of the 2006 standards will be beneficial relative to the existing environmental baseline because when the permits are re-issued, the effluent limits will become more stringent in order to ensure that the more stringent water quality standards are met in the water body. For new NPDES sources, the environmental baseline may likely be degraded from its baseline condition because the permit will allow some level of pollutants to be discharged to the water body. However, the water body will not be allowed to exceed the applicable water quality standards. EPA's effect analysis in Section 5.H., however, focuses on the effects to species after compliance with the new water quality standards.

a) NPDES Permits for Municipal and Industrial Dischargers

Municipal wastewater treatment facilities and industrial facilities that discharge wastewater are regulated under National Pollutant Discharge Elimination (NPDES) permits. NPDES permits are required for any point source discharges of pollution to waters of the state that are also waters of the United States. These permits set limits to the amount of pollutants that may be discharged to ambient waters. Limitations are established for wastewater wherever: a) EPA or the state has established minimum technology-based controls for a wastewater pollutant for the type of activity being regulated, or b) a reasonable potential exists for the wastewater discharge to exceed a water quality criterion. NPDES permits are on a five year renewal cycle that allows new water quality standards to be considered and incorporated in existing permits. Temperature and dissolve oxygen related (e.g., BOD/COD and ammonia) effluent limits are common limits included in NPDES permits for municipal and industrial discharges.

b) NPDES General Permits for Small but Numerous Point Sources of Pollution

The General Permit program was established in recognition there are some point sources of pollutants that are minor contributors individually but are very numerous around the state.

General permits cover a wide range of potential dischargers (e.g., municipal stormwater, industrial stormwater, construction stormwater, municipal drinking water systems, dairies, animal feeding operations, confined animal feeding operations, boatyards, aquatic pesticides, fish hatcheries, log sort yards, sand and gravel pits). Ecology's general permits can be viewed at: http://www.ecy.wa.gov/programs/wq/permits/index.html#general_permits.

General permits generally do not include specific water quality-based effluent limits. Rather, they generally include a menu of best management practices, or in some cases discharge benchmarks, designed to meet standards. The stormwater water general permits control run-off rates and effect summer base flows, which can affect the temperature levels in the river. The stormwater permits also control peak flow conditions, which can affect the physical conditions of the river, which also can affect water temperature. The dairy and animal feeding general permits are primarily focused on bacteria pollution, however, control of waste from these operations also helps minimize dissolved oxygen impacts.

3) Dams and Hydrological Modifications

Modifications to the channels, substrate, or flows of surface waterbodies are not regulated through a single permit program such as exists for point source pollutants. Opportunities to bring the wide variety of activities in this category into compliance with the water quality standards are highly variable.

a) Private and Non-federal Publicly Owned Hydropower Dams

Most existing and new proposed private and public utility hydropower dams require a federal operating license from FERC. As part of obtaining the license, the state must certify (under section 401 of the Clean Water Act) that the operation of the dam will not cause or contribute to a violation of the state water quality standards. As part of the 401 certification, a state may establish conditions for operation and structural improvements to protect water quality. These state requirements become part of the facilities federal license. Dams can have a significant impact on river temperatures and certifying that the dam meets temperature standards is a challenging aspect of many 401 certifications. The new temperature standards will generally make the 401 certification process more rigorous, especially with respect to the new spawning criteria.

b) Federal Hydropower Dams

Federal agencies are required by federal law to meet state water quality standards. The state, however, has no direct permitting or regulatory authority over federal projects. As such, the state relies on negotiations, and if necessary lawsuits against federal agencies, to bring these projects into compliance with the state standards. Similar to private dams, meeting temperature standards is a challenge for federal dams (e.g., Federal dams on the Columbia, Snake, and Yakima Rivers).

c) Non-Hydropower Dams

Owners of non-hydropower dams are required by state and federal law to meet state water quality standards. The state, however, has no comprehensive regulatory mechanism to ensure compliance at these dams. The state does have a number of regulations that cover some of the activities that occur at these sites: construction and stormwater NPDES permits; 401 water quality certifications for construction, fill and dredging; and shoreline permits.

d) Hydraulic Permits and In-Water Construction

Construction activities that occur in streams require a hydraulic permit from the state Department of Fish and Wildlife (WDFW). The primary purpose of these permits is to protect fish habitat, however, under interagency agreement WDFW will also notify Ecology if it appears water quality standards would be violated through an approved permit (typically focused on spikes in turbidity, which is an important water quality issue). If this occurs then Ecology will use permits or orders, as appropriate, to condition the activity further so as to achieve compliance with the water quality standards. Temperature and dissolved oxygen are typically not a significant issue with these permits.

e) Irrigation Projects

Federal Irrigation Projects are similar to federal dams (discussed above). The state does not possess formal review or permitting authority over the federal projects. The state does, however, have the authority to establish discharger permits to condition the application of aquatic pesticides in these waters. This is because the water itself is still waters of the state subject to the state water quality standards, and the application of pesticides can be considered point source pollution.

4) Nonpoint Source Controls

People or entities that contribute to nonpoint source pollution are not allowed to cause or contribute to a violation of the water quality standards. However, no formal permit or review program exists to ensure that all sources of nonpoint source pollution are controlled. Additionally, some potential solutions to nonpoint source pollution, such as establishing buffers and setbacks in building ordinances and zoning restrictions are not within the authority and influence of the department of Ecology. With the notable exception of forest practices activities, Ecology relies on cost sharing and voluntary compliance to obtain compliance from nonpoint sources. Ecology's Centennial and 319 Grant funds provide many opportunities each year for local governments and nonprofit organizations to develop new programs or otherwise improve their capacity to help control nonpoint pollution sources. Due to limited resources, Ecology reserves formal enforcement actions for only the most serious situations.

Washington's Water Quality Management Plan to Control Nonpoint Sources of Pollution, Volume 3, June 2005, recognizes elevated temperature as a major problem with the state's rivers and streams. Because of that recognition, one major objective that was developed is to restore degraded systems.

a) Forestry

In Washington forest practice regulations are specifically designed to comply with the state surface water quality standards. Through an adaptive management process, best management practices (prescriptions) undergo scientific scrutiny to select and promulgate rules that will meet the state standards. These rules are applied to forest practices throughout the state. Revisions to the water quality standards are to be followed by further evaluations to determine to what extent current prescriptions will need to be changed to reflect the water quality standards revisions. Compliance with temperature standards is a significant water quality consideration for the forest practices regulations. Waterbodies that have more stringent temperature criteria (i.e., water designated "Char" use ; "Class A" waters designated as "Core Summer Salmonid Habitat; and waterbodies where the application of the 13°C spawning criteria is applied) may need to be considered in future evaluations of the forest practice regulation.

b) Agriculture
No formal program exists to regulate nonpoint pollution from farms. Agricultural return water from nonpoint source runoff is exempt from NPDES permitting, except for agricultural operations which specially require NPDES permits (e.g. dairies, confined and unconfined Animal feeding operations, hatcheries and fish farms, etc.). For those agricultural operations that are not regulated under NPDES permits, Ecology primarily relies on education, cost sharing, and voluntary compliance to bring them into compliance with the standards. For facilities that create serious problems or threats to water quality, Ecology pursues formal enforcement actions to bring them rapidly into compliance. Ecology has entered into a memorandum of agreement with the state's conservation districts. That agreement brings the districts into partnership with Ecology in helping to bring farms into compliance with the state standards. The districts take a lead role in developing farm plans that will curb nonpoint runoff from problem farms and attain compliance with the state standards. These farm plans are also voluntarily adopted by farmers wanting to improve their operations. Agricultural activity has considerable impact of temperature and dissolved oxygen levels. Therefore, the new standards will serve to guide these agricultural related programs.

c) Urban Development
There is no formal review or permitting programs for nonpoint source pollution caused by urbanization. However, Ecology does anticipate the requirements of the municipal stormwater NPDES permits will assist source control efforts. Ecology recently expanded its municipal stormwater permit program to include small and medium cities located within the U.S. Census defined urban areas. The municipal stormwater permit program has not yet expanded to small municipalities outside the Census defined urban areas. Construction stormwater, industrial stormwater, and municipal stormwater NPDES permits are, however, designed to address point sources of pollution in the urban environment. As discussed above, urban stormwater can impact temperature conditions in the river. Existing stormwater permits are designed to attain standards. As more monitoring occurs, if rivers fail to attain standards (including the new temperature standards), stormwater permits may be revised in the future to require more stringent measures to attain standards.

5.C. Effects from Interrelated Actions

For EPA's proposed approval of Washington's Water Quality Standards there is no distinction between indirect effects, discussed in section 5.B., and interrelated actions.

5.D. Effects from Ongoing Project Activities

As discussed in the environmental baseline section, land management actions in the State of Washington can affect water quality that, in turn, can have effects to aquatic biota including listed fish species. Because the Action Area is the entire State of Washington, specific ongoing human activities are varied and extensive. The brief discussion below is intended to reiterate the many actions across the State that effect temperature and dissolved oxygen levels. Generally, attaining the standards that EPA is proposing to approve will help improve the habitat conditions for listed salmonids in Washington.

Stream temperature regimes and dissolved oxygen levels are influenced by processes that are external to the stream as well as those that occur within the stream and its associated riparian zone. Human related activities that affect these processes are ones that either alter the processes that deliver/remove heat/DO for the stream or alter the physical characteristics of the stream itself. These activities include discharges from municipal and industrial facilities, discharges from nonpoint sources such as agriculture, forestry, and urban areas, and other human activities such as hydromodifications and water withdrawals. Stream characteristics such as depth, velocity, width, sediment transport, and water clarity affect temperature/DO. A summary of mechanisms resulting in reduced water quality and the related human activities are listed in **Table 5-2.** Limiting factors to salmonids in Washington are further described in the Puget Sound Salmon Recovery Plan (Volume I, 2007) and the Bull Trout Recovery Plans (USFWS 2004a, 2004b, 2002c). The extent of human activities that effect water temperature and DO is addressed in the Environmental Baseline (Section 5.E.).

Table 5-2. Human activities related to water temperature/dissolved oxygen effects.

Water quality effect	Limiting factor	Related Human Activity
Increased water temperature	Removal of riparian zone resulting in reduced stream shading	Road construction, forest timber harvest, agriculture, livestock grazing, conversion to urban/residential land use
Increase water temperature	Altered floodplain dynamics result in decreased hyphoreic flow	Road construction, forest timber harvest, agriculture, livestock grazing, conversion to urban/residential land use, flood control structures.
Increased water temperature	Altered channel morphology results in increased width/depth ratio increasing solar radiation to stream	Road construction, forest timber harvest, agriculture, livestock grazing, increased impervious surface from urbanization
Increased water temperature	Decreased summer flows	Agricultural water withdrawal for irrigation
decreased DO	Increased sedimentation	Road construction, forest timber harvest, agriculture, livestock grazing, conversion to urban/residential land use
decreased DO	Organic matter increase	livestock grazing, urban/residential land use (run-off from impervious surfaces)
decreased DO	Organic matter increase	Point-sources including treatment facilities

5.E. Description of how the Environmental Baseline would be Affected

5.E.1. Introduction

As described in the Environmental Baseline section of this document (see section 4.0), many rivers in Washington, with endangered or threatened salmonids species, exceed the temperature (and dissolved oxygen) criteria in the 1997 water quality standards as well as the temperature (and dissolved oxygen) criteria in the 2006 water quality standards. To the extent that CWA programs and other programs are successful in reducing these river temperatures (and increasing DO levels) to attain the 2006 water quality standards the environmental baseline will be improved. For rivers where the 2006 standards are more stringent and the 1997 standards are currently exceeded, the environmental baseline is expected to improve by a greater degree than under the 1997 standards.

The only situations where the environmental baseline may worsen are where: (1) the 2006 standards are less stringent than the 1997 standards and (2) the river segment is in attainment with the 1997 standards. As discussed below, there are two situations where this is possible. One situation is a river segment designated as "Core Summer Salmonid Habitat" use in the 2006 standards that was previously designated as "Class AA" in the 1997 standards and which is in attainment with the 1997 criteria. In this case, approving the 2006 water quality standard may allow an increase of 1°C to the river segment. A second situation is a river segment designated as "Salmon Spawning, Rearing, and Migration" use in the 2006 standards that was previously designated as "Class A" in the 1997 standards and which is in attainment with the 1997 criteria. In this case, the temperature of the river segment may be allowed to increase by 0.5°C.

However, for following reasons, EPA concludes it will be a rare circumstance (if at all) that the environmental baseline will become worse due to its approval of the 2006 water quality standards, including the above two situations. First, few river segments currently attain the 1997 standards or contribute to downstream river segments that attain the 1997 standards (this is particularly the case for river segments that were previously designated "Class A"). Second, for many of the situations where river segments were previously designated as "Class AA" and the temperature criterion in the 2006 standards is 1°C higher, the new more stringent 13°C spawning criterion also applies in July, August, or September 1st, which effectively keeps the stream temperatures below summer maximum criterion of 16°C (see below discussion). Third, many of the rivers that do attain the 1997 standards are in areas with established management programs in place that serve to minimize future degradation of water quality (e.g., national parks and national forest lands). Fourth, the State's antidegradation requirements are applicable in situations where the 1997 standards are currently attained and the 2006 standards are less stringent, which serve to minimize any degradation to these streams

The discussion below summarizes the relative difference between 1997 and 2006 temperature standards. EPA notes, however, that the effects analysis in Section 5.H focuses on the effects to listed salmonid species from the 2006 standards themselves, not the incremental change between the 1997 and 2006 standards. The discussion below is just to provide context on the incremental change in the standards.

Washington's 1997 water quality standards (1997 WQS) used a "Class-based" system which assigned each waterbody to a particular "Class." For example, fresh waters were assigned to either Class AA, Class A, Class B, or Lake Class. Each "Class" contained a suite of beneficial uses (i.e., water supply uses, recreational uses, fish and shellfish use, etc.). In the 1997 WQS temperature criteria are specified for each Class. **Table 5-3** summarizes the temperature criteria for each Class.

Table 5-3. Existing Water Quality Criteria for Temperature (1997 WQS).

Class	Use	Temperature Criteria[1]
Class AA (extraordinary)	Salmonid and other fish migration, rearing, spawning, and harvesting.	16°C
Class A (excellent)	Salmonid and other fish migration, rearing, spawning, and harvesting.	18°C
Class B (good)	Salmonid and other fish migration, rearing, and harvesting. Other fish spawning.	21°C
Lake Class	Salmonid and other fish migration, rearing, spawning, and harvesting.	No measurable change from natural

1. Represents daily maximum temperature.

The 2003 WQS revisions removed the "Class" system and instead applied the beneficial uses that were contained in a "Class" directly to specific waterbodies. The general "fish and shellfish" use that was contained in each of the 1997 Classes was divided into specific aquatic life use categories in the 2003 WQS, and a new temperature criterion was adopted for each of these new aquatic life uses. The 2006 water quality standards revisions refined the “name” of the aquatic life use designations (as well as re-designated some waterbodies). **Table 5-4** below summarizes the new aquatic life designated uses and associated temperatures in the 2006 water quality standards revisions, which includes the 2003 WQS revisions:

Table 5-4. 2006 WQS Revision for Aquatic Life Uses and Temperature

Designated Use	Description	Highest 7-DADMax
Char Spawning and Rearing	The key identifying characteristics of this use are spawning or early juvenile rearing by native char (bull trout and Dolly Varden), or use by other aquatic species similarly dependent on such cold water. Other common characteristic aquatic life uses for waters in this category include summer foraging and migration of native char; and spawning, rearing, and migration by other salmonid species. Note: Where Ecology determined the Char Spawning and rearing temperature criterion of 12° C would likely not result in protection of spawning and incubation the 9° C criterion was applied.	12° C 9° C
Core Summer Salmonid Habitat	The key identifying characteristics of this use are summer (June 15 – September 15) salmonid spawning or emergence, or adult holding; use as important summer rearing habitat by one or more salmonids; or foraging by adult and subadult native char. Other common characteristic aquatic life uses for waters in this category include spawning outside of the summer season, rearing, and migration by salmonids. Note: Where Ecology determined the Core summer salmonid habitat criterion of 16° C would likely not result in protection of spawning and incubation the 13° C criterion was applied.	16° C 13° C
Salmonid Spawning, Rearing, and Migration	The key identifying characteristic of this use is salmon or trout spawning and emergence that only occurs outside of the summer season (September 16 -June 14). Other common characteristic aquatic life uses for waters in this category include rearing and migration by salmonids. Note: Where Ecology determined the Salmonid spawning, rearing, and migration criterion of 17.5° C would likely not result in protection of spawning and incubation the 13° C criterion was applied.	17.5° C 13° C
Salmonid Rearing and Migration only	The key identifying characteristic of this use is use only for rearing or migration by salmonids (not used for spawning).	17.5° C
Non-anadromous Interior Redband Trout	For protection of waters where the only trout species is a nonanadromous form of self-reproducing interior redband trout (O. mykis), and other associated aquatic life.	18° C
Indigenous Warm Water Species	For protection of waters where the dominant species under natural conditions are temperature tolerant indigenous nonsalmonid species. Examples include dace, redside shiner, chiselmouth, sucker, and northern pikeminnow.	20° C

The following describes the temperature changes that occur when changing from the 1997 Class-based system to the proposed use-based system. The change in temperature that will occur to a waterbody based on the application of its new use designation and associated temperature criterion are summarized in **Table 5-5** below.

Table 5-5. Temperature changes resulting from the new use designations and associated temperature criteria.

1997 Water Quality Standards	2006 Water Quality Standards	

Class	Temperature criterion[1] (7DADMax)	Use designation	Temperature criterion (7DADMax)	Temperature change as a result of revised Water Quality Standards
Class AA	15°C	Char spawning and rearing (approx. 20% of State)	12 °C 9 °C (part of year)	- 3.0 °C - 6.0 °C (part of year)
Class AA	15°C	Core summer salmonid habitat (approx. 30% of State)	16 °C 13 °C (part of year)	+1 °C - 2 °C (part of year)
Class A	17°C	Salmonid spawning, rearing and migration (approx. 30% of State)	17.5 °C 13 °C (part of year)	+ 0.5 °C - 4.0 °C (part of year)
Class A	17°C	Core summer salmonid habitat (approx. 15% of State)	16 °C 13 °C (part of year)	- 1.0 °C - 4.0 °C (part of year)
Class A	17°C	Char spawning and rearing (<1% of State)	12 °C	- 5 °C
Class B	20 °C	Salmonid rearing and migration only (approx. 5% of State)	17.5 °C	- 2.5 °C
Class B	20 °C	Salmonid spawning, rearing and migration (<1% of State)	17.5 °C	- 2.5 °C
Lake Class	No measurable change from natural condition	Core summer salmonid habitat	Temperature increase can't exceed 0.3 °C above natural conditions	No change from how Ecology implemented their 1997 standard

Notes
1. The temperature standards in the 1997 Water Quality Standards were expressed as a 1-day maximum temperature. Class AA had a temperature criterion of 16 °C which is approximately equal to a 7DADMax of 15°C; Class A had a temperature criterion of 18°C which is approximately equal to a 7DADMax of 17°C; Class B had a temperature criterion of 21°C which is approximately equal to a 7 DADMax of 20°C.

1) Class AA Waters

Waters designated as Class AA in the 1997 WQS are designated as either "Char spawning and rearing designation" or "Core Summer Salmonid Habitat" in Washington's 2006 WQS. For those Class AA waters designated as "Char spawning and rearing designation" the temperature criterion will change from a daily maximum of 16°C to a 7-DADMax of 12°C. A daily max of 16°C is approximately equivalent to a 7-DADMax of 15°C (see *EPA Region 10 Guidance for Pacific Northwest State and Tribal Temperature Water Quality Standards*, April 2003 for explanation of temperature metric comparisons and references). Therefore, the Class AA streams that are designated as "Char spawning and rearing" designation will have approximately 3°C reduction in the allowable temperature. Approximately 20% of the State's streams fall into this category. These waters are generally in higher elevation regions of the State, generally above 700 feet on the west side of the Cascade Mountains and 2000 feet on the east side of the Cascade Mountains.

For those Class AA waters designated "Core Summer Salmonid Habitat" the temperature criterion will change from a daily maximum of 16°C to a 7-DADMax of 16°C. A daily maximum of 16°C would on be approximately equivalent to a 7-DADMax of 15°C. Therefore, the Class AA streams that are designated as "Core summer salmonid habitat" designation will have approximately 1°C increase in the allowable temperature. Approximately, 30% of the State's streams fall into this category. In general, these waterbodies are located in the western and eastern foothills of the Cascade Mountains (including the national forest lands), the Olympic peninsula, and the Colville, Okanogan, and Umatilla national forest lands in eastern Washington. These waterbodies are typically downstream of the “Char spawning and rearing” waters. It should be recognized, however, that the new 13°C spawning criteria also applies in these waters where ESA listed salmon occur. For many of these rivers segments, the 13°C criterion applies in July, August or September 1st, which effectively keeps the stream temperatures below the 16°C 7-DADMax criterion. This is because in order to attain the 13°C criterion, in most cases the seasonal temperature pattern necessitates that the summer maximum temperature be below 16° C. The 13°C criterion applies in July, August or September 1st for many of these rivers in this category in the Nooksack, Upper Skagit, Kitsap, Elwha-Dungennes, Wenatchee, Eniat, and Methow WRIAs. During the spawning/egg incubation period itself, the 2006 criteria would be 2°C more stringent than the 1997 criteria for most of the rivers in this category.

2) Class A Waters

Waters designated as Class A in the 1997 WQS were generally either designated as “Salmonid Spawning, Rearing and Migration.” or “Core Summer Salmonid Habitat” in Washington’s 2006 WQS. For those waters designated as “Salmonid Spawning, Rearing and Migration,” the temperature criterion will change from a daily maximum of 18°C to a 7-DADMax of 17.5°C. A daily max of 18°C would be approximately equivalent to a 7-DADMax of 17°C. Therefore, the Class A streams that are designated as “Salmonid spawning rearing and migration” will have approximately 0.5°C increase in the allowable temperature. Approximately, 30% of the State’s streams fall into this category. The vast majority of these streams are in eastern Washington, much of which are not used by listed ESA salmonids. A few lower main stem portions of large rivers in western Washington fall into this category (e.g., Stilliguamish, Snohomish, Duwamish, and Chehalis Rivers). It should be noted that salmon spawning/egg incubation that occurs in the rivers that fall under this category does not occur in the summer. For a few rivers in this category the 13°C spawning criteria applies from October 1 thru May 15 to protect spawning/egg incubation, which would be 2°C more stringent than the 1997 criteria (e.g., Lower Stilliguamish, Chehalis, and Wenatchee Rivers).

For those Class A waters designated “Core summer salmonid habitat,” the temperature criterion will change from a daily maximum of 18°C (approximately 17°C 7-DADMax) to a 7-DADMax of 16°C. Therefore, the Class A streams that are designated as “Core summer salmonid habitat” will have approximately 1°C decrease in the allowable temperature. Approximately 15% of the State’s streams fall into this category. This is the category of river segments that were designated as “Core summer salmonid habitat” as a result of EPA’s 2006 disapproval action. Most of the river segments in this category are in lower elevation regions in western Washington and the Columbia gorge.

Two Class A waters are designated as “Char spawning and rearing” in the 2006 WQS. In these cases, the temperature criterion will change from a daily maximum of 18°C (approximately 17°C 7-DADMax) to a 7-DADMax of 12°C. Therefore, Class A streams that are designated as “Char spawning and rearing” will have approximately 5°C decrease in the allowable temperature. These two waterbodies are located in WRIA 62 (Cedar Creek and Tacoma Creek).

3) Class B Waters

In general, most Class B waters will be designated as “Salmonid rearing and migration only,” there were also a few Class B waters that were designated as “Salmonid spawning, rearing, and migration." In both of these cases the temperature criterion will change from a daily maximum of 21°C to a 7-DADMax of 17.5°C. A daily max of 21°C would on be approximately equivalent to a 7-DADMax of 20°C. Therefore, the Class B streams that are designated as "Salmonid rearing and migration only" will have approximately 2.5°C decrease in the allowable temperature. Approximately 5% of the State's streams are designated as "Salmonid rearing and migration only," mostly in eastern Washington where no ESA listed salmonid occur. A few rivers with ESA listed salmonids are designated as "Salmon rearing and migration only" (e.g., lower Duwamish River, Lower Puyallup River, and Lower Hoquiam River).

4) Lake Class Waters

Lake Class waters will be designated as "Core summer salmonid habitat." The temperature criterion for Lake Class was "no measurable change from natural." In the new water quality standards, the temperature criterion is "For lakes, human actions considered cumulatively may not increase the 7-DADMax temperature more than 0.3°C above natural conditions."

5.E.2. Human Activities in the Environmental Baseline affected by the Action

In Section 5.B the various CWA programs affected as a result of the change in the water quality standards are discussed. The following sections describe human activities that are part of the environmental baseline that are likely to be affected to some degree by the changes in the water quality standards.

5.E.2.1. Point Source Dischargers

The State's NPDES permit database indicates that there are 370 individually permitted facilities in Washington. EPA classifies over 75% of these facilities as minor dischargers [facilities discharging less than 1 million gallons per day (mgd) and not likely to discharge toxic pollutants in toxic amounts]. **Table 5-6** provides a summary of all individual permits by industry and permit type.

Table 5-6. Summary of Individual NPDES Permitted Dischargers in Washington[1]

Standard Industrial Classification		Number of Facilities	
		Majors	Minors
Agriculture, Forestry, and Fishing			
01	Agricultural Production – Crops	-	4
02	Agricultural Production – Livestock and Animal Specialties	-	7
07	Agricultural Services	-	3
09	Fishing, Hunting, and Trapping	1	23
Mining			
10	Metal Mining	1	-
12	Coal Mining	1	1
14	Nonmetallic Minerals	-	3
Construction			
16	Heavy Construction	-	1
Manufacturing			
20	Food and Kindred Products	1	32
24	Lumber and Wood Products	-	15
26	Paper and Allied Products	15	1
28	Chemicals and Allied Products	1	7
29	Petroleum and Coal Products	5	3
32	Stone, Clay, and Glass Products	-	4

Standard Industrial Classification		Number of Facilities	
		Majors	Minors
33	Primary Metal Industries	8	3
34	Fabricated Metal Products	-	1
35	Industrial Machinery and Equipment	-	1
36	Electronic and Other Electronic Equipment	-	3
37	Transportation Equipment	1	12
38	Measuring, Analyzing, and Controlling Instruments	-	1
Transportation and Public Utilities			
42	Trucking and Warehousing	-	5
44	Water Transportation	-	1
45	Transportation by Air	-	1
47	Transportation Services	-	1
49	Electric, Gas, and Sanitary Services; except 4952	1	5
4952	Sewerage Services (POTWs)	30	135
Wholesale Trade			
51	Wholesale Trade – Nondurable Goods	-	8
Retail Trade			
55	Automotive Dealers and Service Stations	-	2
Services			
70	Hotels and Other Lodging Places	-	1
80	Health Services	-	2
82	Educational Services	-	2
87	Engineering, Accounting, Research, Management, and Related Services	1	3
Public Administration			
95	Administration of Environmental Quality and Housing Programs	-	1
96	Administration of Economic Programs	-	1
97	National Security and International Affairs	-	7
99	Nonclassifiable Establishments	-	1
	No SIC Code (blank in PCS)	-	3
	Total	66	304

'-' = None.
1. Source: Based on Washington State GIS files of NPDES facilities.

There are also 1,691 general permit dischargers (all classified as minor dischargers), most of which are small commercial facilities, small agricultural operations (e.g., cattle feed lots and dairy farms), and construction operations (e.g., sand and gravel pits). **Table 5-7** provides a summary of the general permits by industry.

Table 5-7. Summary of General NPDES Permitted Dischargers in Washington[1]

Standard Industrial Classification		Number of Facilities
Agriculture, Forestry, and Fishing		
01	Agricultural Production – Crops	1
02	Agricultural Production – Livestock and Animal Specialties	88
07	Agricultural Services	82
08	Forestry	4
09	Fishing, Hunting, and Trapping	77
Mining		
10	Metal Mining	3
12	Coal Mining	1
14	Nonmetallic Minerals	355
Construction		
16	Heavy Construction	1

Standard Industrial Classification		Number of Facilities
17	Construction – Special Trade Contractors	1
	Manufacturing	
20	Food and Kindred Products	37
22	Textile Mill Plants	2
24	Lumber and Wood Products	52
25	Furniture and Fixtures	1
26	Paper and Allied Products	10
27	Printing, Publishing, and Allied Products	2
28	Chemicals and Allied Products	37
29	Petroleum and Coal Products	26
30	Rubber and Miscellaneous Plastic Products	27
31	Leather and Leather Products	1
32	Stone, Clay, and Glass Products	64
33	Primary Metal Industries	8
34	Fabricated Metal Products	54
35	Industrial and Commercial Machinery and Computer Equipment	22
36	Electronic and Other Electrical Equipment and Components	6
37	Transportation Equipment	105
38	Measuring, Analyzing, and Controlling Instruments	4
39	Miscellaneous Manufacturing Industries	8
	Transportation and Public Utilities	
40	Railroad Transportation	5
41	Local and Interurban Passenger Transit	13
42	Trucking and Warehousing	70
44	Water Transportation	26
45	Transportation by Air	10
49	Electric, Gas, and Sanitary Services; except 4952	36
4952	Sewerage Services (POTWs)	7
	Wholesale Trade	
50	Wholesale Trade – Durable Goods	24
51	Wholesale Trade – Nondurable Goods	10
59	Miscellaneous Retail	1
	Services	
73	Business Services	1
76	Miscellaneous Repair Services	2
79	Amusement and Recreation Services	1
82	Educational Services	1

Table 5-8 continued. Summary of General NPDES Permitted Dischargers in Washington[1]

Standard Industrial Classification		Number of Facilities
	Public Administration	
95	Administration of Environmental Quality and Housing Programs	2
97	National Security and International Affairs	2
99	Nonclassifiable Establishments	1
	No SIC Code (blank in PCS)	400
	Total	**1,691**

1. Source: Based on Washington State GIS files of NPDES facilities.

5.E.2.2. Agriculture

Approximately 15,318,000 acres of land in Washington are used for production of crops or livestock for commercial sale and personal benefit (USDA, 2004). The most common agricultural activities leading to temperature impairments are those associated with crop growing (clear cutting), livestock access to riparian areas, and excess nutrients from runoff or irrigation return flows. Cultivating crops, clear cutting trees, and grazing livestock too close to stream banks can reduce stream shading, increase nutrients in runoff, and increase erosion rates which may lead to increases in stream levels.

In 1999, a coalition of farmers, environmental groups, government agencies, legislators, and tribes joined in a collaborative effort, known as the "Agriculture, Fish, and Water" (AFW) process, to address fish recovery and pollution control on farmland. The goal of this effort was to identify agriculture BMPs that could be placed into rule similar to the forest practices rules (see Section 2.3.3). However, the effort was unsuccessful, and Ecology staff and conservations districts are currently working directly with farmers to get them to take actions necessary to prevent water pollution.

State and Federal agencies also encourage pollution control efforts by providing technical and financial assistance to producers to implement structural and practice BMPs. For example, the Washington State Conservation Reserve Enhancement Program (CREP), authorized in 1998, set aside $250 million in State and Federal funding over 15 years to help pay for installation and other costs associated with riparian buffers on agricultural land (USDA, 1998). In addition, existing regulations in some counties require new agricultural operations to keep or plant riparian buffers (Ecology, 2003a).

5.E.2.3. Forestry

Over 20 million acres of private, State, and Federal lands in Washington are managed for commercial timber harvest (Ecology, 2000a). Forestry activities that can impair temperature include riparian harvest and road construction. Washington regulates forestry activities on State and private lands through the Washington Forest Practices Act (chapter 76.09 RCW) and the associated forest practices rules (Title 222 WAC). The forest practices rules dictate how the Forest Practices Act should be implemented. Although the rules are primarily implemented by the Department of Natural Resources (DNR), Ecology has authority to independently enforce the "water quality" components. The Washington Forest Practices Board (the authority empowered to enforce forest practices rules) designed and adopted the forest practice rules, in part, to meet the requirements of the CWA and State water quality standards. The rules contain an array of BMPs, including riparian buffer requirements, to protect water quality, provide fish and wildlife habitat, protect capital improvements, and ensure that harvested areas are reforested.

5.E.2.4. Urban Development

Urban development affects stream temperatures levels mainly through the higher temperatures and increased quantities of storm water runoff from impervious surfaces, and increased erosion of stream banks (Ecology, 2000a). Urban land tends to be six to eight degrees Fahrenheit warmer in the summer, and two to four degrees Fahrenheit warmer in the winter, than nonurban land (CWP, 2003). Storm water management is related primarily to land use. The regulation of land use is governed by the State Environmental Policy Act (SEPA), the Shoreline Management Act (SMA), and the Growth Management Act (GMA).

SEPA (43.21C RCW) requires a comprehensive environmental review for all projects that need a permit or approval from a State or local government entity (e.g., many construction activities), unless they fall into certain exempted categories.

SMA (90.58 RCW) provides authority for local governments to plan and regulate land uses on upland areas within 200 feet of shorelines, which include all marine waters, lakes over 20 acres in area, and streams with a mean annual flow of greater than 20 cubic feet per second (cfs). Under the SMA, each city and county adopts a shoreline master program based on State guidelines tailored to the specific needs of the community. More than 200 cities and all 39 counties have shoreline master programs. Most of these master programs contain provisions that require replanting in disturbed areas after project completion, prohibit beach enhancement within spawning, nesting, or breeding habitat, and ensure that shoreline uses and activities are conducted in a manner that minimizes environmental damage (e.g., implementation of reasonable setbacks, buffers, and storage basins for storm water).

The GMA (36.70A RCW) requires certain counties and cities to update their comprehensive plans with the intent to reduce urban sprawl. Each comprehensive plan shall include chapters on land use, transportation, housing, capital facilities, utilities, shorelines, and rural (for counties). Chapters addressing economic development and parks and recreation also are required, if State funding is provided (CTED, 2005). The plans are carried out by development regulations, such as zoning and land division codes. If the plans and regulations are inconsistent with the GMA, citizens, other local governments, or State agencies can challenge them before a growth management hearings board (CTED, 2005). The plans are also required to incorporate the city or county's shoreline management plan.

Additional programs support nonregulatory approaches for controlling pollution from urban sources, including the DNR's Urban and Community Forestry program, and local government plans and activities under the Watershed Planning Act (Ecology, 2000a).

5.E.2.5. Hydromodification

Hydromodification involves alteration of hydrologic characteristics of surface waters. Examples of hydromodification activities include stream channelization and channel modification, dam building, and vegetative clearing that leads to streambank and shoreline erosion. Hydromodification is regulated under SEPA and SMA (described above), as well as the Hydraulic Code (75.20 RCW). The Hydraulic Code and SMA require permits for projects at the land-water interface; the Hydraulic Code governs activities in the water, whereas the SMA governs those on land. The regulations implementing the Hydraulic Code state, in part, that "channel change/realignment projects shall only be approved where the applicant can demonstrate benefits or lack of adverse impact to fish life," and that these projects "shall incorporate mitigation measures as necessary to achieve no-net-loss of productive capacity of fish and shellfish habitat." The regulations also require erosion protection for disturbed areas, as well as other practices to avoid or reduce nonpoint source pollution (Ecology, 2000a).

5.E.2.6. Water Withdrawals

Water withdrawals are permitted by Ecology's Water Resources Program. The primary statutes relating to flows and flow setting are:

- Water Code (Ch. 90.03 RCW) – gives Ecology the exclusive authority to set flows and condition permits to established flows
- Minimum Water Flows and Levels Act of 1967 (Ch. 90.22 RCW) – establishes process for protecting instream flows and among other provisions, requires Ecology to consult with the Department of Fish and Wildlife and conduct public hearings
- Water Resources Act of 1971 (Ch. 90.54 RCW) – contains provisions that require base flows to be retained in streams except where there are "overriding considerations of the public interest," and allocation of water generally be based on the securing of "maximum net benefits" to the people of the State, and authorizes Ecology to reserve waters for future beneficial uses
- Construction Projects in State Waters (Ch. 77.55 RCW) – requires Ecology to consult with the Department of Fish and Wildlife prior to making a decision on any water right application that may affect flows for food and game fish
- Watershed Planning Act (Ch. 90.82 RCW) – requires local government to assess the impacts of current water withdrawals, and recommends the establishment of instream flows to protect aquatic ecosystems.

Ecology is required by law to protect instream flows by adopting regulations and to manage water uses that affect streamflow (Ecology, 2004c). An instream flow rule sets the minimum flows needed during critical times of the year to protect water quality. However, existing water rights are unaffected by such a rule (Ecology, 2004d).

5.E.2.7. Summary of Estimated Economic Impacts of the Action

Ecology developed a cost-benefit analysis on the 2006 water quality standards revisions. Ecology concluded the new rule would have an annual cost of $5.5 million to attain the new standards. Non-point sources in the form of establishing riparian buffers constituted the largest cost of $5.2 million annually. Point source control costs were estimated to be $318,000 annually. These cost estimates were upper bound estimates to reflect the incremental cost associated the attaining the 2006 standards relative to attaining the 2003 standards. However, these cost estimates probably more accurately represent the cost of meeting the 2006 standards relative to current conditions. Note: the new Char designations in the 2003 standards are not including in this analysis because they were previously adopted in 2003.

The following is an excerpt from the *Economic Analysis of the Proposed Water Quality Standards for the State of Washington,* June 2006, Washington State Department of Ecology.

Point Sources

Approximately 50 individual industrial and municipal facilities (5 majors and 45 minors) may discharge to waters for which the rule establishes revised uses and criteria compared to the 2003 WQS revision.[1] Major facilities have the greatest potential to influence costs due to their large

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1 General permitted facilities are not included in the cost analysis. Data for these facilities are extremely limited, and flows from such facilities are usually negligible. In addition, few general permits currently contain requirements to monitor for temperature, DO, BOD, or nutrients, and none currently contain numeric effluent limits. Thus, there

flows. Since relatively few majors are affected, the estimated costs reflect evaluations of each facility. For minors, costs represent estimates for a sample of facilities in each use classification reflecting a change in temperature criteria, extrapolated to all such minor facilities in each category (e.g., minor facilities affected by a change in use classification from noncore rearing to core summer salmonid habitat, and those discharging to waters specifically designated for char and spawning). Each of the facilities affected by a change in DO criteria is also affected by the change in temperature criteria (45 of 50 facilities). Thus, the sample of facilities used in the temperature analysis provides a means of estimating the incremental impacts attributable to the revised DO criteria. Potential compliance costs vary based on these proposed changes in use designations and associated temperature and DO criteria.

However, available data indicate that few facilities would have incremental impacts associated with the proposed rule. Annual estimated control costs range from $178,000 to $318,000, and reflect land application of a portion of the discharge during periods of high effluent temperature or nutrient and biochemical oxygen demand (BOD) concentrations.

Nonpoint Sources and Other Activities

Nonpoint sources that affect instream temperatures and DO concentrations include agriculture, forestry, and urban development. In the TMDLs Ecology developed to meet existing temperature standards, increased effective shade is the primary nonpoint source control for reducing stream temperatures; the primary measure for nonpoint source control is riparian buffers. Thus, riparian buffers are also likely to be the primary means for nonpoint sources to comply with the temperature provisions of the proposed rule.

Riparian buffers would reduce stream temperatures by increasing effective shade, improving thermal microclimates, reducing erosion and improving stream bank stability, increasing woody debris, and reducing channel width. A 100-foot buffer on either side of waters affected by the revised temperature criteria should provide maximum effective shading while also providing microclimate and other benefits.

Approved TMDLs for DO in Washington indicate that the DO criteria can be achieved through reductions in stream temperatures and BOD and nutrient (e.g., nitrogen and phosphorus) loads. Riparian buffers not only provide shade and microclimate benefits, reducing stream temperatures, but also provide filtration and serve other functions that reduce nutrient loadings to water. Reduced loadings of nutrients and sediment (including organic matter) will result in reduced BOD, which will in turn lead to higher instream DO concentrations. Lower stream temperatures also contribute to higher DO levels, since oxygen is more soluble in lower temperature water. Thus, for streams not affected by the change in temperature criteria (i.e., those waters upgraded from salmonid rearing and migration only to salmonid spawning, rearing, and migration), the incremental costs of achieving the DO criteria would include construction of a riparian buffer.

Riparian buffers are already required in some instances. The Washington Forest Practices Act and associated rules contain an array of best management practices (BMPs), including riparian

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are no data available to evaluate the impact that the revised 2006 standards would have on general facilities. However, Ecology is beginning to require additional monitoring in a number of general permits. If such monitoring shows that the discharger has the potential to cause or contribute to an exceedance of the proposed criteria, the permits could be changed to include temperature or DO limits, or an individual permit may be issued with requirements for temperature or DO in the context of a TMDL.

buffer requirements, to protect water quality and achieve other environmental goals. Thus, the proposed standards do not represent new requirements for the forestry sector.

As for point sources, compliance with the 2003 WQS revision represents the baseline control scenario for nonpoint sources; only incremental controls and costs needed to achieve further reductions represent the impact of the proposed rule. However, water quality modeling would likely be needed to determine baseline temperatures after implementation of controls (including riparian buffers) needed to attain the 2003 revision. An upper-bound scenario of the extent of riparian buffers that may be needed is all potentially plantable land adjacent to affected waters; this scenario likely overstates acreage needed and costs for compliance with the proposed rule.

Based on GIS analysis of USGS land cover data, there are 39,300 acres of agricultural, urban, or other potentially plantable (not including forest lands) land within 100 feet of waters affected by the proposed rule. Implementation costs of riparian buffers include unit costs of planting buffers and any opportunity costs associated with changing land use in the buffer area. Unit costs for planting riparian buffers range from $38/ac/yr to $43/ac/yr, and opportunity costs range from $0 to $5,592/ac/yr, depending on current land use. Assuming that riparian buffers would be implemented on all potentially plantable acres (e.g., agriculture, urban, and other potentially plantable lands) adjacent to affected waters, annual costs are approximately $2.8 million for newly designated core summer salmonid habitat waters, $2.2 million for newly designated spawning waters, $0.1 million for newly designated char waters, and $0.1 million for newly designated salmonid spawning, rearing, and migration waters (i.e., those waters affected only by the change in DO criteria), with a total annual cost of approximately $5.2 million.

The potential impact of the proposed rule on existing water rights is likely to be limited. State laws that protect instream water flows do not affect existing rights for off-stream water use (Ecology, 2004d). To enhance instream flows, the State can purchase existing water rights from willing owners. In these instances, the State bears the cost voluntarily (which implies that the benefits exceed the costs).

There are 146 dams within a 500-foot buffer of affected waters, 14 of which are Federally-owned. Sufficient monitoring data are not available to assess the impact that each of these dams may have on downstream stream temperatures or DO concentrations. To achieve the temperature criteria on spawning waters and the DO criteria on newly designated core summer salmonid habitat, char habitat, and salmonid spawning, rearing, and migration waters, dam modifications (e.g., change location of reservoir outlet) may be necessary, although for hydropower dams, any potential actions will be addressed during Federal relicensing and 401 certifications. Given the factors that influence which control actions should be implemented and the lack of available data, it is not possible to estimate incremental control costs for dams associated with the proposed rule. However, it is likely that controls necessary to meet the 2003 WQS revisions (i.e., baseline standards) would also result in compliance with the 2006 proposed standards.

5.F. Effects of the Action on Essential Elements of Critical Habitat

NOAA Fisheries and U.S. Fish and Wildlife Service designate critical habitat based on physical and biological features that are essential to listed species. Essential features of designated critical habitat include substrate, water quality, water quantity, water temperature, food, riparian vegetation, access, water velocity, space, and safe passage. In the ‘Effects to Listed Species’ section (section 5.H.) the effects to the listed species from the proposed temperature standard are examined. The primary issues addressed in this BE are the effects of water temperature to listed species. Any effects to listed species would likewise be an effect to Critical Habitat as the two are intrinsically linked. For example, excessive temperature is an effect to water quality (a Critical Habitat factor) and an effect to listed species. As previously stated in the Environmental Baseline (Section 4), water quality is integrated with other characteristics of physical habitat for fish in freshwater habitats. Efforts to control thermal inputs or to restore streams to thermal regimes that are more like conditions prior to human disturbance will have positive effects on other essential elements of critical habitat such as habitat complexity, cover from riparian vegetation, sorting of substrate.

5.G. Use of Best Scientific and Commercially Available Data

Most information used to evaluate the effects of temperature to listed fish species was from the document:

Water Temperature Criteria Technical Workgroup (WTCTW) 2001. Technical synthesis: Scientific issues relating to temperature criteria for salmon, trout, and char native to the Pacific Northwest. A summary report submitted to the policy workgroup of the USEPA Region 10 Water Temperature Criteria Guidance Project. EPA-910-D-01-007, May 2001.

This document synthesizes the available literature regarding thermal tolerances of northwest salmonids at various life history phases. This document was produced by a technical workgroup of Pacific Northwest scientists and resource managers that was established by the USEPA, with the purpose of examining important temperature related salmonid issues including: 1) the most recent science on how temperature affects salmonid physiology and behavior; 2) the combined effects of temperature and other stressors on threatened fish stocks; 3) the pattern of temperature fluctuations in the natural environment; and (4) other issues relevant to developing temperature guidance to protect salmonids. The resulting documentation that was used to generate the synthesis paper listed above consisted of the following five technical summaries.

Sauter et al. 2001. Issue paper 1: Salmonid behavior and water temperature. Prepared as Part of USEPA Region 10 Temperature Water Quality Criteria Guidance Development Project. EPA-910-D-01-001, May 2001.

Dunham et al. 2001. Issue paper 2: Salmonid distribution and temperature. Prepared as Part of USEPA Region 10 Temperature Water Quality Criteria Guidance Development Project. EPA-910-D-01-002, May 2001.

Poole et al. 2001. Issue paper 3: Spatial and temporal patterns of stream temperature. Prepared as Part of USEPA Region 10 Temperature Water Quality Criteria Guidance Development Project. EPA-910-D-01-003, May 2001.

Materna 2001. Issue paper 4: Temperature interaction. Prepared as Part of USEPA Region 10 Temperature Water Quality Criteria Guidance Development Project. EPA-910-D-01-004, May 2001.

McCullough et al. 2001. Issue paper 5: Summary of technical literature examining the physiological effects of temperature on salmonids. Prepared as Part of USEPA Region 10 Temperature Water Quality Criteria Guidance Development Project. EPA-910-D-01-005, May 2001.

The six papers listed above, along with USEPA's final Temperature Guidance document (USEPA 2003), provide the most recent, comprehensive, evaluation of the effects of temperature on salmonids in the Pacific Northwest. These resources are the primary sources used in this BE to assess the effects of Washington's proposed water quality temperature standards on salmonids found in Washington waters.

The technical synthesize documents were used to inform the EPA in the development of the EPA Region 10 Guidance for Pacific northwest state and tribal temperature water quality standards (USEPA 2003). As with the technical synthesis, the EPA Region 10 Temperature Guidance had the participation of numerous State, Tribal, Federal and other entities including personnel from the Fish and Wildlife Service and NOAA Fisheries (USEPA 2003). The temperature guidance contains summary information that was generated in the technical synthesis. The purpose of the temperature guidance is to describe the approach endorsed by the EPA for adopting temperature water quality standards. The guidance contains recommendations on how States and Tribes can designate uses and establish temperature numeric criteria for waterbodies that insure that the standards are protective under section 101(a)(2) of the Clean Water Act. Therefore, the temperature guidance is also referenced in the effects section.

A primary feature of this effects determination is the spatial distribution of each of the 'Designated Uses'. Because these designated uses are based on the salmonid use by life history phase, information on both spatial and temporal distribution was used by both Washington for the application of the designated uses to each waterbody and by the EPA for the approval of these water quality standards. The best available information of this type is from two Washington Department of Fish and Wildlife databases. The *Washington Lakes and Rivers Information System* (WLRIS) is a GIS database that contains the most recent information on salmonid distribution by life history phase, including known spawning and rearing, for specific species for specific waters (WDFW 2004). The fish distribution data in WLRIS are based on limiting factors analysis for defining the documented, presumed, and potential presence categories. For the determination of spatial application of the various temperature standards, the WLRIS data that was used was attributed with the documented fish presence data category (rather than presumed or potential). The database contains salmon, steelhead and bull trout data distribution data as well as known spawning and rearing information where it is available. The WLRIS database information used in this analysis were current as of June 2004 and were updated as WDFW received corrections.

The *Salmon Stock Inventory* (SaSI), database contains the spawning run timing periods for all known salmon runs in Washington (available online at http://wdfw.wa.gov/fish/sasi/.).

As a quality check of these two databases, the EPA held numerous meetings in 2005 with Tribes to solicit additional or updated information. The Washington Department of Fish and Wildlife also held several meetings in November/December 2005 with their state biologists to add updates or corrections. EPA acknowledges that, even with these efforts to ensure that the most current information on salmonid distribution and spawning timing were included in the analysis some areas may not be well known. However, these are the best available datasets for this type of analysis and much effort was made to ensure that these databases were up-to-date.

Information on distribution of char by life history was less well known by Washington State resource agencies. EPA relied on the US Fish and Wildlife Service recovery plan (USFWS 2002c, USFWS 2004a, USFWS 2004b). EPA supplemented this information by again soliciting for new information from local state, federal (USFWS and USFS), and tribal biologists.

5. H. Effects Determinations for Listed Fish Species and Designated Critical Habitats

As stated above in Section 5.B. all of the possible effects to T&E species from this action of approving Washington State's Water Quality Standards are considered indirect effects. This means that approval of the Washington's Water Quality Standards will not result in direct effects to Listed Species, rather effects may occur as a result of the application of these standards by the State of Washington, to the waters of the State. The evaluation of possible effects to species in this section considers the effects to listed species assuming the waters of the state are in attainment with the standards. As stated previously, the following effects analysis examines the effect to listed species from the 2006 WQS, and does not the address the adequacy of CWA program implementation or the incremental difference between the 1997 and 2006 WQS.

There are three possible determinations of effects to Listed Species under the ESA (USFWS and NMFS 1998). The determinations and their definitions are:

1) **No Effect (NE) -** the appropriate conclusion when the action agency determines its proposed action will have no adverse effects to listed species or critical habitat.

2) **Is not likely to adversely affect (NLAA) -** the appropriate conclusion when effects on listed species are expected to be discountable, insignificant, or completely beneficial. Beneficial effects are contemporaneous positive effects without any adverse effects to the species. Insignificant effects relate to the size of the impact and should never reach the scale where 'take' occurs. Discountable effects are those extremely unlikely to occur. Based on best judgment, a person would not (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or (2) expect discountable effects to occur.

3) **is likely to adversely affect (LAA) –** is the appropriate conclusion if any adverse effect to listed species may occur as a direct or indirect result of the proposed action or its interrelated or interdependent actions, and the effect is not discountable, insignificant, or beneficial (see definition of "is not likely to adversely affect"). In the event the overall effect of the proposed action is beneficial to the listed species, but also is likely to cause any adverse effects, then the proposed action "is likely to adversely affect" the listed species. An "is likely to adversely affect" determination requires formal section 7 consultation.

For the purposes of Section 7 of the ESA, any action that is reasonably certain to result in "take" is likely to adversely affect a proposed or listed species. The ESA (Section 3) defines "take" as "to harass, harm, pursue, hunt, shoot, wound, trap, kill, capture, collect or attempt to engage in any such conduct." Further, the term "harass" is defined as "an intentional or negligent act that creates the likelihood of injuring wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns such as breeding, feeding, or sheltering" (50 CFR 17.3). NOAA Fisheries has interpreted "harm" as "an act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, feeding, or sheltering" (64 FR 60727). The USFWS further defines "harm" as "significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering."

The analysis of effects of the proposed actions assumes that the species of interest are exposed to waters meeting the water quality standards. There are many waters in the State of Washington that currently do not meet the standards for temperature and dissolved oxygen. The action under consideration, at this time, is whether EPA's approval of Washington's new or revised standards will have an adverse effect on species of interest. As the State of Washington completes TMDLs designed to meet the revised standards, issues or re-issues NPDES permits in conjunction with those TMDLs, and incorporates nonpoint source controls to meet water quality standards, the condition of impaired waters, and thus the environmental baseline, will improve.

The following table (**Table 5-9**) describes the organization of location of the Standards that will be addressed in this BE.

Table 5-9. Organization of other water quality standards addressed in this BE.

BE section	New/revised Washington WQS regulations being considered by USEPA	Comment
N/A	Definitions - WAC-173-201A-020	definitions will be consulted on in the context of the provisions in which they are used
5.H.3-5.H.8.	Fresh water numeric temperature criteria, WAC 173-201A -200(1)(c), Table 200(1)(c)	Addressed concomitantly with the numeric criteria
5.H.3-5.H.8.	Fresh water aquatic life designated uses WAC 173-201A-200(1)(a)	Addressed concomitantly with the numeric criteria
5.H.9.-5.H.11.	Fresh water narrative temperature criteria, WAC 173-201A -200(1)(c)(i), (ii)(A), (iv),and (v)	
5.H.12.	Fresh water numeric dissolved oxygen criteria, WAC 173-201A-200(d)	EPA is approving the dissolved oxygen (D.O.) criteria only for those waterbodies where the D.O. criteria has changed
5.H.13.	Fresh water dissolved oxygen narrative criteria, WAC 173-201A -200(1)(d)(i) - (ii)	
5.H.14.	Fresh water total dissolved gas narrative criteria, Special fish passage exemption for the Snake and Columbia Rivers, WAC 173-201A -200(1)(f)(ii)	
5.H.15-5.H.16.	Marine water narrative temperature criteria, WAC 173-201A-210(1)(c)(i),(ii)	
5.H.17.	Natural and irreversible human conditions , WAC-173-201A-260(1)(a)	
5.H.18.	Procedures for applying criteria, WAC 173-201A-260(3)(a)	
5.H.18.	Upstream actions, WAC 173-201A-260(3)(b)	
5.H.18.	Multiple criteria, WAC 260(3)(c)	
BE section	**New/revised Washington WQS regulations being considered by USEPA**	**Comment**
5.H.3.-5.H.8.	Aquatic life use designations in WAC 173-201A-600(1) and in Table 602	Addressed concomitantly with the numeric criteria

5.H.1. Overview of Numeric Temperature Criteria

Washington's numeric criteria specified in Table 200(1)(c) are intended to generally be protective of the fresh water aquatic life uses. However, in some instances, early spawning salmonid may not be protected by these criteria. In these cases, more stringent spawning and incubation criteria are applied to protect these uses. Ecology's salmonid uses and applicable numeric criteria are similar to those EPA recommended in the Temperature Guidance. The scientific rationale and basis for EPA's recommended criteria, and by extension Washington's criteria, is described in the EPA Temperature Guidance (2003) and the supporting six Technical Issue Papers (EPA 2001).

Three of the Washington Water Quality Standards form the majority of the effects that are evaluated in this BE: the Fresh Water Numeric Temperature Criteria, WAC 173-201A - 200(1)(c), Table 200(1)(c); the Fresh Water Aquatic Life Designated Uses WAC 173-201A-200(1)(a); and the application of the Fresh Water Aquatic Life Uses found in, WAC 173-201A-600(1), and Table 602. These three elements of the standards, 'designated use', the associated 'numeric criteria', and 'location' of the designated use (i.e. the use designation that is assigned to a particular waterbody), are interrelated in their effect to salmonid species as they dictate: the species and life history phase that is effected, the temperature that a particular species and life history are exposed to, and, finally, the location of that effect based on species distribution. For this reason the evaluation of effects will address these portions of the water quality standards concomitantly. The remaining portions will be addressed separately.

The aquatic life use and associated temperature that the EPA is proposing to approve are those listed in Table 200(1)(c) of the Washington State Water Quality Standards. A list of the aquatic life use applied to waterbodies in Washington State is contained in Table 602 of Washington's Water Quality Standards (see Appendix A). Maps showing stream segments that need additional protection for spawning and incubation are included in Appendix C. The effects of each of these standards are analyzed in the following sections of this BE as show in the following Table (**Table 5-10**).

Table 5-10. BE sections that address each portion of the Fresh Water criteria from Washington Ecology Table 200(1)(c).

Table 200(1)(c) Aquatic Life Temperature Criteria in Fresh Water		
BE section	**Category**	**Highest 7-DADMax**
5.H.3	Char Spawning and Rearing designated use	12°C (53.6°F)
5.H.3.	Char spawning	9°C (48.2°F)
5.H.4.	Core Summer Salmonid Habitat designated use	16°C (60.8°F)
5.H.4.	Salmon and trout spawning	13°C (55.4°F)
5.H.5.	Salmonid Spawning, Rearing, and Migration designated use	17.5°C (63.5°F)
Table 200(1)(c) Aquatic Life Temperature Criteria in Fresh Water (continued)		
5.H.6.	Salmonid Rearing and Migration Only designated use	17.5°C (63.5°F)
5.H.7.	Non-anadromous Interior Redband Trout designated use	18°C (64.4°F)
5.H.8.	Indigenous Warm Water Species designated use	20°C (68°F)

*Note: both the non-andromous interior redband trout (18°C) and indigenous warm water species (20°C) freshwater criteria are currently not applied to any waters in the State of Washington therefore the effects determination of these two is limited to only the use and the numeric criteria.

Table 5-11 and **Table 5-12** below, provide summaries of the important water temperature considerations, which formed the scientific basis of USEPA's recommended temperature criteria. The tables are taken from the Temperature Guidance (USEPA 2003) and the supporting six Technical Issue Papers (see Table footnotes). Refer to these documents for more detail on the derivation of the numbers in the tables.

Table 5-11. Summary of Temperature Considerations for Salmon and Trout Life Stages (From Temperature Guidance, USEPA 2003).

Life Stage	Temperature Consideration	Temperature & Unit	Reference
Spawning and Egg Incubation	Temperature range at which spawning is most frequently observed in the field	4 - 14 °C (daily avg.)	Issue Paper 1,[1] pp. 17-18 Issue Paper 5,[2] p. 81
	Egg Incubation Studies - In good gravel - Optimal range	4 - 12 °C (constant) 6 - 10 °C (constant)	
	Reduced viability of gametes in holding adults	13 °C (constant)	Issue Paper 5, p. 16
Juvenile Rearing	Lethal temperature (1-week exposure)	23 - 26 °C (constant)	Issue Paper 5, pp. 12, 14 (Table 4), 17, and 83-84
	Optimal growth - Unlimited food - Limited food	13 - 20 °C (constant) 10 - 16 °C (constant) 10 - 17 °C (constant)	Issue Paper 5, pp. 3-6 (Table 1), and 38-56
	Rearing preference temperature in lab and field studies	<18 °C (7DADM)	Issue Paper 1, p. 4 (Table 2) USEPA 2003
	Impairment to smoltification	12 - 15 °C (constant)	Issue Paper 5, pp. 7 and 57-65
	Impairment to steelhead smoltification	>12 °C (constant)	Issue Paper 5, pp. 7 and 57-65
	Disease risk (lab studies) - High - Elevated - Minimized	>18 - 20 °C (constant) 14 - 17 °C (constant) 12 - 13 °C (constant)	Issue Paper 4,[3] pp. 12-23
Adult Migration	Lethal temperature (1-week exposure)	21 - 22 °C (constant)	Issue Paper 5, pp. 17, 83-87
	Migration blockage and migration delay	21 - 22 °C (average)	Issue Paper 5, pp. 9, 10, 72-74 Issue Paper 1, pp. 15-16
	Disease risk (lab studies) - High - Elevated - Minimized	>18 - 20 °C (constant) 14 - 17 °C (constant) 12 - 13 °C (constant)	Issue Paper 4, pp. 12 - 23
	Adult swimming performance - Reduced - Optimal	>20 °C (constant) 15 - 19°C (constant)	Issue Paper 5, pp. 8, 9, 13, 65 - 71
	Overall reduction in migration fitness due to cumulative stresses	>17 - 18 °C (prolonged exposure)	Issue Paper 5, p. 74

[1] Sauter, S.T., J. McMillan, and J. Dunham. 2001. *Issue paper 1: salmonid behavior and water temperature*. Prepared

as part of USEPA Region 10 Temperature Water Quality Criteria Guidance Development Project.

2 McCullough, D.A., S. Spalding, D. Sturdevant, and M. Hicks. 2001. *Issue paper 5: summary of technical literature examining the physiological effects of temperature on salmonids.* EPA-910-D-01-005. U.S. Environmental Protection Agency. 114 pp.

3 Materna, E. 2001. *Issue paper 4: temperature interaction.* EPA-910–D-01-004. Prepared as part of the U.S. Environmental Protection Agency's Region 10 Temperature Water Quality Criteria Guidance Development Project, Seattle, WA. 33 pp.

Table 5-12. Summary of Temperature Considerations for Bull Trout Life Stages (McCullough 2001).

Life Stage	Temperature Consideration	Temperature & Unit	Reference
Spawning and Egg Incubation	Spawning initiation	<9 °C (constant)	Issue Paper 5,[1] pp. 88 - 91
	Temperature at which peak spawning occurs	<7 °C (constant)	Issue Paper 5, pp. 88 - 91
	Optimal temperature for egg incubation	2 - 6 °C (constant)	Issue Paper 5, pp. 88 - 91 Issue Paper 5, p. 16
	Substantially reduced egg survival and size	6 - 8 °C (constant)	Issue Paper 5, pp. 18, 88 - 91
Juvenile Rearing	Lethal temperature (1-week exposure)	22 - 23 °C (constant)	Issue Paper 5, p. 18
	Optimal growth - Unlimited food - Limited food	12 - 16 °C (constant) 8 - 12 °C (constant)	Issue Paper 5, p. 90; Selong et al. 2001; Bull trout peer review 2002, as cited in USEPA 2003
	Highest probability to occur in the field	12 - 13 °C (daily maximum)	Issue Paper 5, p. 90; Issue Paper 1,[2] p. 4 (Table 2); Dunham et al. 2001 and Bull trout peer review 2002, as cited in USEPA 2003
	Competition disadvantage	>12 °C	Issue Paper 1, pp. 21 - 23; Bull trout peer review 2002, as cited in USEPA 2003

[1]McCullough, D.A., S. Spalding, D. Sturdevant, and M. Hicks. 2001. *Issue paper 5: summary of technical literature examining the physiological effects of temperature on salmonids.* EPA-910-D-01-005. U.S. Environmental Protection Agency. 114 pp.

[2]Issue Paper 1: Sauter, S.T., J. McMillan, and J. Dunham. 2001. Salmonid behavior and water temperature. Prepared as part of USEPA Region 10 temperature water quality criteria guidance development project.

5.H.2. Change in metric used to define the water temperature criteria/use categories (WAC 173-201A-200(1)(c))

The following is a discussion of the change in the temperature criteria metric in the Washington's 2003/2006 WQS. As stated previously, EPA is not examining the incremental change of the 2006 standards relative to the 1997 standards, which includes, in part, the change in temperature metric for the criteria. The effect determinations throughout Section 5.H examine the effects of the new 2006 standards (including the 2003 revisions) on listed species. The temperature metric is an integral aspect of the temperature numeric criteria. Therefore, the metric is not independently assessed, but rather considered as part of the effect assessment of the actual criteria. The discussion below, however, provides some context when comparing a 7-DADM temperature value to a maximum or weekly average value.

Washington's proposed metric for expressing water temperature will effects the application of all freshwater aquatic life temperature criteria. Prior to the 2003 rule change, an instantaneous maximum temperature was used as the water temperature metric. The new metric is the 7-day Average Daily Maximum (7-DADMax). The 7-DADMax is the measure of the maximum temperatures in a stream, averaged over a seven day period. This metric is considered better than the previous water temperature metric of an instantaneous Maximum because it is believed to integrate more information into one value. The metric is not overly influenced by the maximum temperature of any single day as it reflects an average temperature that fish are exposed to over a week-long period.

The 7DADMax metric is recommended for temperature standards by the USEPA *Region 10 Guidance for Pacific Northwest State and Tribal Temperature Water Quality Standards* (EPA910-B-03-002, April 2003, hereafter referred to as the Temperature Guidance, USEPA 2003). The Temperature Guidance and the six Technical Issue Papers that serve as the scientific basis for the recommendations in the Guidance may be found at: www.epa.gov/r10earth/temperature.htm.

The EPA recommends the use of this metric in the water temperature standard because it is believed to more adequately protect aquatic life against acute[2] effects (e.g. lethality) because the metric incorporates daily maximum temperatures. This metric can also be protective of chronic[3] effects to aquatic life (e.g. reduced growth) because the metric describes the thermal exposure over 7 days. The Temperature Guidance considered both acute and chronic effects to fish when developing its recommended temperature criteria.

When developing the recommended criteria in the Temperature Guidance EPA looked at a variety of salmonid studies to develop the temperature criteria protective of different salmonid uses (i.e., spawning, egg incubation, and fry emergence; juvenile rearing; and migration). Many of the studies that were reviewed by EPA expressed temperature as a "constant" value (i.e., the temperature in the study was kept at a constant value). For example, in
Table 5-11 the egg incubation studies show that the optimal temperature range for salmon and trout ranges from 6 - 10° C constant temperature. Using the salmonid studies EPA determined the "constant" temperature value that was protective of salmonid uses. Once that value was determined EPA translated the value to a 7-DADMax value. EPA used the method described below to translate the "constant" temperature value to a 7-DADMax value.

In general, studies have shown the 7-DADMax temperature in Pacific Northwest salmon and trout streams is about 3° C higher than the weekly mean temperature. For example, a stream with a 7-DADMax of 18° C will generally have a weekly mean value of 15° C. Additionally, based on studies of fluctuating temperatures, EPA concluded that when the mean temperature is above the optimal growth temperature for salmon (derived from the optimal growth studies), the mid-point between the mean and maximum temperatures is the "equivalent" constant temperature. The "equivalent" constant temperature is the value that can be compared to the "constant" value temperature in the salmon studies. Therefore, in Pacific Northwest salmon and

2 Acute – a stimulus severe enough to rapidly induce an effect such as lethality.
3 Chronic - a stimulus that lingers over a relatively long period of time. It is measured as reduced growth, reduced reproduction, lethality, etc.

trout streams, which have a 3° C temperature differential between the 7-DADMax and the weekly mean, the 7-DADMax temperature can be translated to an "equivalent" constant temperature by subtracting 1.5° C (i.e., the mid-point between the 7-DADMax and the weekly mean) from the 7-DADMax temperature. Conversely, a 7-DADMax temperature can be derived from a "constant" value temperature by adding 1.5° C to the "constant" value temperature. For example, based on the studies summarized in Table 5-1, the highest "constant" value temperature protective of salmon and trout juvenile rearing, under limited food conditions is 16°C. This constant value temperature can be translated to the 7-DADMax temperature by adding 1.5° C, which results in 17.5° C.

It should be noted that the Temperature Guidance states that for some chronic effects to salmon and trout (e.g., disease), it may be appropriate to subtract 3° C from the 7-DADMax criterion to determine thee "equivalent" constant temperature for comparison with the "constant" value temperature.

For bull trout streams, where the difference between the 7-DADMax and the weekly mean is smaller because there is less diurnal variation, EPA believes it is appropriate to subtract 0.5°C from the 7-DADMax criterion to make comparisons to juvenile growth studies at constant temperature in a typical stream (see Temperature Guidance, pages 19-20).

It is important to note that there are confounding variables related to in-stream temperatures that are difficult to account for but are important to recognize. For instance, the amount of diurnal variation in rivers and streams in the Pacific Northwest varies considerably; therefore, the difference between the 7-DADMax and the weekly mean will vary. The difference between the 7-DADMax temperature and the weekly mean may be less than 1°C for rivers with little diurnal variation and as high as 9°C for streams with high diurnal variation (USEPA 2003). Another variable is food availability. The temperature for which there is optimal juvenile growth depends on the food supply. Optimal growth temperatures under limited food supply are lower than those under unlimited/satiated food supply. Generally, EPA believes that laboratory studies under limited food availability are most reflective of environmental conditions fish typically experience. However, it is likely that there are situations where food is abundant, with the result that optimal growth temperatures would be higher. Thus, a particular 7-DADMax numeric criterion may be more protective in a situation where there are high diurnal variation and/or abundant food, and will be less protective in a situation where there is low diurnal variation and limited food.

5.H.3. Effects Determination for 12°C and 9°C Numeric Temperature Criteria applied to Char Spawning and Rearing Designated Use

5.H.3.1. Introduction

The key identifying characteristics of this designated use are spawning or early juvenile rearing by native char (bull trout and Dolly Varden), or use by other aquatic species similarly dependent on cold water. Other common characteristic of aquatic life uses for waters in this category include summer foraging and migration of native char; and spawning, rearing, and migration by other salmonid species. This section assesses the effects of 1) the 12°C temperature on the designated use, 2) the spatial application of the 12°C criterion, and 3) the spatial application of the 9°C early spawning char criterion.

5.H.3.2. Effects determination for 12°C and 9°C Temperature Criteria

Washington adopted 12°C (54°F) 7-DADMax to protect waters designated for char species (i.e. bull trout and Dolly Varden) spawning or early juvenile rearing. This criterion is the same as that recommended in the EPA Temperature Guidance (USEPA 2003). The 12°C 7-DADMax criterion roughly translates to a maximum weekly average temperature of 11°C, and an equivalent constant temperature of 11.5°C (53°F) for comparison to juvenile growth studies at constant temperatures (USMCCULLOUGH ET AL. 2001). The criterion is recommended by the EPA in order to: 1) protect juvenile bull trout from lethal temperatures [22°C to 23°C (72 to 73°F) constant]; 2) provide conditions during the period of summer maximum temperature and other times of the year that are in the optimal range when food is limited for juvenile growth [8 to12°C (46 to 54°F) constant]; 3) provide temperatures where juvenile bull trout are not at a competitive disadvantage with other salmonids [greater than 12°C (54°F) constant]; and 4) provide temperatures that are consistent with the temperatures observed in field studies identifying where juvenile bull trout have the highest probability to occur [12 to 13°C (54 to 55°F) daily maximum] (see **Table 5-11**).

EPA's Temperature Guidance (USEPA 2003) recommends a temperature of 9°C (48°F) to protect bull trout spawning. Because bull trout generally spawn in the late summer and fall in the same waters where young fluvial and resident juvenile bull trout rear, it is generally appropriate to protect both bull trout spawning and rearing use with a single numeric temperature criterion of 12°C (54°F), (EPA 2003). EPA has concluded that 12°C for the char spawning life history phase is protective. Thermal temperature patterns in Washington char waters indicate that if the summer maximum temperature is 12°C (54°F), temperatures will naturally decrease to levels that are protective of char spawning [9°C (48°F)] during the time of spawning in late summer and early fall (Washington Department of Ecology 2005, Unpublished Data). Likewise, temperatures will decline further with the progession of fall/winter resulting in temperatures that are protective of egg incubation [2 to 6°C (36 to 43°F)] during the winter incubation period.

Protectiveness of 12°C Criterion

Information used to determine if the 12°C temperature criterion is protective of bull trout is from the EPA Technical Synthesis of the Information Used to Develop the Temperature Guidance (MCCULLOUGH ET AL. 2001). This document is a synthesis of available literature with technical conclusions from a Workgroup of State, Federal, and Tribal scientists and water quality policy experts. From this synthesis, it was determined that 8-12°C is the thermal condition range that supports char biological functions of optimal growth of juveniles (Table 5-11).

The 12°C temperature is within the thermal range for optimal growth, indicating that char populations would be functional under this thermal condition. EPA has determined that its approval of the 12°C criterion, found in Table 200(1)(c) in WAC 173-201A-200(1)(c), **is not likely to adversely affect** Coastal/Puget Sound bull trout and Columbia River Basin bull trout.

The 12°C temperature is within the range of other salmon species that may co-occur with bull trout. According to the Technical Synthesis Document, 12°C is well within the thermal condition range of anadromous salmonids at various life history phases (Table 5.1). For these reasons, EPA has determined that its approval of the 12°C use found in Table 200(1)(c) in WAC 173-201A-200(1)(c) **is not likely to adversely affect:** Chinook salmon (Snake River Fall Run ESU, Snake River Spring/Summer Run ESU, Upper Columbia River Spring Run ESU, and Puget Sound ESU); Steelhead (Snake River ESU, Upper Columbia River ESU, Middle Columbia River ESU, and Puget Sound ESU).

USEPA has determined that its approval of the 12°C char temperature criterion found in Table 200(1)(c) in WAC 173-201A-200(1)(c) will have **no effect** on the following species because these fish do not occur in waters where this criterion applies: Snake River sockeye salmon and Ozette Lake sockeye salmon, Columbia River chum salmon, and Hood Canal chum salmon, Lower Columbia River coho salmon, lower Columbia Chinook and lower Columbia Steelhead.

Protectiveness of 9°C Criterion

Some bull trout populations spawn very early (e.g. late August) in the State of Washington. In waterbodies inhabited by these early spawners, Washington determined that the application of the 12°C (54°F) 7-DADMax criterion will not be protective of the char spawning designated use. In these areas, dependence on declining water temperatures in the autumn alone may be insufficient to protect these early spawners. Washington has adopted a spawning and incubation criterion (WAC 173-201A-200-(1)(c)(iv)) and has designated where and when the char spawning criterion is needed to protect the spawning and incubation life history phases for char.

According to the EPA Technical Synthesis of the information used to develop the Temperature Guidance (McCullough et al. 2001), temperatures of ≤ 9°C initiate spawning and spawning activity peaks at temperatures of ≤7°C . Successful bull trout egg incubation occurs at temperatures 2-6°C (Table 5-11).

The 9°C temperature is protective of the bull trout spawning life history as this is the temperature needed by bull trout to initiate spawning. At this temperature, the natural decline of temperatures associated with the progression of the autumn season will allow for the attainment of the peak spawning temperatures (≤7°C). Further declines in temperature result in optimum incubation temperatures (2-6°C). Therefore, EPA has determined that its approval of the 9°C criterion, found in Table 200(1)(c) in WAC 173-201A-200(1)(c), **is not likely to adversely affect** Coastal/Puget Sound bull trout and Columbia River Basin bull trout.

The 9°C temperature is within the range of spawning and incubation life history phases of salmon species that may co-occur with bull trout. According to the Technical Synthesis Document (McCullough et al. 2001) anadromous salmon, spawning is initiated between 7-14°C and incubation is optimal between 6-10°C (Table 5.1). For this reason, EPA has determined that its approval of the 9°C use found in Table 200(1)(c) in WAC 173-201A-200(1)(c) **is not likely**

to adversely affect: Chinook salmon ESUs (Snake River Fall Run, Snake River Spring/Summer Run, Upper Columbia River Spring Run, and Puget Sound); Steelhead (Snake River, Upper Columbia River, Middle Columbia River, and Puget Sound);

USEPA has determined that its approval of the 9°C char temperature criterion found in Table 200(1)(c) in WAC 173-201A-200(1)(c) will have **no effect** on the following species because these species do not occur in waters where this criterion applies: Snake River sockeye salmon and Ozette Lake sockeye salmon, Columbia River chum salmon and Hood Canal chum salmon, and Lower Columbia River coho salmon, lower Columbia Chinook, and lower Columbia Steelhead.

5.H.3.3. How streams were designated as Char Use by Washington State Department of Ecology

Washington converted streams that were Class AA and A waterbodies under the old 1997 State Water Quality Standards to the "Char" use designation if Washington knew or had reason to believe that char spawning and rearing took place in those waters. When designating streams for char use, Washington Ecology used the Washington Department of Fish and Wildlife (WDFW) database that identifies known char spawning areas. Databases are not available that document known early tributary rearing areas, however, Washington determined that early tributary rearing was typically in the same general locations as the known spawning areas. Because the databases documenting char spawning and rearing locations are incomplete, Washington could not use them exclusively to depict the locations of this use. Therefore, Ecology developed a method to estimate char use based on physical characteristics of Washington streams where that use has been confirmed. Washington Ecology studied the locations of known spawning areas in the WDFW database and found that their occurrence is largely restricted to a relatively narrow range of elevations and stream orders. Washington used this pattern of elevation and stream order to determine which streams would reasonably be expected to be current or potential char habitat.

Washington Ecology found that approximately 92% of all known spawning occurs in 1st, 2nd, and 3rd order streams[4]. The following table shows the stream orders of the known spawning areas (**Table 5-13**).

Table 5-13. Stream orders of known char spawning streams.

Stream Order	Known Spawning Streams		
	East Side	West Side	Combined
1	18%	24%	21%
2	36%	36%	36%
3	35%	35%	35%
4	10%	5%	8%
5	1%	0%	0%

Washington Ecology also analyzed the spawning data in relation to elevation. For each known

4 The stream order concept is a method of classifying streams. Headwater streams are assigned a stream order of 1. When two 1st order streams join, they form a 2nd order stream. When two second order streams join, they form a 3rd order stream, and so on.

spawning stream, the lowest elevation was calculated. The following table (**Table 5-14**) provides summary information of known spawning steams and their elevations:

Table 5-14. Elevation of known char spawning streams.

Elevation (in feet) of known spawning streams	East Side	West Side
Number of Streams	77	67
Average Elevation	3136	1395
Maximum Elevation	4650	3320
Minimum Elevation	1419	420
Lower 95th percentile	1889	676

Washington also found that the known spawning areas were concentrated at high elevation streams. Washington found that 94% of known spawning areas were above 2000 feet on the east side of the State, and above 700 feet on the west side of the State. Using the information about stream order and elevation of know spawning areas, Washington developed the following factors for determining which streams should be protected for char use:

1. All known spawning areas
2. All streams upstream of know spawning areas
3. All 3rd order streams and their tributaries, if they join a 4th order stream
4. All 2nd order streams and their tributaries will be protected if they join 4th order stream and they are above a stream protected by criteria 1 and 2, above

In addition to the above process for identifying waters that have the char spawning and rearing designated use, Washington Ecology included waters that were identified by EPA as needing this same designation. EPA conducted an analysis of all waters that were identified by USFWS in their Draft Recovery Plans for Bull Trout (USFWS 2002c, 2004a, 2004b). These draft plans include streams USFWS determined to be key bull trout spawning and juvenile rearing habitat for the 124 local bull trout populations in Washington State. There were approximately 92 stream reaches covering an estimated 600 stream miles the USFWS considered key spawning and juvenile rearing habitat that were not designated as “Char” use by the physical/landscape process used by Washington Ecology (described above).

EPA reviewed the information contained in the USFWS draft recovery plan as well as WDFW Databases for bull trout spawning, and other available information on bull trout use in each of these 92 stream reaches. EPA determined that streams should be considered as having the “Char” designated use if: 1) bull trout spawning has been documented based on WDFW data or other sources, 2) bull trout spawning/early tributary juvenile rearing is presumed based on indicators of such use (e.g., documentation of adult spawners, multiple age class use, proximity to known spawning, or isolated juvenile rearing in conjunction with available spawning habitat), or 3) bull trout spawning/early tributary juvenile rearing is likely to occur in the near future because the stream reach is viewed to be within the historic range, has suitable habitat, and is necessary to connect areas of known use and provide sufficient area to support a local bull trout population. Following this procedure, the EPA concluded that approximately 69 of the 92 stream reaches identified in the USFWS draft recovery plans should receive the “Char” use and should be protect with a 12°C temperature criterion. EPA considered the documentation of

"Char" use in the other 23 stream reaches as more speculative and without adequate basis to designation these stream segments as char.

Washington Ecology concurred with the EPA's findings and included the 69 stream reaches as 'Char' use. All stream reaches upstream of the 'Char' use were also designated as 'Char' to assure that the downstream waterbodies attain the 12°C criterion necessary to support their 'Char´use designation. All waters that receive a 'Char' use and application of the 12°C water quality standard are shown on Washington's GIS maps (see website: http://www.ecy.wa.gov/pubs/0610038/start.pdf.). Washington Ecology notes that this criterion is to protect char species, however, other salmonid species may be found in char waters. The 12°C criterion is well within their optimum thermal range of other salmonid species as described earlier.

5.H.3.4. Effects Determination for the application of 12°C to Char Spawning and Rearing Designated Use to specific waters of Washington State

This effects determination considers whether or not all waters in the Washington State that should have the designated use of Char spawning and rearing were actually identified and included. As discussed above, the EPA believes that a thorough review of existing literature as well as the application of a physical/landscape model resulted in a complete identification of char use waters. EPA has determined that Washington's application of the 12°C criterion to specific waters of the State as listed on Table 602 (Appendix A) to protect char spawning and rearing uses **is not likely to adversely affect:** Columbia River Basin bull trout and coastal/Puget Sound bull trout (except for several specific reaches described below), Chinook salmon ESUs (Snake River Fall Run, Snake River Spring/Summer Run, Upper Columbia River Spring Run, and Puget Sound); Steelhead ESUs (Snake River, Upper Columbia River, Middle Columbia River, and Puget Sound);

EPA has determined that application of the 12°C criterion to specific waters of the State to protect char spawning and rearing uses will have **no effect** on the following species because these fish do not occur in these waters. Snake River sockeye salmon and Ozette Lake sockeye salmon, Columbia River chum salmon and Hood Canal summer run chum salmon, lower Columbia River coho salmon, lower Columbia River Chinook, and lower Columbia River steelhead.

Of the waters identified by the USFWS as having likely or potential char spawning/juvenile use (USFWS 2004a, 2004b, 2002c), only 23 reaches were not included as char use by Washington because the data to support that these areas indeed are used by char were very sparse and inconclusive. Two of these reaches (Damfino Creek in WRIA 1 and Miller Creek in WRIA 7) occur in National Forest Service Wilderness Areas and the likelihood of human perturbation in these areas will be very minimal into the future. Of the remaining 21 reaches, future data collection as well as the possibility of range expansion could result in a change of status in these area (i.e. may have documented char use in the future). Therefore, EPA has determined that lack of application of the 12°C criterion to these stream reaches is **likely to adversely effect** Coastal/Puget Sound bull trout and Columbia River bull trout that may possibly inhabit these specific stream reaches (**Table 5-15**). The total stream length in this category is 114.1 miles.

Table 5-15. Stream reaches with a determination of 'Likely To Effect' to coastal/Puget Sound bull trout and Columbia River Basin bull trout for the lack of application of the 12°C to Char Spawning and Rearing Designated Use.

WRIA	Reach	Current Designated Use and Temperature Criterion	Reach length (mi)
WRIA 1 – Chilliwack/Nooksack	S Fork Nooksack R – RM 10.0 to RM 19.0	Core , 13°C Sept 1 – July 1	9
WRIA 1 – Chilliwack/Nooksack	Fobes Cr. (RM 18.5)	Core only	0.3
WRIA 7 - Snohomish/Skykomish R.	Money Creek – mouth to forks and above	Core only	4.2
WRIA 10 – Puyallup/White River	Clearwater River and tributaries – mouth to Milky Creek	Core , 13°C Sept 1 – July 1	7
WRIA 27 – Lewis River	Lewis River – from inlet of Yale Lake Reservoir to Swift Dam (RM 45- RM 48.3)	Core only	3.3
WRIA 27 – Lewis River	Lewis River – from RM 72.2 to RM 83.9	Core only	11.7
WRIA 27 – Lewis River	Speelyai Creek –mouth/confluence with Yale Lake/Reservoir to headwaters	Core only	4.5
WRIA 27 – Lewis River	Ole/Rain Creeks	Core only	1.4
WRIA 35 – Middle Snake River	Asotin Creek – confluence of South Fork to char designation	Core, 13°C Feb. 15-June15	0.8
WRIA 35 – Middle Snake River	Wormell Creek	Core only	5.2
WRIA 35 – Middle Snake River	Hefflefinger Creek	Core only	5
WRIA 35 – Middle Snake River	Charlie Creek – mouth to RM 2.3	Core only	2.3
WRIA 37 – Lower Yakima River	North Fork Ahtanum Creek – mouth to confluence of Middle Fork Ahtanum	Core, 13°C Feb. 15-June15	10.7
WRIA 39 – Upper Yakima	Upper Yakima River – upstream from Lake Easton (RM 202) to RM 208	Core, 13°C Sept1-June15	6
WRIA 39 – Upper Yakima	Middle Fork Teanaway – upper 9.2 mi.	Core, 13°C Sept15-June15 partial	9.2
WRIA 46 – Entiat River	Tillicum Creek – confluence of Mad River to char designation	Core, 13°C Aug15-June15 partial	2.4
WRIA 48 – Methow	Twisp River – confluence of Little Bridge Creek to char designation (War Creek Campground)	Core, 13°C Aug 15-July15	7.2
WRIA 62 – Pend Oreille	Harvey Creek – from Sullivan Lake to Paupac Creek	Core only	1.6
WRIA 62 – Pend Oreille	Ruby Creek – mouth to headwaters	Core only	12.5
WRIA 62 – Pend Oreille	Mill Creek – mouth to mile 1.3	Core only	1.3
WRIA 62 – Pend Oreille	Tacoma Creek –confluence of Little Tacoma to headwaters	Core only	8.5

5.H.3.5. How Ecology applies 9°C criterion to protect early char spawning

Washington determined the specific waterbodies where this criterion should apply by adopting the results of a data analysis conducted by EPA as documented in the EPA's disapproval documents (see Appendix D). The EPA compiled information on distribution of early bull trout spawning from numerous sources including WDFW's Bull Trout SaSI Report (WDFW 1998) and more recent data collected by U.S. Fish and Wildlife Service, U.S. Forest Service, and WDFW. From this data search, the EPA identified 25 stream reaches where early spawning occurs. These are presented in Appendix F of EPA's partial disapproval of Washington Water Quality Standards (see Appendix D of this document for a copy of EPA's partial disapproval letter). Based on the data found on char spawning timing in each of these reaches, EPA applied the following convention for a meaningful temporal application of the 9°C criterion to protect early char spawning: If bull trout spawning timing from the above sources indicated bull trout start spawning in "mid-August," "late August," or "the last week of August," then application of 9°C starts August 21. If bull trout spawning timing information indicated "September 1st" or "early September," then application of 9°C starts September 1st. Finally, EPA determined from discussions with local biologist that an end-date of May 15 for the 9°C criterion was appropriate as bull trout incubation is completed by this date across all areas.

Washington Ecology concurred with the findings of this analysis including both location of these 'early bull trout spawning reaches' and the start/end-dates for the application of the 9°C. Ecology adopted these into their water quality standards as depicted on Washington's GIS maps (see website: http://www.ecy.wa.gov/pubs/0610038/start.pdf). Washington Ecology notes that this criterion is to protect char species, however, other salmonid species may be found in bull trout waters. The 9°C criterion is within the optimum thermal range of other salmonid species as described earlier (**Table 5-12**).

Effects Determination for Application of 9°C locations

This effects determination considers whether or not all waters in Washington State with the designated use of char spawning and rearing, where pre-September spawning occurs, were actually identified and included in the Washington Standards. The EPA believes that the thorough review of existing literature and information from local biologists resulted in a complete identification of these waters. For the streams where this seasonal criterion of 9°C applies (see website: http://www.ecy.wa.gov/pubs/0610038/start.pdf). EPA has determined that its approval of the 9°C temperature criterion for Char Spawning use found in Table 200(1)(c) in WAC 173-201A-200(1)(c) **is not likely to adversely affect:** Columbia River Basin bull trout (except for several specific reaches listed below), Coastal/Puget Sound bull trout; Chinook salmon ESUs (Snake River Fall Run, Snake River Spring/Summer Run, Upper Columbia River Spring Run, , and Puget Sound); and Steelhead ESUs (Snake River, Upper Columbia River, Middle Columbia River).

USEPA has determined that its approval of the char temperature criterion found in Table 200(1)(c) in WAC 173-201A-200(1)(c) will have **no effect** on the following species because these fish do not occur in waters where this criterion applies: Snake River sockeye salmon and Ozette Lake sockeye salmon, Columbia River chum salmon, Hood Canal summer run chum salmon, lower Columbia River Chinook, lower Columbia River coho salmon, and lower

Columbia River Steelhead.

There were two reaches in the Naches River Basin (WRIA 38) where local biologist provided input that these area are used by early-spawning char, but Washington did not designate as needing the 9°C criterion to protect the early spawning Char use. The data to support their inclusion was considered insufficient. Because future data collection could result in a change of status of these two reaches and the fact that other reaches in this basin do have early spawning bull trout, the EPA has determined that the lack of application of the 9°C temperature criterion to these specific stream reaches listed in **Table 5-16** is **likely to adversely effect** Columbia River Basin bull trout.

Table 5-16. List of reaches with 'likely to adversely effect' Columbia River Basin bull trout determination based on lack of application of 9°C to early bull trout spawning.

WRIA	Location	Comment
WRIA 38 – Naches River	Upper Bumping River	Suspected early spawning by USFWS field biologists but currently no supporting data available.
WRIA 38 – Naches River	Upper North Fork Tieton River	Suspected early spawning by USFWS field biologists but currently only one redd showing October spawning.

5.H.4. Effects Determination for 16°C and 13°C Numeric Temperature Criterion applied to Core Summer Salmonid Habitat Designated Use

Introduction

The key identifying characteristics of the 'Core Summer Salmonid Habitat' designated use are: summer (June 15 – September 15) salmonid spawning, emergence, or adult holding; use as important summer rearing habitat by one or more salmonids; or foraging by adult and sub-adult native char. Other common characteristic of aquatic life uses for waters in this category include spawning outside of the summer season, juvenile rearing, and migration by salmonids. This section assesses the effects of: 1) the 16°C and 13°C temperature on the designated use, 2) the spatial application of the 16°C criterion, and 3) the spatial application of the 13°C criterion to protect spawning and incubation.

5.H.4.1. Effects determination for 16°C and 13°C Temperature Criterion

Washington adopted the16°C 7-DADMax criterion as the general year around criterion to protect waters designated for 'Core Summer Salmonid Habitat' use. This criterion is the same as that recommended in the EPA Temperature Guidance (EPA 2003) for use by salmon/trout 'Core' juvenile rearing life histories and also includes adult salmon holding use over the summer and adult and sub-adult bull trout foraging and migration use over the summer.

Washington also adopted the 13C 7-DADMax criterion that is applied at specific times and specific places to protect the salmon spawning and emergence life histories of this use if the natural decline in temperature was insufficient to protect these life histories.

EPA's Temperature Guidance (USEPA 2003) recommends a temperature of 13°C 7DADMax (55°F) to protect salmon spawning. However, because salmon generally spawn in the late summer and fall, EPA indicated in its Temperature Guidance (2003) that it may be appropriate to protect a combined salmon spawning and rearing use with a single numeric temperature criterion that limits summer maximum temperatures. The justification for a single criterion is based on the temporal nature of thermal patterns in Washington streams/rivers. Data from Washington Department of Ecology (Washington Department of Ecology, 2005,Unpublished Data) indicate that in Washington salmon-bearing waters where the summer maximum temperature is 16°C, temperatures will naturally decrease to levels that are protective of salmon spawning (i.e., 13°C) when spawning occurs in the mid-September or later. Also, temperatures will further decrease to protect egg incubation (6 to 10°C) during the winter.

There are only some stream reaches designated 'Core Summer Salmonid Habitat' use, where natural declines in water temperature with the onset of autumn coinciding with spawning activity are adequate to protect salmon spawning (i.e., those with spawning starting in mid-September). However, in most reaches with this use designation salmon and trout spawn relatively early. Dependence on natural temperature declines is insufficient to insure adequately cold water for early spawners in these stream reaches. In these locations, Washington applied the spawning criterion of 13°C (55.4°F) to protect salmon and trout spawning life history phases where this early spawning occurs. The 13°C criterion is also applied to waters where the fry of late season (spring) spawning steelhead emerge in summer, thus needing protection from warming summer conditions.

Protectiveness of 16°C criterion

Washington adopted this criterion to protect the "Core Summer Salmonid Habitat" use, which includes waters that support core salmon and steelhead juvenile rearing, adult salmon holding over the summer, and/or adult and sub-adult bull trout foraging and migration during the summer months. This criterion is identical to the criterion USEPA recommended in the Temperature Guidance (USEPA 2003) for this use, which roughly translates to 13°C maximum weekly mean, and an equivalent constant temperature of 14.5°C (58°F) for comparison to juvenile growth studies at constant temperatures. This criterion is designed to:

(1) protect juvenile salmon and steelhead from lethal temperatures [23 to 26°C (73 to 79°F) constant];

(2) provide conditions during the period of summer maximum temperature and other times of the year that are in the optimal range when food is limited for juvenile growth [10 to 16°C (50 to 61F) constant];

(3) protect against temperature-induced elevated disease rates [14 to 17°C (57 to 63F) constant];

(4) provide temperatures that juvenile salmon and trout prefer, as demonstrated by studies indicating fish in high densities at these temperatures [10 to 17°C (50 to 63F) constant or less than 18C (64F) 7DADM] (see Table 5-10);

(5) protect salmon and steelhead from competitive disadvantage with cool and warm water species which can occur when average temperatures are greater than 15°C and maximum temperatures exceed 17-18°C (see Ecology 2002 pp. 67);

(6) provide conditions during the period of summer maximum temperatures that

protect adult and sub-adult foraging and migration [less than 15°C] (see USEPA 2003 pg 27; and Bull Trout Peer Review 2002); and

(7) provide conditions that protect chinook salmon that are holding over the summer (see USEPA 2003).

This numeric criterion applies during the warmest times of the summer, the warmest years, and throughout the water body, including the lowest downstream extent of the waterbody designated for this use, which means that the 7DADM temperatures will be cooler than 16°C most of the time where this use occurs. This is true because: 1) if the criterion is met during the summer maximum period, then temperatures will be colder than that value during the rest of the year, and 2) because the criterion must be attained at the furthest point downstream where this use is designated, temperatures will generally be colder where the use occurs upstream due the effect of elevation on temperature, and 3) the criterion must be met in the warmest years, so that in most years, the waters will be colder.

Information used to determine if the 16°C temperature criterion is protective of salmonid species is from the EPA Technical Synthesis (McCullough et al. 2001) of the information used to develop the Temperature Guidance (USEPA 2003). This document is a synthesis of available temperature effects literature with conclusions from a Workgroup of State, Federal, and Tribal scientists and water quality policy experts.

Washington also elected to include summer salmon spawning or emergence (between June 15 – September 15) as part of the "Core summer salmonid habitat" use. However, 16°C is not the applicable criterion to protect salmon spawning, egg incubation, or emergence or the gametes in adult ripe salmon in the couple of weeks just prior to spawning. Rather, the 13°C criterion is the applicable criterion to protect these life history phases that are included as part of this use, unless the spawning occurs late enough in the year that the natural thermal decline is sufficient to protect these life history phases. The protectiveness of the 13°C criterion to support pre-spawning, spawning, egg incubation, and fry emergence is described separately below.

Temperature requirements for the salmon and trout reproductive life history phases (i.e. holding of adults with mature gametes, spawning/fertilization, and embryo development to emergence) are generally <16°C, based on available literature (see Table 5.1). Mature gametes within adult salmonids exposed to excessive temperatures can reduce fertilization success or embryo survival to emergence. Salmonid gamete viability is reduced at adult holding temperatures of >13-16°C according to the EPA (2001). A literature review of Chinook and other salmonids found that 16°C is excessive (McCullough 1999) for the protection of gametes in holding Chinook salmon. (EPA Temperature Guidance Issue Paper 5 – Summary of Technical Literature Examining the Physiological Effects of Temperature on Salmons pages 30-38).

Of the various reproduction related life history phases of salmon/trout (maturation of gametes, spawning/fertilization, embryo development, hatching), the gamete maturation process in holding adults occurs earliest in time. As previously stated, temperatures below ≤13 to16°C are considered protective of holding adults with mature gametes (EPA 2001). The Temperature Guidance recommends 16°C for adults holding over the summer and 13°C for spawning. These two temperatures effectively bracket the period where some adults may hold with mature gametes. The decline of temperature with the onset of fall or the application of the 13°C criterion will result in exposure of salmon at this life history to temperatures that are protective.

The 16°C temperature is protective of the "Core Summer Salmonid Habitat" because it is within the range of temperatures that are used by salmonid life histories specified under the designated uses listed by Washington Ecology including, emergence, adult holding; summer rearing, and foraging by adult and sub-adult salmonids. The 16°C is not protective of the reproductive life history phases of fertilization, embryo development, and hatching unless spawning occurs late enough that the natural temperature decline results in sufficiently cool temperatures. However, in cases where spawning occurs relatively early, the 13C criteria along with the natural decline in temperature protects this these history phase. This is discussed in the next section on the protectiveness of 13°C. Also, the 13°C criterion is applied into the spring where the 16°C would not be protective of late emerging steelhead fry.

For these reasons stated above, EPA has determined that its approval of the "Core summer salmonid habitat" temperature criterion (16°C) **is not likely to adversely affect:** Chinook salmon ESUs (Snake River Fall Run, Snake River Spring/Summer Run, upper Columbia River Spring Run, lower Columbia River, and Puget Sound); Steelhead ESUs (Puget Sound, Snake River, upper Columbia River, middle Columbia River, and lower Columbia River); Columbia River chum salmon, Hood Canal summer run chum salmon, and lower Columbia River coho salmon.

Information to substantiate the thermal needs of char during the sub-adult foraging and migration life history phases was limited (McCullough et al. 2001). Based on this limited information it is believed that bull trout temperature preferences in mainstem systems is <15°C. It is likely but unknown that the 16°C salmon and trout rearing criterion would be protective of sympatric char species. Assuming char species would be unlikely to be exposed to average temperatures above 15°C and would likely find and use coldwater refugia in these larger systems, the application of the 16°C criterion would result in substantial area of colder water useable by char. Also, the upstream contributing stream reaches that the char would be migrating to would have colder temperatures because of higher elevation. For these reasons, EPA has determined that its approval of the "Core summer salmonid habitat" temperature criterion (16°C) **is not likely to adversely affect:** Columbia River Basin bull trout and Coastal/Puget Sound bull trout.

EPA has determined that its approval of the "Core summer salmonid habitat" temperature criterion (16°C (61°F)) will have **no effect** on the following species because these do not occur in any of the waters where this criterion applies: Snake River sockeye salmon and Ozette Lake sockeye salmon.

Protectiveness of 13°C criterion

Salmon/trout species spawn relatively early (e.g. late August and early September) in many waters of the State of Washington. In these particular areas, Washington determined that application of 13°C 7-DADMax criterion is needed to protect salmon/trout spawning use, as the natural decline of water temperatures in the autumn alone may be insufficient to yield adequately cold water for the spawning life history phase. Likewise, spring spawners that commence spawning activity late enough so that embryos could be exposed to warmer temperatures in the summer need to be protected with a specific criterion of 13°C. Washington has adopted a 13°C spawning and incubation criterion (WAC 173-201A-200(1)(c)(iv)) and has designated where and when this criterion is needed to protect spawning and incubation (see Appendix C).

Washington adopted this criterion to protect salmon and steelhead juvenile spawning through fry emergence. This criterion is identical to the criterion recommended in the USEPA Temperature Guidance (USEPA 2003) for this use. The diurnal variation when this criterion is applied is likely less than the diurnal variation in the summer so USEPA hypothesis that this 13°C 7DADM criterion would result in maximum weekly mean between 10-12°C for a typical stream. This criterion is designed to protect spawning, egg incubation, and fry emergence for salmon and trout. Meeting this criterion at the onset of spawning for salmon and at the end of incubation for steelhead trout will likely provide protective temperatures for egg incubation [6 to 10°C (43 to 50°F)] that occurs over the winter (salmon) and spring (trout), assuming the typical annual thermal pattern. This criterion is designed to:

(1) protect ripe gametes inside adults during the weeks just prior to spawning [less than 13°C (55°F) constant],

(2) provide temperatures at which spawning is most frequently observed in the field [4 to 14°C (39 to 57°F) daily average], and

(3) provide protective temperatures for egg incubation [4 to 12°C (39 to 54F) constant for good survival and 6 to 10°C (43 to 50°F) constant for optimal range] that occurs over the winter (salmon) and spring (trout), assuming the typical annual thermal pattern (see Table 5-10).

According to the “Technical Synthesis of the Information Used to Develop the Temperature Guidance” (McCullough et al. 2001), anadromous salmon spawning is most frequently observed within a temperature range of 4-14°C and incubation is optimal between 6-10°C (Table 5-10). Exposure of eggs in ripe females or newly deposited in gravel, and egg maturation are negatively affected by exposure to temperatures above approximately 12.5 to 14°C. A survey of temperature effects on spawning in fall –spawning salmonids, found that spawning temperatures of spring/fall Chinook has a 12.8°C peak and that a declining temperature trend into the autumn would satisfy biological requirements for developing salmonid embryos.

Salmonid gamete viability is reduced at adult holding average temperatures of >13-16°C according to the USEPA (2001). Similar to the logic that 13°C applied at the beginning of the spawning period will likely result optimal (6 to 10°C) temperatures for egg incubation over the winter assuming the typical annual temperature pattern, the 13°C criterion also is likely to result in temperatures that are protective of gametes in ripe adults just prior to application date of the spawning criterion (average temperature less than 13°C and short term maximum temperatures less than 14-15°C).

EPA has determined that its approval of the 13°C criterion, found in Table 200(1)(c) in WAC 173-201A-200(1)(c), **is not likely to adversely affect:** Chinook salmon ESUs (Snake River Fall Run, Snake River Spring/Summer Run, Upper Columbia River Spring Run, Lower Columbia River, and Puget Sound); Steelhead ESUs (Puget Sound, Snake River, Upper Columbia River, Middle Columbia River, and Lower Columbia River); Columbia River chum salmon, Hood Canal summer run chum salmon, and Lower Columbia River coho salmon.

Use by char of waters with the 13°C criterion would be predominately by bull trout during their foraging/migration life history phase, which as discussed above regarding the 16°C criterion, is sufficiently protective of this life history phase. For this reason, EPA has determined that its approval of the 13°C for salmon and trout spawning use found in Table 200(1)(c) in WAC 173-201A-200(1)(c) **is not likely to adversely affect** Columbia River Basin bull trout, Coastal/Puget Sound bull trout. Reaches where colder criteria of 12°C and 9°C were not applied to protect bull trout spawning and rearing, though they may have been appropriate, are addressed in the previous section (5.H.3.4.).

EPA has determined that its approval of the 13°C for salmon and trout spawning use found in Table 200(1)(c) in WAC 173-201A-200(1)(c) will have **no effect** on the following species because these fish do not occur in any of the waters where this criterion applies: Snake River sockeye salmon and Ozette Lake sockeye salmon.

5.H.4.2. How streams were designated as 'Core Summer Salmonid Habitat' Use by Washington State Ecology.

Washington State converted waters classified as Lake Class and Class AA waters under the old 1997 rules that were not assigned a "Char" use designation, as "Core Summer Salmonid Habitat". Although this simple conversion of the class-based waters to use-based waters adequately assigned many Washington streams to the correct use of "Core Summer Salmonid Habitat", some waters were not correctly identified with this method. EPA conducted an analysis of fish distribution data to identify other waterbodies that warranted the application of 16°C criterion based on use by rearing salmonids. The process used by EPA is thoroughly discussed in EPA's partial disapproval letter (Appendix D) and is summarized as follows.

EPA analyzed available fish information documenting the types of salmonid uses by life history phase in Washington State. EPA assessed these data in terms of five general fish presence categories where the EPA Temperature Guidance recommends applying a "Core Summer Salmonid Habitat" use designation and a 16° C. These use factors are:

1. moderate-to-high density *summer* juvenile salmon rearing
2. *summer* salmon/steelhead spawning or incubation
3. *summer* adult/sub-adult bull trout foraging and migration
4. *summer* juvenile rearing with current streams temperature at or below 16°C
5. the potential to support moderate-to-high density *summer* juvenile rearing that is important for the recovery of salmonids

The primary data used for this analysis were databases available from WDFW. These databases contain salmon/steelhead distribution and spawning timing data. WDFW Databases do not contain information documenting the timing/location of summer juvenile salmon rearing and summer adult/sub-adult bull trout foraging and migration. Therefore, EPA could not directly determine which streams should be designated for these two uses from WDFW Databases. Besides the WDFW databases, a thorough solicitation for additional information from Indian Tribes and local biologists was conducted to add updates and rectify any gaps or omissions in these databases. A summary of this additional information and the associated cited literature are in Appendix D of this document (see Appendix C and D of EPA's Partial Disapproval letter for additional information).

EPA determined that if the WDFW database indicated stream reaches had summer salmon/steelhead spawning or incubation, this was an adequate indication of other important fish uses that occur in these streams during summer (e.g. adult holding, juvenile rearing, bull trout foraging and migration). EPA concluded that the areas depicted as summer salmon/steelhead spawning or incubation in the WDFW GIS database should be assigned the 'Core Summer Salmonid Habitat' designated use and should be protected with a 16°C summer maximum criterion.

The rationale for designating streams with summer salmon/steelhead spawning or incubation as "Core Summer Salmonid Habitat" use, with an associated 16°C temperature criterion, is summarized below.

1. Adult Chinook, pink, sockeye, and chum salmon runs that begin spawning in the summer (i.e., mid-September or earlier) are present at the spawning grounds days to weeks, or sometimes months (e.g., spring Chinook) prior to the onset of spawning. These holding adult salmon need summer maximum temperatures at or below 16°C with declining temperature prior to spawning to protect the adults from disease and maintain the viability of developed gametes (after ovulation in females and after sperm maturation in males) (McCullough et al. 2001). This period prior to spawning essentially straddles the period of declining temperatures from 16°C to those temperatures protective of the spawning (13°C).

2. Salmon stocks need daily maximum temperatures to decrease to 13°C during the time of spawning for survival and growth of eggs (EPA Temperature Guidance Issue Paper 5 – Summary of Technical Literature Examining the Physiological Effects of Temperature on Salmonids pages 30-38, McCullough et al. 2001). Based on a review of the temperature patterns in Washington, streams with a 17.5°C summer maximum temperature are unlikely to cool to 13°C maximum temperatures by mid-September, but streams with a 16°C summer maximum temperature are more likely to cool to 13°C maximum temperatures by mid-September (Washington Department of Ecology, March 2005, Unpublished Data). Therefore, salmon stocks that begin spawning in mid-September or earlier are unlikely to be protected by a 17.5°C summer maximum criterion.

3. Incubating steelhead eggs need maximum temperatures to be at or below 13°C through the final stages of egg incubation and fry emergence for good survival and growth (McCullough et al. 2001). Based on a review of the temperature patterns in Washington, streams with a 17.5°C summer maximum temperature are unlikely to have 13°C maximum temperatures needed to protect egg incubation at the end of June, while those rivers with a 16°C summer maximum temperature are more likely to have 13°C maximum temperatures at the end of June (Washington Department of Ecology, March 2005). Steelhead stocks that end spawning in early June will likely have significant number of eggs in the final stages of incubation and fry emerging in late June. Steelhead eggs generally incubate in the gravels for 5-7 week. Time to emergence is also influence by the well known relationship between temperature and embryonic development where the rate of development is faster in warmer water (Quinn 2005).

A review of site-specific spawning and redd information indicates steelhead stocks that end spawning in early June (according to WDFW's SaSI Datatbase) will typically have substantial portion of spawning activity in mid to late May and occasionally have a few fish that spawn in early June. With the 5-7 week incubation period, steelhead stocks where the SaSI database indicates spawning ends in early June (and thus most spawning occurs in May), will likely have a substantial number of eggs in the final stages of incubation and fry emerging into late June because most of the spawning occurred in May. Some of these fry emerge into July.

4. Salmon fry emerge from the gravel in the spring (and into the summer for steelhead). These juveniles begin rearing near where they emerged from the spawning grounds. Some juvenile Chinook and all steelhead rear over the summer during their first year of life. The waters in the vicinity of the salmon/steelhead spawning areas are important initial rearing areas for these juveniles and often have relatively moderate-to-high density juvenile rearing use throughout the summer.

EPA applied the interpretation to the WDFW database that streams reaches depicted by WDFW as 1) salmon spawning beginning in mid-September or earlier *or* 2) steelhead spawning ending in early June or later, should be designated as "Core Summer Salmonid Habitat" use and protected with a 16°C temperature criterion.

There are several situations where EPA relied on site specific information that resulted in exceptions to EPA's general approach of relying on WDFW's Databases for determining where "Core" use is the appropriate use. In some situations, the WDFW Databases did not show summer salmon/steelhead spawning or incubation, but EPA did make a "Core" use determination based on one or more of the other factors listed previously. In other situations, the WDFW Databases showed summer salmon/steelhead spawning or incubation, but EPA did *not* make a "Core" use determination. Details of these specific determinations are explained in EPA's Partial Disapproval Letter contained in Appendix D of this document (see Appendix C and D of EPA's Partial Disapproval Letter for specific determinations).

EPA determined that tributaries that drain into waterbodies that EPA identified as needing the "Core Summer Salmonid Habitat' use and 16°C criterion should also have the 'Core' use designation. The reason for the extension of the use upstream is to assure that the downstream reaches attain the 16°C criterion necessary to support their "Core" use designation. This is consistent with Washington's approach for tributaries (see WAC 173-201A-600(1)). The only exceptions to this convention are in the lower elevation portion of several rivers. EPA determined it is not necessary for all tributaries to these river segments to have a 16°C criterion, unless summer salmon/steelhead spawning or incubation occurs in the tributary. This applies to tributaries to 1) the lower portions of the Nooksack, Skagit, Snohomish, Nisqually, and Klickitat Rivers and 2) the lower portion of four tributaries to the upper Yakima River (Teanaway River, Swauk Creek, Taneum Creek, and Manastash Creek). These lower elevation rivers are unique because EPA has determined that they should be "Core" use to (or nearly to) the mouth and they are glacially fed or drain mountainous regions. EPA believes a few relatively low flow tributaries with a 17.5°C criterion in the lower downstream portion of these rivers will have a negligible impact on attaining the rivers "Core" use designation.

Washington Ecology concurred with the methods used by EPA to apply the 16°C criterion to the specified waters of the State and adopted the results of this analysis into their water quality standards. The waters with the 16°C criterion are shown on maps (website: http://www.ecy.wa.gov/pubs/0610038/start.pdf.) and are listed in the Table 602 (Appendix A).

5.H.4.3. Effects Determination for application of 16°C to 'Core Summer Salmonid Habitat' designated use to specific waters of Washington State

This effects determination considers whether or not all waters in Washington State that have the designated use of 'Core Summer Salmonid Habitat' were actually identified and included. Besides the waters converted over from the old AA Class, Washington included the reaches identified in the EPA fish data analysis. As described above, the EPA used a process of 1) developing a protocol for what types of fish use should be considered within this designated use category of 'Core Summer Salmonid habitat', 2) defining which waterbodies had these fish uses from the best available GIS databases, 3) depicting all of these stream reaches on GIS maps, 4) verifying the correctness of this distribution with local WDFW biologists, 5) modifying the use maps based on additional information gathered from Tribes and other organizations, and 6) receiving input on possible errors during a public review period and conducting a final update of maps.

The EPA believes that this process resulted in an accurate depiction of where the 16°C criterion should be applied for the 'Core Summer Salmonid Habitat' designated use and that the application of this standard to these waters is protective of the listed salmonid species that inhabit these waters. Except for specific waters where this water quality standard was not applied (discussed below), the EPA has determined that the application of the 'Core Summer Salmonid Habitat' designated use and the associated 16°C criterion **is not likely to adversely effect** the following listed salmon and trout fish species except in specific stream reaches: Chinook salmon [Snake River Fall Run ESU, Snake River Spring/Summer Run ESU, Upper Columbia River Spring Run ESU, Lower Columbia River ESU, and Puget Sound ESU(except in specific stream reaches listed in **Table 5-17**)]; Steelhead [Puget Sound ESU (except in specific stream reaches listed in **Table 5-17**), Snake River ESU, upper Columbia River ESU, middle Columbia River ESU, and lower Columbia River ESU]; Columbia River chum salmon and Hood Canal summer run chum salmon, and lower Columbia River coho salmon.

Several stream reaches, which were questionable in terms of whether or not they meet the criteria for 'Core Summer Salmonid Habitat' designated use, were not included by Washington. The reason for this exclusion was that the data to support that these area indeed had the "Core Summer Salmonid Habitat' designated use were very sparse or unsubstantiated. Future data collection as well as the possibility of range expansion by some species could result in a change of status in these stream reaches. EPA has determined that lack of application of the 16°C criterion to these specific stream reaches **is likely to adversely effect** listed salmon and trout fish species. These stream reaches and the listed salmon and trout species that may be effected are listed in Table 5-17 Salmon and trout species that may be effected are Puget Sound fall Chinook and Puget Sound Steelhead.

Table 5-17. List of stream reaches with likely to adversely affect determination for Puget Sound Chinook, Puget Sound Steelhead, coastal/Puget Sound bull trout and Columbia Basin bull trout. These reaches are not designated as "Core Summer Salmonid Habitat' use with associated 16°C temperature criteria but may have distribution of listed species during relevant life history phases to justify this use designation.

WRIA	Stream Name	Location	Listed species affected	Current Designated Use and Temperature Criterion	Comment
1	California Cr.	all	Puget Sound Steelhead, Puget Sound Chinook	'Salmonid Spawning, Rearing, and Migration' 17.5°C (no 13°C)	Limited information on steelhead spawning.
5	Stillaguamish River	from mouth to north and south forks (river mile 17.8)	Coastal/Puget Sound bull trout	'Salmonid Spawning, Rearing, and Migration' 17.5°C (13°C Oct. 1 – May 15)	Char presence/migration & juvenile rearing shown in WDFW Dist. Char adults and juvenile/sub-adults documented by Stillaguamish Tribe (2004).
7	Snohomish River	mouth to south tip of Ebey Island (RM 8.1)	Coastal/Puget Sound bull trout	'Salmonid Spawning, Rearing, and Migration' 17.5°C (no 13°C)	Char adult and sub-adult presence/migration & juvenile rearing shown in WDFW Dist.
7	Snoqualmie	Above Skykomish to Essency Cr.	Coastal/Puget Sound bull trout	'Salmonid Spawning, Rearing, and Migration' 17.5°C (no 13°C)	Char adult and sub-adult presence/migration
9	Duwamish River	mouth to Black R. confluence (rm 11.0)	Coastal/Puget Sound bull trout	'Salmonid Rearing and Migration Only'17.5°(no 13°C)	Char adult and sub-adult presence/migration & juvenile rearing shown in WDFW Dist
9	Green River	Green R. from Black R. confl. (rm 11.0) upstream to RM 24.	Coastal/Puget Sound bull trout	'Salmonid Spawning Rearing and Migration' 17.5°C (no 13°C)	Char adult and sub-adult presence/migration & juvenile rearing shown in WDFW Dist
10	White River	Rm 0.0-4.0	Puget Sound Fall Chinook, Coastal/Puget Sound bull trout	'Salmonid Spawning, Rearing, and Migration' 17.5°C (no 13°C)	Char adult and sub-adult presence/migration & juvenile rearing shown in WDFW Dist. Early September Chinook spawning data is difficult to collect due to turbid conditions in mainstem glacial system [R. Ladley Pers. Comm. 12/13/04]. Low population numbers contributes to difficulty in obtaining spawning data. Suitable Chinook spawning habitat available in this reach.
10	Puyallup River	Rm 0.0-1.0	Coastal/Puget Sound bull trout	'Salmonid Rearing and Migration Only'17.5°C (no 13°C)	Char adult and sub-adult presence/migration & juvenile rearing shown in WDFW Dist.
22	Humptulips River	Rm 0.0-4.0	Coastal/Puget Sound bull trout	'Salmonid Spawning, Rearing, and Migration' 17.5°C (no 13°C)	Char adult presence/migration shown in WDFW Dist.
22	Wishkah R.	Lower mainstem	Coastal/Puget Sound bull trout	'Salmonid Rearing and Migration Only'17.5°C (no 13°C)	Char adult and sub-adult presence/migration
22	Satsop R.	Lower mainstem	Coastal/Puget Sound bull trout	'Salmonid Spawning, Rearing, and Migration' 17.5°C (no 13°C)	Char adult and sub-adult presence/migration
22	Chehalis R.	Lower mainstem	Coastal/Puget Sound bull trout	'Salmonid Spawning, Rearing, and Migration' 17.5°C (no 13°C)	Char adult and sub-adult presence/migration
23	Chehalis R.	Upper mainstem to Independence Cr.	Coastal/Puget Sound bull trout	'Salmonid Spawning, Rearing, and Migration' 17.5°C (no 13°C)	Char adult and sub-adult presence/migration

Table 5-16 continued. List of stream reaches with likely to adversely affect determination for Puget Sound Chinook, Puget Sound Steelhead, coastal/Puget Sound bull trout and Columiba Basin bull trout. These reaches are not designated as "Core Summer Salmonid Habitat' use with associated 16°C temperature criteria but may have distribution of listed species during relevant life history phases to justify this use designation.

WRIA	Stream Name	Location	Listed species affected	Current Designated Use and Temperature Criterion	Comment
24	Willapa R.	Lower mainstem to Oxbow Cr.	Coastal/Puget Sound bull trout	'Salmonid Spawning, Rearing, and Migration' 17.5°C (no 13°C)	Char adult and sub-adult presence/migration
32	Mill Cr.	Mouth to Yellowhawk Cr.	Columbia Basin bull trout	'Salmonid Spawning, Rearing, and Migration' 17.5°C	Char adult and sub-adult presence/migration. Migrating bull trout spring through fall.
35	Tucannon R.	Mouth upstream ~10 mi. above Willow Cr.	Columbia Basin bull trout	'Salmonid Spawning, Rearing, and Migration' 17.5°C	Char adult and sub-adult presence/migration
35	Grande Rhonde R.	From Snake R. confluence upstream	Columbia Basin bull trout	'Salmonid Spawning, Rearing, and Migration' 17.5°C	Char adult and sub-adult presence/migration
37	Ahtanum Cr.	Mouth to upper forks	Columbia Basin bull trout	'Salmonid Spawning, Rearing, and Migration' 17.5°C	Char adult and sub-adult presence/migration
39	Wenas Cr.	Mouth to Dry Cr.	Columbia Basin bull trout	'Salmonid Spawning, Rearing, and Migration' 17.5°C	Char adult and sub-adult presence/migration
39	Upper Yakima Tributaries	Reecer, Wilson, Cherry, Badger, Trail, and Naneum cr	Columbia Basin bull trout	'Salmonid Spawning, Rearing, and Migration' 17.5°C	Char adult and sub-adult presence/migration
45	Wenatchee R.	Mouth to Ingalls Cr.	Columbia Basin bull trout	'Salmonid Spawning, Rearing, and Migration' 17.5°C (13°C Oct.1-May 1)	Char adult and subadult presence/migration shown in WDFW Dist.
46	Entiat R.	Mouth to Tilicum Cr.	Columbia Basin bull trout	'Salmonid Spawning, Rearing, and Migration' 17.5°C (no 13°C)	Char adult and subadult presence/migration shown in WDFW Dist.
48	Methow R.	Mouth to Twisp R.	Columbia Basin bull trout	'Salmonid Spawning, Rearing, and Migration' 17.5°C (13°C Oct.1-June 15)	Char adult and subadult presence/migration shown in WDFW Dist.

As described in the above section, adult and sub-adult bull trout summer foraging and migration use occurs in many of the streams where Washington has applied the ‘Core Summer Salmonid Habitat’ designated use and the 16°C criterion. Although data are limited, the Technical Synthesis (McCullough et al. 2001) concluded that the 16°C criterion is protective of these specific char life-history phases. However, maximum temperatures in excess of 16°C can reduce the growth of adult and sub-adult bull trout and create thermal stress that can place them at a competitive disadvantage with other fish species (EPA 2001). EPA has determined that the application of the 16°C criterion to stream reaches that are used by the adult and sub-adult bull trout during their summer foraging and migration life history phases **is not likely to adversely affect:** Columbia River Basin bull trout and Coastal/Puget Sound bull trout.

As with the salmon and trout species, specific stream reaches that did not receive the 16°C criterion due to lack of data may inadequately protect char species in specific waters. EPA has determined that lack of application of the 16°C criterion to these specific stream reaches **is likely to adversely effect** Columbia River Basin bull trout and Coastal/Puget Sound bull trout. These specific stream reaches are listed in Table 5-17 above.

EPA has determined that its approval of the application of “Core summer salmonid habitat” designated use and the associated temperature criterion (16°C (61°F)) to specific stream reaches will have **no effect** on the following species because these species do not occur in any of the waters where this criterion applies: Snake River sockeye salmon and Ozette Lake sockeye salmon.

5.H.4.4. How Ecology applies 13°C Temperature Criterion (timing and location)

Introduction

Washington applies a 13°C criterion to specific stream reaches where salmon stocks begin spawning in July, August, or early September. This criterion is necessary in these waters as the summer maximum criteria of 16°C or 17.5°C is unlikely to protect the spawning and early egg incubation life histories. The 16°C or 17.5°C temperature criteria are inadequate because 1) stream temperatures are unlikely to decline sufficiently in the fall prior to the onset of spawning, or 2) embryos of spring spawning steelhead have not yet emerged prior to the onset of summer temperature increases. The timing of the application of the 13°C criterion and the specific stream reaches where it should be applied were determined by an analysis conducted by the EPA.

How the timing for the application of the 13°C spawning criterion was determined

The EPA analyzed patterns of salmon spawning timing in Washington to develop a set of conventions for the start-date for the application of the 13°C to protect early spawning salmon . The dataset used for this analysis was WDFW Salmon Stock Inventory known as SASI (WDFW 1993, also available online: http://wdfw.wa.gov/fish/sasi/), which is a database of the spawning run timing periods for all know salmon stocks in Washington. Site specific data provided by Tribes and other entities were also used when available (this information is contained in Appendix C of EPA’s Disapproval Letter; Appendix D of this document contains EPA’s Disapproval Letter). Because spawning start-dates are variable both among and within stocks, setting conventions for start-dates involved the consideration of many factors related to the available data. In order to interpret the start-dates listed in the SASI database, EPA reviewed the original field data that the start-dates listed in the database were developed from. This raw data included dates of presence of live fish, redds and dead fish for the various stocks.

EPA found that the SASI database generally reflected the earliest redds documented for a particular stock over the period of record and that the spawning start-date for the majority of the run begins a week or more later that this date of earliest spawning. Based on this characteristic of the SaSI data in relation to the raw data it appeared reasonable to apply the 13°C criterion approximately one week later than the spawning start-date indicated in SaSI database. Thus, the more typical spawning start date for a particular stock would be reflected in the start-date. Although this seemed to be a reasonable interpretation of the data, there were many other factors that warranted consideration. Factors that suggest that a more conservation early application of 13°C include:

- Field surveys of spawning are designed to estimate run production for fisheries management purposes and are not necessarily intended to document the first redds. Thus, the beginning of spawning period may not be fully documented in some years.
- Field surveys are done periodically, not daily, thus when a redd is documented, actual spawning may have been days or a week prior.
- Turbid conditions in some rivers prevent redd/spawner surveys, thus actual early spawning may not be documented.
- Human caused elevated temperatures are likely to have truncated the full timing distribution of early spawning stocks (*i.e*., historically, more fish spawned earlier), thus some wild stocks are unlikely to exhibit their full timing distribution due to present day low returns.

Factors that suggest a more liberal later application of the 13°C include:

- For most salmon stocks, the week that spawning starts only represents a small percent (e.g., 5%) of the total number of spawning fish.
- It is likely that a portion of some salmon runs spawn when temperatures are slightly higher than 13°C 7DADM. Exploitation of a range of environmental conditions is an important evolutionary trait of salmon, which maintains population diversity and thus the ability to adapt to environmental variability and disturbance.
- For salmon runs with a large spatial spawning distribution that encompass a large range of elevations, the earliest spawning may occur only in the higher elevation portion of the spawning distribution. Thus, if 13°C is to be applied at the lower elevation part of the distribution, this spatial difference in spawning timing needs to be considered.

After considering these factors, EPA decided that a reasonable interpretation of the SaSI data was to apply 13°C approximately one week later than the start-date indicated in the SaSI database (rounding to either the 1st or the 15th of the month). This was used as the convention for assigning the start-date of the application of the 13°C criterion to Washington salmon stocks listed in **Table 5-18**.

Table 5-18. EPA interpretation of SaSI spawning start dates.

Spawning Start-date listed in the SaSI Database	Start-Date for application of 13°C criterion
Late July	August 1st
Early to Mid-August	August 15th
Late August	September 1st
Early September	September 15th

EPA determined the end-date for the application of the 13°C criterion based on the extent of the incubation period for both summer/fall spawned salmon/char and spring spawned steelhead. The typical completion of egg incubation for both summer/fall spawning salmon and char is May 15 based on SaSI and consultation with WDFW biologists. Therefore, May 15th was established as the end-date for the application of the 13°C criterion in waterbodies with salmon runs. Note May 15th is also the end-date for the 9°C early char spawning criterion (discussed in section 5.H.3.).

In contrast with salmon stocks, steelhead are winter/spring spawners. Therefore the critical period where 16°C and 17.5°C criteria may not be protective is during the egg incubation period prior to emergence. Juvenile steelhead that have not emerged prior to the increasing stream temperatures with the onset of summer need to be protected with the 13°C criterion. Similar to the analysis of the SaSI data for salmon spawning start dates, steelhead spawning periods were analyzed, accounting for the typical incubation period of 5-7 weeks for steelhead eggs. EPA determined that the 13°C criterion should apply from February 15 and end according to the dates described in the following Table (**Table 5-19)** in waters with steelhead runs. These conventions were applied to the majority of the steelhead stocks. Site specific data were used to determine 13°C end-dates in some locations (this information is contained in Appendix D of EPA's Disapproval Letter; Appendix D of this document contains EPA's Disapproval Letter).

Table 5-19. EPA interpretation of SaSI steelhead spawning end dates.

Spawning End in the SaSI Database	End Date for 13°C
Early June	June 15th
Mid to Late June	July 1st
July	July 15th

How streams were designated as early 13°C spawning criterion

The EPA analysis of start and end-dates were determined on a stock by stock basis from the SaSI database to establish a temporal application of 13°C for each stock. Likewise, the spatial extent of the application 13°C criterion was based on the spatial distribution of each of the stocks as contained within WDFW GIS Salmonscape database. Washington Ecology concurred with the findings by the EPA for both the temporal and spatial application of the 13°C criterion, adopting both the timing conventions for the start-dates and end-dates for the application of the 13°C and the stock by stock spatial distribution from the Salmonscape data. Additional site-specific information on either timing or distribution of early spawners/later emerging fry included in the EPA analysis was also incorporated into Washington's application of 13°C The temporal and spatial application of the 13°C criterion is shown on the Washington Ecology Maps (see website: http://www.ecy.wa.gov/pubs/0610038/start.pdf). Waterbodies with multiple salmon/steelhead runs (a common occurrence) have start/end dates that bracket the full temporal extent (i.e. summer spawning and summer incubation) of all runs present.

Effects determination for spatial and temporal application of 13°C Criterion

The 13°C criterion was applied to waterbodies as determined by the best available datasets modified with current site-specific data. As with the analysis of 'core summer salmonid habitat' the EPA used the process of 1) developing a protocol for how the data should be interpreted to assign start and end-dates for the 13°C criterion 2) defining which waterbodies these dates should be applied to from the best available GIS databases, 3) depicting all of these stream reaches on GIS maps, 1) verifying the correctness of this distribution with local WDFW biologists, 2) modifying the use maps based on additional information gathered from Tribes and other organizations, and 3) receiving input on possible errors during a public review period and conducting a final update of maps. The EPA believes that this process resulted in an accurate depiction of where the 13°C criterion should apply and that the application of this criterion to these waters is protective of the listed salmonid species.

The EPA has determined that the application of 13°C temperature criterion in the specified stream reaches **is not likely to adversely effect** the following listed fish species except in specific stream reaches listed in **Table 5-20**.

Washington did not apply the 13°C criterion to several stream reaches where data were either sparse or unsubstantiated. Future data collection as well as the possibility of range expansion by some species could result in a change of status in these stream reaches. EPA has determined that lack of application of the 13°C criterion through the steelhead incubation/emergence period **is likely to adversely effect** listed Middle Columbia River steelhead in two stream reaches (Table 5-20).

Table 5-20. List of stream reaches with, likely to adversely affect determination for listed Middle Columbia River steelhead. These reaches are not designated as "Core Summer Salmonid Habitat' use with associated 13°C temperature criteria but may have distribution of this listed species during spawning life history phases to justify this use designation with the associated 13°C temperature criterion.

WRIA	Stream Name	Location	Listed species present	Current Designated Use and Temperature Criterion	Comments
38	Tieton River	Mouth to reservoir	Middle Columbia River Steelhead	16 °C Core Salmonid Summer habitat (no application of 13°C)	Steelhead spawning not documented at present time.
39	Upper Yakima River	Kachess confluence to Kechelus Reservoir	Middle Columbia River Steelhead	16 °C Core Salmonid Summer habitat (13°C Sept 13-May 15 to protect Chinook[1] spawning)	No data of steelhead spawning but is likely thus 13°C to June 15 may be found as more appropriate in future..

[1]Note: Middle Columbia River Chinook are not a listed species.

USEPA has determined that its approval of the 13°C temperature criterion in the specified stream reaches will have **no effect** on the following species because these fish do not occur in the WRIAs where this criterion applies: Snake River and Ozette Lake sockeye salmon.

5.H.5. Effects Determination for 17.5°C Temperature Criterion for 'Salmonid Spawning, Rearing, and Migration' use

Introduction

The key identifying characteristics of the 'Salmonid Spawning, Rearing, and Migration' designated use is salmon or trout spawning and emergence that only occurs outside of the summer season (September 16 - June 14). Other common aquatic life uses for waters in this category include rearing and migration by salmonids. This use applies to areas where the most sensitive life history phases of salmonids, spawning and incubation, would not be exposed to summer elevated temperature, as temperatures will have declined prior to the spawning period in the fall or fry emergence would occur before summer warming. Therefore, Washington imposes a less stringent temperature criterion of 17.5°C to this designated use. The upstream extent of the 'Salmonid Spawning, Rearing, and Migration' designated use is driven by where the 'Core Summer Salmonid Habitat' designated use is delineated. Generally, waterbodies that would be appropriately assigned this designated use, are found in the mid and lower part of a basin, typically downstream of the areas designated as "Core Summer Salmonid Habitat' use. Besides the lower ends of river systems, this is the predominant use designation throughout many eastside Washington basins. This section assesses the effects of: 1) the 17.5°C temperature on the designated use and 2) the spatial application of the 17.5°C criterion (i.e. are all areas where the 17.5°C should be applied to protect this designated use included). The waterbodies with this proposed designated use are mapped on Washington Ecology's website (see website: http://www.ecy.wa.gov/pubs/0610038/start.pdf.) and are listed on the 602 Table (Appendix A).

5.H.5.1. Effects determination for 17.5°C Temperature Criterion

Washington adopted 17.5°C 7-DADMax as the general year around criterion to protect waters designated for the 'Salmonid Spawning, Rearing, and Migration' use where spawning occurs after mid- September and egg emergence occurs before mid-June. In a few locations where salmon spawning starts in late September, Washington also applied the 13°C criterion to protect the spawning life history phase of this use (e.g., Lower Stilliguamish, Chehalis, and Wenatchee Rivers). The effect analysis for the 13°C criterion is discussed in Section 5.H.4.1. For the other areas where this use is designated, the use is protected with the single 17.5°C criterion.

EPA indicated in its Temperature Guidance (2003) that it may be appropriate to protect a combined salmon spawning and rearing use with a single numeric temperature criterion (e.g., 17.5°C) that limits summer maximum temperatures. A review of the temperature patterns in Washington, found streams with a 17.5°C summer maximum temperature are likely to cool to 13°C maximum temperatures by October but not before, (Washington Department of Ecology, March 2005) and, streams with a 17.5°C summer maximum temperature are likely to have 13°C maximum temperatures needed to protect egg incubation at mid-June but not later. Therefore, this designated use specifies the temporal limitation of the salmonid spawning and incubation life histories present in these waterbodies. The 17.5°C is meant to be protective of salmonid spawning and incubation for waters where these life histories occur only in the October through mid-June.

Protectiveness of 17.5°C:

Washington adopted 17.5°C (64°F) to protect waters designated for juvenile rearing and migration.

This criterion is 0.5°C lower than the criterion recommended in USEPA Temperature Guidance (USEPA 2003) to protect these uses. This criterion (which roughly translates to a 14.5°C maximum weekly mean and an equivalent constant temperature of 16°C (62°F) for comparison to juvenile growth studies at constant temperatures is designed to:

(1) protect against lethal conditions for both juveniles and adults [21 to 22°C (70 to 72°F) constant];

(2) prevent migration blockage conditions for migrating adults [21 to 22°C (70 to 72°F) average];

(3) provide near optimal juvenile growth conditions (under limited food conditions) during the summer maximum conditions and optimal conditions during the rest of the year [10 to 16°C (50 to 61°F) constant];

(4) protect adults and juveniles from high disease risk and provide minimal risk to temperatures that can lead to elevated disease rates [14 to 17°C (57 to 63°F) constant]; (see Table 5-10); and

(5) protect salmon and steelhead from a competitive disadvantage with cool and warm water species which can occur when average temperatures are greater than 15°C and maximum temperatures exceed 17-18°C (see Ecology 2002).

Information used to determine if the 17.5°C temperature criterion is protective of salmonid species is from the EPA Technical Synthesis (McCullough et al. 2001). In this synthesis of temperature literature, thermal temperature ranges important to juvenile salmon and trout include: lethal temperatures of 23-26°C, optimum growth with limited food temperatures of 10-16°C, preferred rearing temperatures of 10-17°C. Studies of thermal barriers to adult salmon migration indicate blockages occur at temperatures ranging from 18°C to 23.9°C (McCullough et al. 2001). Adult salmon migration studies indicate reduced migration fitness due to cumulative stress with prolonged exposure to >17-18°C. Impairment of smoltification occurs at temperatures of 12-15°C for salmon and >12°C for steelhead. Elevated disease risk for both rearing juveniles and migrating adults occur at temperatures ranging from 14-17°C (
Table 5-11). Increased stress, immune response, and virulence of the disease organism influence this temperature/disease relationship. Other behavioral characteristics can be influenced by elevated temperatures including interspecies competition occurring outside of the thermal optimum, which could pose a competitive disadvantage for the species with the lower thermal optimum. Elevated temperatures can also increase the feeding rate of predatory fish putting the prey species at a disadvantage. For example native fish such as northern pikeminnow (Ptychocheilus oregonensis) can have increase feeding success on juvenile salmonids under elevated temperatures. Likewise many invasive fish species function best in cool water transition areas between cold water optimal for salmonids and warmer water optimal for warm-water fishes, resulting in increased predation of coldwater fishes (e.g. salmon and steelhead).

The EPA considers the 17.5°C temperature to be protective of salmonids based on the temperature ranges for life history activities associated with this designated use. Although some limited adverse effects are possible to individual fish (e.g., potential for elevated disease under an unusual situation where prolonged average exposure exceeds 15°C), EPA concludes that these possible adverse effects to salmon are discountable in Washington due to the limited application of this use/criterion in waters used by salmonids in the summer. Therefore, the EPA has determined that its approval of the 17.5°C criterion applied to the "Salmonid Spawning, Rearing, and Migration" designated use **is not likely to adversely affect:** Chinook salmon ESUs (Snake River Fall Run, Snake River Spring/Summer Run, Upper Columbia River Spring Run, Lower Columbia River, and Puget Sound); steelhead ESUs (Puget Sound, Snake River, Upper Columbia River, Middle Columbia River, and lower Columbia River);Columbia River chum salmon, Hood Canal summer run chum salmon, and lower Columbia River coho salmon.

USEPA has determined that its approval of the 17.5°C temperature criterion will have **no effect** on Snake River and Ozette Lake sockeye salmon because these listed fish species do not occur in the WRIAs where this criterion applies.

This criterion is not intended to protect bull trout uses that occur in the summer, however, adult and sub-adult bull trout may use these waters designated with this use during the non-summer period. However, a summer maximum of 17.5°C is likely to result in temperature below 16°C (see Section 5.H.4.1) during the non-summer period when bull trout might use water designated with this use. Therefore, the EPA has determined that its approval of the temperature criterion (17.5°C) applied to the "Salmonid Spawning, Rearing, and Migration" designated use **is not likely to adversely affect** Columbia River Basin and Coastal/Puget Sound bull trout.

EPA notes that any summer time exposure of listed char to this temperature criterion results from assignment of this criterion to waterbodies in Washington State. Spatial application of the 17.5°C criterion is addressed in the next two sections (5.H.5.2. and 5.H.5.3.).

5.H.5.2. How streams were designated as 'Salmonid Spawning, Rearing, and Migration' use with 17.5°C Temperature Criterion by Washington State Ecology

Washington State assigned Class A waters under the old 1997 rules, not otherwise designated as "Char" waters, to the "Salmonid Spawning, Rearing and Migration" designated use. Although this simple conversion of the class-based waters to use-based waters adequately assigned many Washington streams to the correct use of "Salmonid spawning, rearing and migration", some waters were not correctly identified with this method. EPA conducted an analysis of fish distribution data to identify other waterbodies that warranted the application of 16°C criterion based on use by rearing salmonids. The process used by EPA is summarized in section 5.H.4.2. above and is thoroughly discussed in EPA's Partial Disapproval Letter in Appendix D of this document. Although, the EPA did not conduct a specific analysis to identify waters that should have the 17.5°C, the analysis of the waters needing the 16°C criterion resulted in the identification of many waters that did have the 17.5°C criterion but needed the more stringent standard of 16°C based on timing of spawning and incubation. Washington concurred with the EPA and reclassified these 17.5°C waters to 16°C. Waters that were not changed are considered correctly classified by EPA as these waters are not used by salmonid species for spawning before mid-September and are not used by incubating eggs after mid-June.

5.H.5.3. Effects Determination for location of application 'Salmonid Spawning, Rearing, and Migration' designated use with 17.5°C temperature criterion to specific waters of Washington State

This effects determination considers whether or not all waters in Washington State that have the designated use of ‘Salmonid Spawning, Rearing, and Migration’ were correctly assigned this use. Besides the waters converted over from the old A Class, Washington modified this list by excluding all of the waterbodies identified in the EPA analysis that were found to require the 16°C criterion for the ‘Core Salmonid Spawning Habitat’ designated use. As described in section 5.H.4.2, the EPA used a process of 1) developing a protocol for what types of fish use should be considered within this designated use category of ‘Core Summer Salmonid habitat’, 2) defining which waterbodies had these fish uses from the best available GIS databases, 3) depicting all of these stream reaches on GIS maps, 4) verifying the correctness of this distribution with local WDFW biologists, 5) modifying the use maps based on additional information gathered from Tribes and other organizations, and 6) receiving input on possible errors during a public review period and conducting a final update of maps. The EPA believes that this process resulted in an accurate depiction of where the 16°C criterion should be applied for the ‘Core Summer Salmonid Habitat’ and therefore the remaining streams classified as ‘Salmonid Spawning, Rearing, and Migration’ are also correct. Specific waters that may have been incorrectly assigned the designated use of Salmonid Spawning, Rearing, and Migration’ when the more stringent 16°C Core Summer Salmonid Habitat’ designated use should have applied are addressed in section 5.H.4.3.

The EPA concurs that the 17.5°C criterion was correctly spatially applied based on the variation in life history from the ‘Core Salmonid Summer Habitat’ designated use. The EPA has determined that the application of the ‘Salmonid Spawning, Rearing, and Migration designated use and the associated 17.5°C criterion **is not likely to adversely effect** the following listed salmon and trout fish species: Chinook salmon ESUs (Snake River Fall Run, Snake River Spring/Summer Run, Upper Columbia River Spring Run, Lower Columbia River, and Puget Sound); Steelhead ESUs (Puget Sound, Snake River, Upper Columbia River, Middle Columbia River, and Lower Columbia River); Columbia River chum salmon, Hood Canal summer run chum salmon, and Lower Columbia River coho salmon, except for Puget Sound Chinook and Puget Sound Steelhead in specific waterbodies listed in **Table 5-16**.

EPA notes this designated use and associated 17.5°C temperature criterion is not intended to apply to char species and char are not expected to be in these waters in the summer, but they may use these water other times of the year. EPA, therefore, determined that the application of the ‘Salmonid Spawning, Rearing, and Migration designated use and the associated 17.5°C criterion **is not likely to adversely effect** the Columbia River Basin and Coastal/Puget Sound bull trout, except in specific waterbodies listed in **Table 5-17** where there is potential summer time use of bull trout. The specific waterbodies that Washington applies the ‘Salmonid Spawning, Rearing, and Migration designated use and the associated 17.5°C criterion are shown on Washington Ecology’s website (see website: http://www.ecy.wa.gov/pubs/0610038/start.pdf.) and are listed on the 602 Table (Appendix A).

USEPA has determined that its approval of OAR 041-0028(4)(c) will have **no effect** on Snake River and Ozette Lake sockeye salmon as these listed fish species do not occur in waters where this criterion applies

5.H.6. Effects Determination for 17.5°C Temperature Criterion for ‘Salmonid Rearing and Migration Only’ use

Introduction

The key identifying characteristic of the ‘Salmonid Rearing and Migration Only” designated use is that these are waterbodies are used exclusively for rearing and migrating salmonids and are not used by salmonids during the spawning and incubation life history phases. The 17.5°C criterion is applied to protect salmonid species where water temperatures are higher than the optimal thermal range during the summer months and where this is considered a normal occurrence. This use is found in the lower part of basins, downstream of reaches used by spawning salmonids.

The purposes of this criterion are: 1) protect against lethal conditions for both juveniles and adults (21 to 22°C constant); 2) prevent migration blockage conditions for migrating adults (21 to 22°C average); 3) provide near optimal juvenile growth conditions (under limited food conditions) during the summer maximum conditions; 4) protect adults and juveniles from high disease risk and minimize the exposure time to temperatures that can lead to elevated disease rates (14 to 17°C constant); and 5) protect salmon and steelhead from a competitive disadvantage with cool and warm water species which can occur when average temperatures are greater than 15°C and maximum temperatures exceed 17-18°C (see
Table 5-11 and Washington Department of Ecology 2002).

5.H.6.1. Effects determination for 17.5°C Temperature Criterion

The protectiveness of the 17.5°C temperature criterion associate with this use is identical to that described for the "Salmonid Spawning, Rearing, and Migration' use (Section 5.H.5), which also has the 17.5°C temperature criterion.

Protectiveness of 17.5°C:

Information used to determine if the 17.5°C temperature criterion is protective of salmonid species is from the EPA Technical Synthesis (McCullough et al. 2001). In this synthesis of temperature literature, thermal temperature ranges important to juvenile salmon and trout include: lethal temperatures of 23-26°C, optimum growth with limited food temperatures of 10-16°C, preferred rearing temperatures of 10-17°C. Studies of thermal barriers to adult salmon migration indicate blockages occur at temperatures ranging from 18°C to 23.9°C (see Issue Paper 5 of EPA Technical Synthesis). Adult salmon migration studies indicate reduced migration fitness due to cumulative stress with prolonged exposure to >17-18°C temperatures. Elevated disease risk for both rearing juveniles and migrating adults occur at temperatures ranging from 14-17°C (see Table 5-1). Based on the temperature ranges for life history activities associated with this designated use (see summary in Table 5-11), the EPA has determined that although the 17.5°C criterion is close to the upper thermal condition range that is protective of salmon and trout life histories relevant to the 'Salmonid Spawning, Rearing, and Migration' the application of the 'Salmonid Spawning, Rearing, and Migration designated use and the associated 17.5°C criterion **is not likely to adversely effect** the following listed salmon and trout fish species: Chinook salmon ESUs (Snake River Fall Run, Snake River Spring/Summer Run, and Puget Sound); Steelhead ESUs (Upper Columbia River and Middle Columbia River).

EPA has determined that its approval of the "Salmonid Rearing and Migration Only" use temperature criterion (17.5ºC) will have **no effect** on the following species because these do not occur in any of the waters where this criterion applies: Chinook salmon ESUs (Upper Columbia River Spring Run and Lower Columbia River),Steelhead ESUs(Puget Sound, Snake and lower Columbia River), Columbia River chum salmon, Hood Canal summer run chum salmon, and Lower Columbia River coho salmon, Snake River sockeye, salmon and Ozette Lake sockeye salmon.

The EPA notes that incorrect spatial application of the 'Salmonid Rearing, and Migration Only' designated use could result in exposure of the more sensitive salmon life history phases. This mis-application of the standard could result in effects to listed species. Spatial application of this use is addressed in the next two sections (5.H.6.2. and 5.H.6.3.).

This criterion is not intended to protect bull trout uses that occur in the summer, however, adult and sub-adult bull trout may use these waters designated with this use during the non-summer period. However, a summer maximum of 17.5°C is likely to result in temperature below 16°C (see Section 5.H.4.1) during the non-summer period when bull trout might use water designated with this use. Therefore, the EPA has determined that its approval of the temperature criterion (17.5 °C) applied to the "Salmonid Spawning, Rearing, and Migration" designated use **is not likely to adversely affect** Columbia River Basin and Coastal/Puget Sound bull trout.

EPA notes that any summer time exposure of listed char to this temperature criterion results from assignment of this criterion to waterbodies in Washington State. Spatial application of the 17.5°C criterion is addressed in the next two sections (5.H.6.2. and 5.H.6.3.).

5.H.6.2. How streams were designated as 'Salmonid Rearing and Migration Only' use with 17.5°C Temperature Criterion by Washington State Ecology.

Washington converted waters that were Class B under the old 1997 rules to the new use based classification of "Salmonid Rearing and Migration Only". EPA did not analyze the application of this use classification in relation to actual fish distribution and presence by life history phase. However, during the analysis of the appropriate application of the 16°C criterion, EPA did identify two streams that Washington had classified as "Salmonid Rearing and Migration Only" that actually had salmonid spawning. EPA determined that these streams (Mill Creek in WRIA 32 and the lower Palouse River in WRIA 34) should be assigned the designated use of "Salmonid spawning, rearing, and migration" as spawning/incubation within of the mid-September to mid-June timeframe is known to occur in these reaches. Washington concurred with these results and assigned the Salmonid Spawning, Rearing, and Migration' use to these streams. The total number of stream miles where this designated use is applied is very limited. The only WRIAs that have any stream miles in this use category are WRIAs 9, 10, 22, 32, 34, and 37.

5.H.6.3. Effects Determination for location of application 'Salmonid Rearing, and Migration only' designated use with 17.5°C temperature criterion to specific waters of Washington State

As with the 'Salmonid Spawning, Rearing, and Migration' use, EPA did not conduct a specific analysis of the fish use of waters assigned the "Salmonid Rearing and Migration Only" use. However, a thorough process used to identify waters needing the more stringent 16°C was conducted by EPA and Washington incorporated these waters into the proposed standards. EPA considered waters that were not converted to the more stringent 16°C to be correctly classified as either "Salmonid Spawning, Rearing, and Migration" (see section 5.H.5.) or "Salmonid Rearing and Migration Only" use, both of which have an associated 17.5°C temperature criterion.

The EPA has determined that the application of the 'Salmonid Rearing, and Migration Only' designated use and the associated 17.5°C criterion **is not likely to adversely effect** the following listed salmon and trout fish species: Chinook salmon (Snake River Fall Run ESU, Snake River Spring/Summer Run ESU, and Puget Sound ESU); and Steelhead (Snake River ESU, Upper Columbia River ESU, and Middle Columbia River ESU), Columbia River Basin and Coastal/Puget Sound bull trout except in specific waterbodies discussed below. The specific waterbodies that Washington applies the 'Salmonid Rearing, and Migration Only' designated use and the associated 17.5°C criterion are shown on Washington Ecology's website (see website: http://www.ecy.wa.gov/pubs/0610038/start.pdf.) and are listed on the 602 Table (Appendix A).

The EPA notes this designated use and associated 17.5°C temperature criterion is not intended to apply to char species. Char use is thought to be limited to the adult migration life history phase in these reaches. Also, char are not expected to be in these waters in the summer, but they may use these waterbodies at other times of the year.

EPA has determined that its approval of the 'Salmonid Rearing and Migration Only' use temperature criterion (17.5ºC) will have **no effect** on the following species because these do not occur in any of the waters where this criterion applies: Chinook salmon (Upper Columbia River Spring Run ESU and Lower Columbia River ESU), Steelhead (Puget Sound ESU, Snake and lower Columbia River ESU), Columbia River chum salmon and Hood Canal summer run chum salmon, and Lower Columbia River coho salmon, Snake River sockeye, salmon and Ozette Lake sockeye salmon.

As described in the 17.5°C protectiveness section above (section 5.H.5.1.), the 17.5°C temperature criterion is not protective of listed char species. There are only a few waterbodies where char distribution is known to overlap with waterbodies that have the 17.5°C criterion. These waterbodies are larger streams located in the lower elevations portions of the bull trout migratory routes. In these specific waterbodies listed in Table 5-17.

5.H.7. Effects Determination for 18°C Temperature Criterion for 'Non-anadromous Interior redband trout' Use

Washington adopted a 'Non-anadromous interior redband trout' designated use category for the protection of waters where the only salmonid species is the non-anadromous form of self-reproducing interior redband trout (O. mykiss), and other associated aquatic life. Washington did not assign any waterbodies to this designated use.

This use/criterion is not intended be applied where any of the ESA listed fish species occur. This use/criterion was not applied to any waterbodies in Washington. The EPA has determined that its approval of the 18°C Temperature Criterion for 'Non-anadromous interior redband trout' designated use will result in **no effect** to Chinook salmon ESUs (Snake River Fall Run, Snake River Spring/Summer Run, Upper Columbia River Spring Run, Lower Columbia River, and Puget Sound), Steelhead ESUs (Puget Sound, Snake River, Upper Columbia River, Middle Columbia River, and Lower Columbia River), Columbia River chum salmon, Hood Canal summer run chum salmon, Lower Columbia River coho salmon, Snake River sockeye salmon, Ozette Lake sockeye salmon, Columbia River Basin bull trout and Coastal/Puget Sound bull trout.

5.H.8. Effects Determination for 20°C Temperature Criterion for 'Indigenous Warm Water Species' Use

Washington adopted an 'Indigenous warm water species' category for the protection of waters where the dominant species under natural conditions would be temperature tolerant indigenous non-salmonid fish species. Examples include dace, redside shiner, chiselmouth, some sucker species, and possibly northern pikeminnow. Washington did not assign any waterbodies to this use.

This use/criterion is not intended be applied where any of the ESA listed fish species occur. Application of this use/criterion would require a future rulemaking. The EPA has determined that its approval of the 20°C Temperature Criterion for 'Indigenous Warm Water Species' designated use will result in **no effect** to Chinook salmon ESUs (Snake River Fall Run, Snake River Spring/Summer Run, Upper Columbia River Spring Run, Lower Columbia River, and Puget Sound), Steelhead ESUs (Puget Sound, Snake River, upper Columbia River, middle Columbia River, and lower Columbia River), Columbia River chum salmon, Hood Canal summer run chum salmon, lower Columbia River coho salmon, Snake River sockeye salmon, Ozette Lake sockeye salmon, Columbia River Basin bull trout and Coastal/Puget Sound bull trout.

5.H.9. Allowable 0.3° C increase in temperature in waters warmer than the criteria

Washington's water quality standards includes the following provision at WAC 173-201A-200(1)(c)(i):

> "*When a waterbody's temperature is warmer than the criteria in Table 200 (1)(c) (or within 0.3 ℃ (0.54 ℉) of the criteria) and that condition is due to natural conditions, then human actions considered cumulatively may not cause the 7-DADMax temperature of that waterbody to increase more than 0.3 ℃ (0.54 ℉).*"

Additionally, the Washington water quality standards contains a provision which allows the natural condition of the waterbody to become the criterion when the natural condition of the waterbody is of lower quality than the criterion assigned in the State's water quality standards (see WAC 173-201A-210A-310(3)). The above provision is consistent with the recommendations in EPA's Temperature Guidance which discusses allowing the temperature in a waterbody to be insignificantly higher than the applicable criteria. The purpose of such a provision is to allow an insignificant level of heat into the river from human activities when the natural conditions criteria is the applicable criteria or where waters are currently exceeding the biologically-based numeric criteria. Absent such a provision, no heat would be allowed from human activities when the natural condition criteria is the applicable criteria. EPA has concluded that this result is unnecessarily restrictive for protection of salmonid uses, and would lead to unnecessary costly expenditures, therefore the EPA recommended such a provision in its Temperature Guidance (USEPA 2003). Furthermore, the EPA believes, for reason described below, that this provision does not undermine the protection of uses provided by the natural conditions criteria.

EPA believes that a 0.3°C or less temperature increase above the natural condition temperature is insignificant because monitoring measurement error for recording instruments typically used in field studies is approximately 0.2°C to 0.3°C. In other words, this level of a temperature increase is considered within the error range associated with typical temperature monitoring equipment.

Based on the above rationale, EPA has concluded that a 0.3°C increase above the applicable natural condition temperature criterion would not adversely affect listed salmonids. However, EPA recognizes that temperatures within the mixing zone of some National Pollutant Discharge Elimination System (NPDES) discharges may result in temperatures near the vicinity of the discharge that may adversely effect salmonids. Because this provision would allow human-caused authorized thermal discharges that may result in potential adverse effects near the vicinity of the discharge, EPA has concluded that its approval of this provision**: is likely to adversely affect** Chinook salmon ESUs

(Snake River Fall Run, Snake River Spring/Summer Run, Upper Columbia River Spring Run, Lower Columbia River, and Puget Sound), Steelhead ESUs (Puget Sound, Snake River, Upper Columbia River, Middle Columbia River, and Lower Columbia River), Columbia River chum salmon, Hood Canal summer run chum salmon, Lower Columbia River coho salmon, Snake River sockeye salmon, Ozette Lake sockeye salmon, Columbia River Basin bull trout, and Coastal/Puget Sound bull trout.

5.H.10. Allowable warming in freshwaters that are cooler than the criteria

Washington's water quality standards include the following provision at WAC 173-201A-200(1)(c)(ii):

> *"(ii) When the natural condition of the water is cooler than the criteria in Table 200 (1)(c), the allowable rate of warming up to, but not exceeding, the numeric criteria from human actions is restricted as follows:*
>
> > *(A) Incremental temperature increases resulting from individual point source activities must not, at any time, exceed 28/(T+7) as measured at the edge of a mixing zone boundary (where "T" represents the background temperature as measured at a point or points unaffected by the discharge and representative of the highest ambient water temperature in the vicinity of the discharge)*;

EPA proposes to approve the allowable temperature increase of 28/T+7, at the edge of a mixing zone, for point source dischargers when the natural condition of a waterbody is cooler than the numeric temperature criteria contained in Table 200(1)(c). Table 200(1)(c) establishes the temperature criteria protective of aquatic life. EPA has reviewed and proposes to approve the criteria in Table 200(1)(c). The incremental temperature increase limits the temperature increase a point source can cause to a waterbody which is cooler than the established temperature criterion, and it does not allow the temperature to increase above the criteria established in the table to protect aquatic life uses.

Washington's anti-degradation policy requires that a Tier II analysis be completed for any State regulated new or expanded action, such as point source discharges, that would warm temperatures by 0.3°C or more at the edge of the mixing zone5. Therefore, a Tier II analysis would have to be completed if the incremental temperature increase of 28/T+7 resulted in an increase of 0.3°C or more at the edge of the mixing zone for point sources. There are other mechanisms that also help maintain water bodies cooler than the State adopted criteria, these are described in Appendix E.

Below is a description of how this provision would be implemented in NPDES permits.

NPDES Implementation

Under the NPDES program, all facilities which discharge pollutants from any point source into waters of the United States are required to obtain an NPDES permit. NPDES permits contain conditions that limit the amount of a pollutant that may be discharged to a surface water. After analyzing the effect of a discharge on the receiving water a permit writer may find that effluent limits are needed in the permit to ensure that the discharge does cause or contribute to an exceedance of the state's water quality standards.

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5 See WAC 173-201A-300, and *Supplementary Guidance, Implementing the Tier II Andi-degradation Rules, WAC 173-201A-320*, Department of Ecology, Water Quality Program, July 18, 2005).

The state's water quality standards are composed of three components: (1) use classifications (i.e., classification system of waterbodies based on the beneficial uses of the waterbody); (2) numeric or narrative water quality criteria deemed necessary to support the use classification; and (3) an anti-degradation policy. Federal regulations at 40 CFR 122.44(d) require permits to contain conditions necessary to achieve the state's water quality standards. Therefore, when developing a permit a waterbodies use designation, the criteria necessary to protect the use, and the State's anti-degradation policy must all be considered.

To evaluate the effect an effluent has on a receiving water, a permit writer must use the State's water quality standards, the allowable mixing zone, and a method for predicting impacts to surface waters, and defining effluent limits for numeric criteria.

Washington's water quality standards at WAC 173-201A-400 allow mixing zones for discharges to surface waters. A mixing zone is an area near the discharge outfall where the water quality standards can be exceeded but they should be small enough so that they do not interfere with the beneficial uses of the water. Additionally, the State's temperature criterion *must* be met at the edge of the mixing zone. In Washington, mixing zones for rivers and streams must comply with the following conditions:

> (1) not extend in a downstream direction more than 300 feet plus the depth of the water over the discharge port, or extend upstream for a distance of over 100 feet upstream from the diffuser (note: the available dilution from this requirement is calculated by using a mixing modeling such as Plumes, Cormix, or Udkhden);
> (2) not use greater than 25% of the flow (note: this dilution is determined by taking 25% of the 7-day average low flow with a return period of 10 years (7Q10); and
> (3) not occupy greater than 25% of the width of the waterbody.

A discharge to a waterbody, that is cooler than the applicable temperature criterion, may have a reasonable potential to cause or contribute to an excursion above the applicable criterion if the temperature at the edge of the mixing zone is above the allowable temperature increase of 28/(T+7). The temperature at the edge of the mixing zone can be calculated using the following equation:

$$T_{MZ} = \frac{T_E + (D * T_S)}{(D + 1)}$$

Where,
T_{MZ} = temperature at the edge of the mixing zone
T_E = effluent temperature
T_S = stream background temperature
D = dilution factor, the dilution provided by the mixing zone

The effluent temperature (T_E) can be estimated as the maximum monthly value over the last three years reported in monthly discharge monitoring reports provided by the facility, or where daily effluent data are available, the maximum 7-DADMax temperature for a given month is used. For stream background temperature (T_S) Washington's *Water Quality Program Permit Writer's Manual* states "… The point of compliance with the temperature standards is at the edge of the chronic mixing zone at the critical condition. The critical condition for temperature is when the ambient temperature of the receiving water is the highest." However, a review of Washington's NPDES permits show that permit writers use the 90th or 95th percentile of the receiving water data rather than the highest receiving water temperature to determine the stream background temperature. The dilution factor (D) is calculated either using a model or by using the following equation when using 25% of the stream flow:

where,
Q_S = portion of stream flow available for dilution
Q_E = effluent flow.

The dilution factor is based on the 7Q10 stream flow, and the average monthly effluent flow.

Washington's 2003 WQS revision allows for incremental increases in downstream temperatures at the edge of the regulatory mixing zone. For waters below the criterion, incremental increases based on the following equation, but not to exceed the criterion, would be allowed:

where,
t = incremental temperature increase at the edge of the mixing zone
T = maximum ambient temperature upstream of the discharge

Any facility whose discharge temperature would increase the temperature at the edge of the mixing zone by more than specified by the above equation (i.e., $(TMZ - Ts) > t$) would have reasonable potential to cause an exceedance of the water quality standard, and an effluent limit for temperature would need to be incorporated into the permit to ensure that the temperature standard was met at the edge of the mixing zone.

Facilities whose discharge temperature would increase the temperature at the edge of the mixing zone by an amount equal to or greater than 0.3°C are required to complete a Tier 2 antidegradation analysis (WAC 173-201A-320) prior to allowing any increase in temperature. A Tier II analysis consists of an evaluation of whether or not the degradation of water quality associated with a proposed action would be necessary and in the public interest.

Because this provision limits the warming of a river after mixing to levels at or below the criterion, EPA has concluded that the allowable incremental warming of the river associated with this provision will not adversely affect listed salmonids. However, EPA recognizes that temperatures within the mixing zone of some National Pollutant Discharge Elimination System (NPDES) discharges may result in temperatures near the vicinity of the discharge that may adversely effect salmonids. Because this provision would allow human-caused authorized thermal discharges that may result in potential adverse effects near the vicinity of the discharge (i.e., within the mixing zone area), EPA has concluded that its approval of this provision: **is likely to adversely affect** Chinook salmon ESUs (Snake River Fall Run, Snake River Spring/Summer Run, Upper Columbia River Spring Run, Lower Columbia River, and Puget Sound), Steelhead ESUs (Puget Sound, Snake River, Upper Columbia River, Middle Columbia River, and Lower Columbia River), Columbia River chum salmon, Hood Canal summer run chum salmon, Lower Columbia River coho salmon, Snake River sockeye salmon, Ozette Lake sockeye salmon, Columbia River Basin bull trout, and Coastal/Puget Sound bull trout.

5.H.11. Allowable temperature increases for lakes

Washington's water quality standards includes the following criteria for spawning at WAC 173-201A-200(1)(c)(v):

> *"(v) For lakes, human actions considered cumulatively may not increase the 7-DADMax temperature more than 0.3°C (0.54°F) above natural conditions."*

The above provision is consistent with the recommendations in EPA's Temperature Guidance which discusses allowing the temperature in a waterbody to be insignificantly higher than the applicable criteria. The purpose of such a provision is to allow an insignificant level of heat into the river from human activities when the natural conditions criteria is the applicable criteria or where waters are currently exceeding the biologically-based numeric criteria. Absent such a provision, no heat would be allowed from human activities when the natural condition criteria is the applicable criteria. EPA has concluded that this result is unnecessarily restrictive for protection of salmonid uses, and would lead to unnecessary costly expenditures which is why EPA recommended such a provision in its Temperature Guidance (USEPA 2003). Furthermore, EPA believes, for reason described below, that this provision does not undermine the protection of uses provided by the natural conditions criteria.

EPA believes that a 0.3°C or less temperature increase above the natural condition temperature is insignificant because monitoring measurement error for recording instruments typically used in field studies is about 0.2°C to 0.3°C. In other words, this level of a temperature increase is considered within the error band associated with typical temperature monitors.

Based on the above rationale, EPA has concluded that a 0.3°C increase above the applicable natural condition temperature criterion would not adversely affect listed salmonids. EPA has concluded that its approval of this provision: **is not likely to adversely affect** Chinook salmon ESUs (Snake River Fall Run, Snake River Spring/Summer Run, Upper Columbia River Spring Run, Lower Columbia River, and Puget Sound), Steelhead ESUs (Puget Sound, Snake River, Upper Columbia River, Middle Columbia River, and Lower Columbia River), Columbia River chum salmon, Hood Canal summer run chum salmon, Lower Columbia River coho salmon, Snake River sockeye salmon, Ozette Lake sockeye salmon, Columbia River Basin bull trout, and Coastal/Puget Sound bull trout.

5.H.12. Freshwater Dissolved Oxygen Numeric Criteria

Washington's water quality standards includes the following provision at WAC 173-201A-200(1)(d) – Table 200(1)(d) Aquatic Life Dissolved Oxygen Criteria in Fresh Water:

Category	**Lowest 1-Day Minimum**
Char	9.5 mg/L
Core summer salmonid habitat	9.5 mg/L
Salmonid spawning, rearing and migration	8.0 mg/L

Note: EPA is proposing to approve the 9.5 mg/L DO criteria for two small waterbodies with a new Char use designation (Cedar Creek and Tacoma Creek in WRIA 62). EPA is proposing to approve the 9.5 mg/L DO criteria for waterbodies with a new Core summer habitat use designation that were previously designated Class A. EPA is proposing to approve the 8.0 mg/L for two small waterbodies with a new Salmon spawning, rearing and migration use designation (Palouse River in WRIA 34 and Mill Creek in WRIA 32). See EPA GIS maps depicting EPA disapproval action for location of specific rivers at www.epa.gov/r10earth/washington-wqs.htm.

EPA is proposing to approve the 9.5 mg/L DO criteria for the "new" Core waters and four other small waterbodies noted above. There is no action for the 9.5 mg/L DO criteria for the other Core & Char waters because the criteria for theses waters are unchanged. Thus, the approval action would be for about 15% of the waters in the state, mostly in Puget Sound and lower Columbia River regions. See "EPA Core" (dark blue lines) on EPA GIS maps.

The Puget Sound Chinook and lower Columbia River Chinook are the species with the highest potential for any effects because of the significant overlap of the "new Core" waters and the spawning distribution of these species. Only a few waterbodies will have revised DO criteria in the Hood Canal region (hood canal summer chum), the eastside of the cascades (mid-Columbia steelhead, upper Columbia Chinook). Char are not affected by this proposed action because Char spawning does not occur in any of the water where the DO criteria has changed.

The revised DO criteria for these waters will be more stringent changing from 8.0 mg/L to 9.5 mg/L. EPA believes the 9.5 DO criteria provides good overall protection along with recognizing there are scenarios where potential adverse effects are likely.

DO concentration of 9.5 mg/L as an absolute minimum during the time of year when DO is lowest (late summer), would provide an excellent level of protection during the non-incubation (rearing/migration) period and would likely result in DO conc. higher than 11 mg/L or 95% saturation during the incubation period. Data indicate that the lowest values are in the late summer and higher concentration throughout the rest of the year (Ecology 2000, or Ecology's website at: ecy.wa.gov/biblio). EPA analyzed data from 60 or so monitoring station for the "new Core" waters that showed that attaining 9.5 mg/L results 11 mg/L or higher than 95% saturation during incubation in most cases. In 49 out of 60 stations that attained 9.5 mg/L, 11 mg/L or 95% saturation was attained throughout the incubation period. For 11 stations, there were samples in the record during incubation that dropped below 95% saturation during incubation (these were generally in the 90-95% range during the first few weeks of incubation).

Antidegration provisions are designed to protect the high DO levels (higher than 9.5 mg/L) that currently exist throughout the year.

Although the assumptions above are generally true, there are scenarios where the 9.5 mg/L criterion could (and do) result in DO levels below 11 mg/L or 95% saturation during part of the incubation period. Levels lower than 95% saturation during incubation would likely result in some level on impairment/take (some embryos that might not develop and smaller fry that are less competitive). This assumes DO in the gravels does drop below 8 mg/L as an average for a period of time.

Based on the above, EPA has determined that its approval of the revised DO criteria for these waters **is likely to adversely affect** Chinook salmon ESUs (Upper Columbia River Spring Run ESU, Lower Columbia River, and Puget Sound), Steelhead ESUs (Puget Sound, Upper Columbia River, Middle Columbia River, and Lower Columbia River), Hood Canal summer run chum salmon, and Lower Columbia River coho salmon.

EPA has determined that its approval of the revised DO criteria for these waters is **no effect** for Chinook salmon ESUs (Snake River Fall Run, Snake River Spring/Summer Run), Snake River steelhead, Columbia River chum salmon, Snake River sockeye salmon, Ozette Lake sockeye salmon, Columbia River Basin bull trout and Coastal/Puget Sound bull trout.

5.H.13. Dissolved Oxygen Narrative Provisions—allowable decreases

Washington's water quality standards includes the following provision at WAC 173-201A-200(1)(d)(i) and (ii):

> *"(i)When a waterbody's D.O. is lower than the criteria in Table 200(1)(d) (or within*

0.2 mg/L of the criteria) and that condition is due to natural conditions, then human actions considered cumulatively may not cause the D.O. of that waterbody to decrease more than 0.2 mg/L."

"(ii) For lakes, human actions considered cumulatively may not decrease the dissolved oxygen concentration more than 0.2 mg/L below natural conditions."

These provisions allow an insignificant decrease in the D.O. level from human activities when the natural condition criterion is the applicable criterion. Dissolved oxygen is a characteristic of a waterbody that can be affected by several different parameters such as temperature, physical characteristics (stream velocities, percent sediments, etc.), nutrients, sunlight, ammonia, etc. Because any oxygen demanding material or nutrient will negatively affect dissolved oxygen, meeting the "natural condition criterion" without allowing some insignificant decrease in dissolved oxygen would require dis-allowing any discharge of any pollutant that would affect dissolved oxygen. Absent such a provision as proposed by Washington, no oxygen demanding material would be allowed from human activities when the natural condition criteria are the applicable criterion. EPA believes that this is unnecessarily restrictive for the protection of designated uses, and would lead to unnecessary and costly expenditures. Additionally, 0.2 mg/L is within the monitoring measurement error for recording instruments typically used to monitor dissolved oxygen. In other words, this level of dissolved oxygen decrease is considered within the error band associated with typical dissolved oxygen monitors, therefore, EPA considers it insignificant.

Therefore, the EPA has determined that its approval of this provision **is not likely to adversely affect** Chinook salmon ESUs (Upper Columbia River Spring Run, Lower Columbia River, Snake River fall Run, Snake River Spring/Summer Run, Puget Sound), Steelhead ESUs (Puget Sound, Snake River Basin, Upper Columbia, Middle Columbia, and Lower Columbia River Basin), Columbia River chum salmon and Hood Canal summer run chum salmon, Lower Columbia River coho salmon, Snake River sockeye salmon, Ozette Lake sockeye salmon, Columbia River Basin bull trout, and Coastal/Puget Sound bull trout.

5.H.14. Total dissolved gas-Snake and Columbia Rivers exemption

Washington's water quality standards includes the following provision at WAC 173-201A-200(1)(f)(ii):

"(ii) …. The following special fish passage exemptions for the Snake and Columbia rivers apply when spilling water at dams is necessary to aid fish passage:

- *TDG must not exceed an average of one hundred fifteen percent as measured in the forebays of the next downstream dams and must not exceed an average of one hundred twenty percent as measured in the tailraces of each dam (these averages are measured as an average of the twelve highest consecutive hourly readings in any one day, relative to atmospheric pressure); and*
- *A maximum TDG one hour average of one hundred twenty-five percent must not be exceeded during spillage for fish passage."*

EPA is proposing to approve the special fish passage exemptions for the Snake and Columbia rivers. The Army Corps of Engineers is authorized under federal statutes to operate eight mainstem projects on the lower Columbia and lower Snake Rivers which provide passage for migratory fish species.

Since 1992, NOAA Fisheries has prepared several Biological Opinions on operation of the Columbia/Snake hydrosystem which call for project spill in the spring and summer for juvenile fish passage. The spill levels needed to protect ESA-listed fish species often result in exceedances of the Oregon and Washington WQS of 110% for TDG saturation. The Corps is currently operating in accordance with the 2004 NOAA Fisheries BiOp on Operation of the Federal Columbia River Power System (FCRPS) and a 2004 Updated Proposed Action (UPA) prepared by the Corps, BPA, and Bureau of Reclamation (Reclamation). NOAA Fisheries referred to the UPA in preparing the 2004 BiOp. In May 2005, the Federal District Court invalidated the 2004 FCRPS BiOp. In October 2005, the Court remanded the BiOp to NOAA Fisheries to produce a BiOp consistent with the Court's order by October 2006. The deadline was later extended to February 2007. The Court also ordered NOAA Fisheries and the Action Agencies to collaborate with sovereign states and tribes on the development of a new proposed action and a jeopardy framework. During the remand, the Court left the 2004 BiOp in effect. Remand discussions are now occurring, both to determine annual river operations and longer range actions to protect ESA-listed fish species. The Actions Agencies continue to operate according to the 2004 BiOp and UPA, as per the Court's order. Minimization of effects from TDG will result from discussions resulting from the remand.

<u>TDG and Fish Physiology</u>

Atmospheric air is comprised of 80% nitrogen, 20% oxygen and trace amounts of other gases, e.g. argon. These gases are water soluble and reach an equilibrium steady state reflecting several physical factors. The solubility of air is directly proportional to the ambient pressure (barometric and hydrostatic) and inversely proportional to water temperature. Air gases pass in or out of solution at the air/water interface. Spill at hydroelectric dams dramatically increases the air/water interface as the water passes over the spillway. The momentum of the spilled water carries the entrained air into the stilling basin depth instantaneously increasing the hydrostatic pressure two to three-fold and therefore the increasing the solubility of the gases.

Stilling basin waters below a spilling dam are turbulent and highly aerated. Some of the gas forced into solution under pressure will quickly be stripped in this aerated zone by passing from dissolved state in the water to a gaseous state in the surrounding bubbles. However, as the spilled water flows from the stilling basin a significant amount of air will remain dissolved in the water. As the river flows downstream the only interface available for further reduction of supersaturation is the river surface itself. Due to the surface to volume ratio of the Columbia River off-gassing via this route is usually a relatively slow process. A high wind generating breaking waves can have an important role in abating the dissolved gas state of the river.

Aquatic organisms living in a supersaturated river, depending on dissolved oxygen for their metabolic oxygen will tend to come into an equilibrium state with the level of dissolved gases surrounding them. As long as the organism remains at adequate depth, benefiting from the hydrostatic pressure, the gases in its tissues will remain at equilibrium. However, if the organism ascends or sounds the gas balance will reflect the pressure change. Ascent will place the organism tissues in an unsteady, supersaturated state. The tissue gases tend to return to a gaseous phase as bubbles and blisters referred to as GBT. Sounding will be increase the solubility of the gases and serve to protect the organism.

Dissolved gas effects all aquatic biota similarly whether salmonids, resident fish and invertebrates. The biological effect is a function of dose response as moderated by hydrostatic pressure, that is, depth. Each meter of depth equates to 10 % of depth compensation. This means that the organisms' depth determines the biological effect of exposure to water supersaturated with atmospheric gas. If the

Corps' Fixed Monitoring Station records a gas level of 120% supersaturation, it is referring to a gas level relative to water surface pressure. This same gas content at 1 m is only 110% supersaturated due to the compensatory influence of hydrostatic pressure. At 2 m it is in equilibrium, i.e., it is no longer supersaturated. The same is true of fish or invertebrate tissue levels of gas. If the fish or invertebrate tissues are equilibrated with the ambient level of dissolved gas and the water total dissolved gas is 120% relative the surface, the organisms cannot develop GBT if they are at 2 m or more of depth. In short GBT is the result of uncompensated hyperbaric pressure of TDG. It is the same for all fish, salmonid or resident species, as well as invertebrates.

Salmonid Species
Columbia River fishery biologists have learned a great deal with regard to aquatic organisms' responses to TDG supersaturation and especially regarding gas levels and the required exposure duration prior to onset of GBT. In the mid-1960s the physiology of TDG and the thresholds for GBT were researched. As a result of these studies the water quality standard of 110% TDG was established. However, the studies conducted leading to this standard were performed in shallow laboratory troughs. These did not allow exposed organisms free access to the depths their normal behavioral repertoire might have led them to. Absent this ability the organisms could not benefit from depth compensation.

Appendix F of the 2000 Biological Opinion was an assessment of risk to juvenile and adult salmonids exposed to dissolved gas supersaturation generated through implementation of the voluntary spill program (NMFS 2000). The 2000 risk analysis was based on the results of the biological monitoring program conducted between 1995 and 1999. During these years the monitoring program collected nearly 200,000 juvenile fish. It has been known for sometime that gas bubble trauma (GBT) in juvenile salmonids may be observed in fish exposed at all gas levels. Even at a relatively low gas supersaturation level of 110%, signs can develop if the exposure is long and the water is shallow. The onset of GBD and GBT is a function of the levels of TDG in the water and the length of exposure of an organism to these levels. Based on several years of data from the biological monitoring program, the average incidence of GBT signs in the Columbia River was low. The accumulated data on GBT in juvenile Chinook salmon and steelhead revealed few GBT signs were ever detected below 120% TDG. The prevalence of signs did not begin to increase until TDG was elevated to 121% and/or 125%. When fish with signs were exposed to gas levels above120%, the incidence and severity of GBT signs increased. However, severe signs did not begin to appear in monitored fish until TDG approached 130%. It is of significance that these greater levels of TDG were observed only during periods of involuntary spill forced by river conditions that exceeded the hydraulic capabilities of the dams. (NMFS 2000).

The monitoring program for adult salmonids showed a similar relationship between gas bubble signs and TDG. When the in-river TDG level was below 120%, few adult fish (in some cases none) displayed signs of GBT. Investigators observed adult tolerance to TDG and hypothesized that it was attributable to the migration depth of adult salmonids. Depth-sensitive radio tags used in adult migration studies confirmed that adults migrate at depths up to 4 meters and find depth compensation protection from GBT.

The Fishery Managers note that the Independent Scientific Advisory Board's evaluation of gas abatement (ISAB Report # 98-8, Review of the U.S. Army Corps of Engineers Dissolved Gas Abatement Program) and the NMFS Biological Opinion for the Federal Columbia River Power System (NMFS 2000) found that dissolved gas levels of 120% saturation were conservative and not harmful to salmon in the river. Further, analysis of three years of research from in-river juvenile salmon sampling in the Columbia River indicates that very low incidences of GBT were found in juvenile salmon that were exposed to dissolved gas levels up to 125% saturation (Backman et al. 2002, as cited in ACOE 2006). These researchers found that GBT was not detected in most of the in-river migrants sampled. This included fish sampled during two high flow years where spill was at uncontrolled levels throughout the FCRPS. Backman and Evans (2002, as cited in ACOE 2006) found that in samples of 4,667 adult Chinook salmon, fish were rarely observed with gas bubble trauma, despite sampling large numbers when total dissolved gas exceeded 130% saturation. Specifically, Backman and Evans (2002, as cited in ACOE 2006) found no statistically significant relation between total dissolved gas and gas bubble trauma for Chinook salmon. For adult sockeye and steelhead, Backman and Evans (2002, as cited in ACOE 2006) found that most gas bubble trauma symptoms were minor (>5% fin occlusion) with severe bubbles (>26% fin occlusion) being observed only when total dissolved gas exceeded 126%.

<u>Resident Fish</u>

In recent years more results of resident fish and invertebrates TDG effects research have become available. The results of these studies coupled with the above salmonid monitoring ameliorate concerns regarding the habitat below Bonneville. Ryan et al. (2000, as cited in ACOE 2006) reported on four years of investigations during which resident fish and invertebrates were collected and inspected for signs of gas bubble trauma. In the study nearly 40,000 specimens were analyzed. The objectives of the study were to investigate the impacts of TDG supersaturation due to the BIOP spill program on this segment of the Columbia River biota as well as document any consequences. The resident fish and invertebrates were collected from three sites, i.e., above Priest Rapids Dam, on the Snake River below Ice Harbor Dam, and below Bonneville Dam in the habitat area of particular concern. All of the fish sampled were collected in a depth range of 0 to 3 m. The investigators recognized that any organisms collected below three meters of depth would have been protected from the effects of supersaturation to a surface level of at least 130%. Benthic invertebrates were sampled to a depth of 0.6 m. The field sampling was conducted from April through June of the years 1994 to 1997. Twenty-eight species of resident fish were collected at the three sampling sites. Of these specimens 3.9% of the fish displayed signs of GBT, most appearing in 1996 and 1997 when involuntary spill was common and TDG was well above BIOP limits. The TDG levels measured during the study reflected the runoff of the water years and the incidence of GBT reflected the gas levels. **Table 5- 21** summarizes Ryan et al. results recorded below Bonneville Dam. The invertebrates sampling efforts produced representatives from 27 taxa. Sampling was conducted only during 1994 and 1995. Of the over 5,400 specimens inspected only 7 showed signs of gas bubble disease.

Table 5- 21. Resident fish and invertebrates collected below Bonneville Dam, sampling year, total dissolved gas levels, number of fish collected and inspected and gas bubble disease signs recorded.

Year	**Total Dissolved Gas Level Monitored**	**Number of Resident Fish Sampled**	**Gas Bubble Disease Incidence**
1994	120%	4955	3 fish with signs
1995	Exceeded 120% four times,	1963	2 fish with signs

	never over 123%		
1996	Daily average peaked over 120% April to mid-May. Over 130% through end of June	1116	5.1% of specimens
1997	Above 125% for 10 weeks, exceeded 135% for 12 days	813	18.0% of specimens

Weitkamp et al. (2003a and 2003b, as cited in ACOE 2006) published results of two resident fish studies in 2003. Both investigations were conducted on resident fish species in the lower Clark Fork River in northern Idaho. The reports addressed the incidence and severity of gas bubble trauma and fish behavior in supersaturated waters. In the former study fish were electrofished in the four years from 1997 to 2000. The year of 1997 was one of high runoff. Resultant involuntary spill in the Clark Fork at Cabinet Gorge Dam resulted in gas levels approaching 150%. The spring runoff in 1999 was more moderate but did result in gas ranging from 120% to 130% in the river. A total of 16 species of resident fish were captured in the investigations. The bulk of the species list was similar to the Ryan et al. (2000, as cited in ACOE 2006) studies discussed above and included large scale sucker, northern pike minnow, peamouth, and mountain whitefish. These species represented 84% of the fish captured. Resident salmonid species comprised the remainder of the list. The Weitkamp et al. (2003b, as cited in ACOE 2006) study is a good indicator of resident fish GBT incidence and severity. In these studies the incidence and severity of GBT signs was less than might have been predicted based on laboratory bioassay results or TDG levels measured at the water surface. It must be noted that after four years of investigation the authors concluded that moderate levels of TDG did not have a substantial effect on resident fish in the lower Clark Fork River. Intermittent exposure to 120-130% TDG resulted in signs in a small number of resident species. The key factor explaining these results is that the fish had access to deeper waters in the river habitat. Further, the normal behavioral repertoire of these species regularly places them in deeper waters. Thus they benefited from depth compensation during periods of high dissolved gas. In the second Weitkamp et al. investigation, pressure sensitive radio frequency tags were placed on examples of local resident species. These included brown trout, bull trout, west slope cutthroat, rainbow trout, mountain whitefish, large-scale sucker and northern pikeminnow. The tagged fish were tracked for periods up to 49 days during the spill season. Fish of each species tended to remain at depth of 2 m or deeper about 12 half of the time. The conclusion is that the normal behavior of these species puts them at depths that mitigate exposure to the TDG supersaturation levels as measured at the water surface. The fish behavior results in depth compensation from elevated TDG.

Therefore, the EPA has determined that its approval of this provision **is likely to adversely affect** Columbia River Basin bull trout, Chinook Salmon ESUs (Upper Columbia River Spring Run, Snake River fall Run, and Snake River Spring/Summer Run), Steelhead ESUs (Snake River Basin, Upper, Columbia River and Middle Columbia River), and Snake River sockeye salmon.

This provision will have **no affect** on species outside of the Columbia and Snake Rivers and those that range below the dammed portion of the Columbia: Coastal/Puget Sound bull trout, Puget Sound Chinook, Lower Columbia River Chinook, Puget Sound steelhead, Lower Columbia River Steelhead, Lower Columbia coho, Ozette Lake sockeye, Hood Canal summer run chum, and Lower Columbia River chum.

5.H.15. Allowable 0.3°C temperature increase in waters marine waters warmer than the criteria

Washington’s water quality standards includes the following provision at WAC 173-201A-

210(1)(c)(i):

“(i) When a waterbody's temperature is warmer than the criteria in Table 210 (1)(c) (or within 0.3°C (0.54°F) of the criteria) and that condition is due to natural conditions, then human actions considered cumulatively may not cause the 7-DADMax temperature of that waterbody to increase more than 0.3°C (0.54°F).”

Additionally, the Washington water quality standards contain a provision which allows the natural condition of the waterbody to become the criterion when the natural condition of the waterbody is of lower quality than the criterion assigned in the State’s water quality standards (see WAC 173-201A-210A-310(3)). The above provision is consistent with the recommendations in EPA’s Temperature Guidance which discusses allowing the temperature in a waterbody to be insignificantly higher than the applicable criteria. The purpose of such a provision is to allow an insignificant level of heat into the river from human activities when the natural conditions criteria is the applicable criteria or where waters are currently exceeding the biologically-based numeric criteria. Absent such a provision, no heat would be allowed from human activities when the natural condition criteria is the applicable criteria. EPA has concluded that this result is unnecessarily restrictive for protection of salmonid uses, and would lead to unnecessary costly expenditures which is why EPA recommended such a provision in its Temperature Guidance (USEPA 2003). Furthermore, EPA believes, for the reason described below, that this provision does not undermine the protection of uses provided by the natural conditions criteria.

EPA believes that a 0.3°C or less temperature increase above the natural condition temperature is insignificant because monitoring measurement error for recording instruments typically used in field studies is about 0.2°C to 0.3°C. In other words, this level of a temperature increase is considered within the error band associated with typical temperature monitors.

Based on the above rationale, EPA has concluded that in most areas a 0.3°C increase above the applicable natural condition temperature criterion would not adversely affect listed salmonids. However, EPA recognizes that temperatures within the mixing zone of some National Pollutant Discharge Elimination System (NPDES) discharges may result in temperatures near the vicinity of the discharge that may adversely effect salmonids. Therefore this provision would allow human caused thermal discharges that may result in potential adverse effects near the vicinity of the discharge. Because this provision would allow human-caused authorized thermal discharges that may result in potential adverse effects near the vicinity of the discharge, EPA has concluded that its approval of this provision: **is likely to adversely affect** Chinook salmon ESUs (Snake River Fall Run, Snake River Spring/Summer Run, Upper Columbia River Spring Run, Lower Columbia River, and Puget Sound), Steelhead ESUs (Puget Sound, Snake River, Upper Columbia River, Middle Columbia River, and Lower Columbia River), Columbia River chum salmon, Hood Canal summer run chum salmon, Lower Columbia River coho salmon, Snake River sockeye salmon, Ozette Lake sockeye salmon, Columbia River Basin bull trout, and Coastal/Puget Sound bull trout.

5.H.16. Allowable warming when marine waters are cooler than the criteria

Washington’s water quality standards includes the following provision at WAC 173-201A-210(1)(c)(ii):

> *“(ii) When the natural condition of the water is cooler than the criteria in Table 210 (1)(c), the allowable rate of warming up to, but not exceeding, the numeric criteria from human actions is*

restricted as follows:

> *(B) Incremental temperature increases resulting from individual point source activities must not, at any time, exceed 12/(T-2) as measured at the edge of a mixing zone boundary (where "T" represents the background temperature as measured at a point or points unaffected by the discharge and representative of the highest ambient water temperature in the vicinity of the discharge);"*

EPA proposes to approve the allowable temperature increase of 12/(T-2), at the edge of a mixing zone, for point source dischargers when the natural condition of a waterbody is cooler than the numeric temperature criteria contained in Table 200(1)(c). Table 210(1)(c) establishes the temperature criteria protective of aquatic life. The incremental temperature increase limits the temperature increase a point source can cause to a waterbody which is cooler than the established temperature criterion, and it does not allow the temperature to increase above the criteria established in the table to protect aquatic life uses.

Additionally, Washington's anti-degradation policy requires that a Tier II analysis be completed for any State regulated new or expanded action, such as point source discharges, that would warm temperatures by 0.3°C or more at the edge of the mixing zone. Therefore, a Tier II analysis would have to be completed if the incremental temperature increase of 12/T-2 resulted in an increase of 0.3°C or more at the edge of the mixing zone for point sources. This criterion would be implemented in the same manner as described in the section which discusses incremental temperature increases for fresh waters.

Provision WAC 173-210A-210(1)(c)(ii)(A) may be used to help preserve cooler waterbodies, however, it does not preclude cooler waterbodies from heating up to the criterion established in Table 210(1)(c). This provision does not allow either point or non-point sources to exceed the criteria established in Table 210(1)(c).

Because this provision limits the warming of a river after mixing to levels at or below the criterion, EPA has concluded that the allowable incremental warming of the marine waters associated with this provision will not adversely affect listed salmonids. However, EPA recognizes that temperatures within the mixing zone of some National Pollutant Discharge Elimination System (NPDES) discharges may result in temperatures near the vicinity of the discharge that may adversely effect salmonids. Because this provision would allow human-caused authorized thermal discharges that may result in potential adverse effects near the vicinity of the discharge, EPA has concluded that its approval of this provision: **is likely to adversely affect** Chinook salmon ESUs (Snake River Fall Run, Snake River Spring/Summer Run, Upper Columbia River Spring Run, Lower Columbia River, and Puget Sound), Steelhead ESUs (Puget Sound, Snake River, Upper Columbia River, Middle Columbia River, and Lower Columbia River), Columbia River chum salmon, Hood Canal summer run chum salmon, Lower Columbia River coho salmon, Snake River sockeye salmon, Ozette Lake sockeye salmon, Columbia River Basin bull trout, and Coastal/Puget Sound bull trout.

5.H.17. Natural and Irreversible human conditions provisions

Washington's water quality standards includes the following provision at WAC 173-201A-260(1):

> *"(1) Natural and irreversible human conditions.*
>
> *(a) It is recognized that portions of many waterbodies cannot meet the assigned criteria*

due to the natural conditions of the waterbody. When a waterbody does not meet its assigned criteria due to natural climatic or landscape attributes, the natural conditions constitute the water quality criteria."

Washington's water quality standards define natural conditions as "…surface water quality that was present before any human-caused pollution. When estimating natural conditions in the headwaters of a disturbed watershed it may be necessary to use the less disturbed condition of neighboring or similar watershed as a reference condition." EPA views criteria based on natural conditions to be fully protective of salmonid uses, even if the natural conditions are higher than the numeric criteria for some waterbodies, because the pollutant level prior to human impacts clearly supported healthy salmonid populations. So even if the natural conditions criteria would result pollutant levels that cause adverse effects to salmonids, those adverse effects would be viewed as naturally occurring adverse effects.

EPA's Temperature Guidance also recommends that when estimating natural conditions (i.e. natural thermal potential) on a case-by-case basis in the context a TMDL, 303(d) listing, NPDES permit, or a 401 certification, the best available scientific information and techniques should be utilized. The Temperature Guidance provides guidance on what EPA considers are the best available methods to estimate the natural conditions for temperature. Washington has described the methods it will use to determine natural conditions in its letter to USEPA from David C. Peeler dated January 19, 2006 (see Appendix F). These methods are consistent with those recommended in EPA's Temperature Guidance.

In the January 2006 letter to EPA, Washington stated that if it is aware of information documenting a violation of the numeric criterion, they will list the waterbody on the 303(d) list, unless they are aware that the exceedance is due to natural conditions. If Washington does not have information that demonstrates the violation is due solely to natural causes, they will use the TMDL process to investigate whether the violation may be attributed to natural condition.

The following discussion outlines the CWA regulatory framework which will ensure Washington's natural condition provision is appropriately implemented. Under the CWA, EPA is required to approve or disapprove Washington's TMDLs and 303(d) listing of impaired waters. For TMDLs where the applicable WQS is the natural condition criteria, the TMDL must document the methodology and resultant estimates of natural thermal potential. If the natural condition determination in the TMDL is inconsistent with Washington's natural condition criteria, EPA has the authority to disapprove the TMDL because the TMDL would not be designed to attain Washington's WQS. If Washington relies on its natural condition criteria as a basis not to list a waterbody that exceeds the biologically-based criteria on the 303(d) list, it must document its basis for making such a determination and its basis must be consistent with its natural conditions criteria in order for EPA to approve the 303(d) list. Further, the subsequent CWA actions described above may also include an ESA consultation. Under the CWA, EPA has oversight authority over the NPDES program. If a natural condition provision is being implemented through the permitting program, EPA can review the natural condition determination to ensure that it is consistent with the State's natural condition provision. EPA does have the authority to object to state issued permits if they are inconsistent with the State's water quality standards and the NPDES regulation. If the State does not adequately address EPA's objection, EPA can federalize the permit (i.e., EPA would be responsible for writing and issuing the permit).

EPA's approval of the natural conditions provision is likely to result in pollutant levels in some waters that lead to adverse effects on listed species, but those adverse effects would be naturally occurring and could not be avoided or minimized without artificial measures to lower the naturally occurring pollutant level.

This provision may affect all the listed species assessed in this BE because it could be applied anywhere in the State. However, because the adverse effects associated with this provision are natural and not attributable to the provision itself, EPA has concluded that its approval of this provision **is not likely to adversely affect** Chinook salmon ESUs (Upper Columbia River Spring Run, Lower Columbia River, Snake River fall Run, Snake River Spring/Summer Run, Puget Sound), Steelhead ESUs (Puget Sound, Snake River Basin, and Upper Columbia, Middle Columbia, and Lower Columbia River Basin), Columbia River chum salmon and Hood Canal summer run chum salmon, Lower Columbia River coho salmon, Snake River sockeye salmon, Ozette Lake sockeye salmon, Columbia River Basin bull trout and Coastal/Puget Sound bull trout.

5.H.18. Procedures for applying water quality standards

Washington's water quality standards include the following provisions at WAC 173-201A-260(3):

> ***"(3) Procedures for applying water quality criteria.*** *In applying the appropriate water quality criteria for a water, the department will use the following procedure:*
>
>> *(b) Upstream actions must be conducted in manners that meet downstream waterbody criteria. Except where and to the extent described otherwise in this chapter, the criteria associated with the most upstream uses designated for a waterbody are to be applied to headwaters to protect nonfish aquatic species and the designated downstream uses.*
>> *(c)Where multiple criteria for the same water quality parameter are assigned to a waterbody to protect different uses, the most stringent criterion for each parameter will apply."*

These provisions will ensure that Washington's water quality standards are applied in a way that will be most protective of aquatic life. Part (b) of this section ensures that when a criterion is being applied in a specific action (e.g., in an NPDES permit or a TMDL) the effects of the action must analyzed in downstream waters to ensure that the downstream criteria will be met.

EPA has determined that its approval of this provision is **not likely to adversely affect** Chinook salmon ESUs (Upper Columbia River Spring Run, Lower Columbia River, Snake River fall Run, Snake River Spring/Summer Run, Puget Sound), Steelhead ESUs (Puget Sound, Snake River Basin, and Upper Columbia, Middle Columbia, and Lower Columbia River Basin), Columbia River chum salmon and Hood Canal summer run chum salmon, Lower Columbia River coho salmon, Snake River sockeye salmon, Ozette Lake sockeye salmon, Columbia River Basin bull trout and Coastal/Puget Sound bull trout.

5.I. Effects Determinations for Listed Non-Fish Species and Designated Critical Habitats

From Section 3, the non-fish species that the EPA determined had some possibility of exposure route are two bird species (bald eagle and marbled murrelet) and three marine mammals (stellar sea lion, humpback whale, and killer whale). Unlike the listed anadromous and freshwater fish species addressed above in this effects analysis, these species would in no way be directly physically exposed to the water temperature or dissolved oxygen levels that are regulated by the Washington Water

Quality Standards. The only exposure is that fish species that would be exposed (e.g. listed species addressed above) are the substantial portion of the the prey base for these five species. Unlike toxic chemicals or metals that accumulate in the tissue of fish and then accumulate in the tissue of the predator species, temperature and dissolved oxygen exposure to prey species will have no affect on the predator species. The only possible effect to these five predator species is if the Approval of the water quality standards resulted in effects to the fish populations that were substantial enough to result in reduced numbers of prey items to the five bird and mammal species. All of the above effects determinations found that there are some possibilities of effects to fish species however these water quality standards are protective and in some cases they are are more protective of listed salmonids that the previous standards. Non of these standards that are being approved are a substantial deviation from water quality limits derived from the literature that are found to be protective of salmonids. Thus, any possible adverse effects would not be operating on the scale that would result in suppression of entire populations that would constitute a possible reduction in the prey base for the listed bird and marine mammal species.

Therefore, the EPA has determined that its approval of all provisions in the Washington State Water Quality Standards **is not likely to adversely affect** bald eagles, marbled murrelets, stellar sea lions, humpback whales, and killer whales.

5.J. Summary of Effects Analysis

The following tables (**Table 5- 21** and 22) list the effects determinations detailed in this BE.

Table 5-21. Summary of Effects Determinations for the Designated uses in WAC 173-201A-600 (Table 602) and associated numeric temperature criteria discussed in sections 5.H.3-5.H.8. These effects determinations are the same for the critical habitat associated with each species as listed in the table.

Species	ESUs	Critical habitat designated	NE/NLAA	LAA
Chinook	Snake R. Fall	58 FR 68543	All	--
Chinook	Snake R. Spring/Sum	58 FR 68543	All	--
Chinook	Upper Columbia Spring	70 FR 52630	All	--
Chinook	Lower Columbia	70 FR 52630	All	--
Chinook	Puget Sound	70 FR 52630	All except	--No application of Core Summer Salmonid Habitat use in two stream reaches (WRIAs: 1,10)
Chum	Columbia R.	70 FR 52630	All	--
Chum	Hood Canal-summer	70 FR 52630	All	--
Coho	Lower Columbia R.*	Not currently designated	All	--
Sockeye	Snake R.	58 FR 68543	All	--
Sockeye	Ozette Lake	70 FR 52630	All	--
Steelhead	Puget Sound	Proposed species no C.H. designation	All except	--No application of Core Summer Salmonid Habitat use in one stream reaches in WRIAs 1)
Steelhead	Snake R.	70 FR 52630	All	--
Steelhead	Upper Columbia R.	70 FR 52630	All	--
Steelhead	Middle Columbia R.*	70 FR 52630	All except	--No application of timing of 13°C for protection of spawning incubation period for several stream reaches (WRIAs: 38,39)
Steelhead	Lower Columbia R.*	70 FR 52630	All	--
Bull trout	Coastal/Puget Sound	50 FR 56212	All except	--No application of Char Spawning and Rearing use in several stream reaches (WRIAs 1,7,10) --No application of Core Summer Salmonid Habitat use (16°C) in several stream reaches (WRIAs: 1, 5, 7, 9, 10, 22, 23, 24).
Bull trout	Columbia R. Basin	50 FR 56212	All except	--No application of Char Spawning and Rearing use in several stream reaches (WRIAs 27, 35, 37, 39, 46, 48, 62) --No application of 9°C for char spawning (2 reaches in WRIA 38) --No application of Core Summer Salmonid Habitat use (16°C) in several stream reaches (WRIAs: 32, 35, 37, 39, 45, 46, 48).

Table 5-22. Summary of Effects Determinations for other WQS provisions discussed in sections 5.H.9 through 5.H.18. These effects determinations are the same for the critical habitat associated with each species as listed in the table. Note: columns 3 and 4 contain the WAC 173-201A provision.

Species	ESUs	Critical Habitat	NE/NLAA	LAA
Chinook	Snake R. Fall	58 FR 68543	200(1)(c)(v) 200(1)(d)(i), (ii) 260(1), (3) 200(1)(d)	200(1)(c)(i), (ii) – Warming allowance in freshwater 200(1)(f)(ii) – Total dissolved gas exception for Columbia/Snake R 210(1)(c)(i), (ii) – Warming allowance in marine water
Chinook	Snake R. Spring/Sum	58 FR 68543	200(1)(c)(v) 200(1)(d)(i), (ii) 260(1), (3) 200(1)(d)	200(1)(c)(i), (ii) – Warming allowance in freshwater 200(1)(f)(ii) – Total dissolved gas exception for Columbia/Snake R 210(1)(c)(i), (ii) – Warming allowance in marine water
Chinook	Upper Columbia Spring	70 FR 52630	200(1)(c)(v) 200(1)(d)(i), (ii) 260(1), (3)	200(1)(c)(i), (ii) – Warming allowance in freshwater 200(1)(d) – 9.5mg/L DO criteria 200(1)(f)(ii) – Total dissolved gas exception for Columbia/Snake R 210(1)(c)(i), (ii) – Warming allowance in marine water
Chinook	Lower Columbia	70 FR 52630	200(1)(c)(v) 200(1)(d)(i), (ii) 200(1)(f)(ii) 260(1), (3)	200(1)(c)(i), (ii) – Warming allowance in freshwater 200(1)(d) – 9.5mg/L DO criteria 210(1)(c)(i), (ii) – Warming allowance in marine water
Chinook	Puget Sound	70 FR 52630	200(1)(c)(v) 200(1)(d)(i), (ii) 200(1)(f)(ii) 260(1), (3)	200(1)(c)(i), (ii) – Warming allowance in freshwater 200(1)(d) – 9.5mg/L DO criteria 210(1)(c)(i), (ii) – Warming allowance in marine water
Chum	Columbia R.	70 FR 52630	200(1)(c)(v) 200(1)(d)(i), (ii) 200(1)(f)(ii) 260(1), (3) 200(1)(d)	200(1)(c)(i), (ii) – Warming allowance in freshwater 210(1)(c)(i), (ii) – Warming allowance in marine water
Chum	Hood Canal-summer	70 FR 52630	200(1)(c)(v) 200(1)(d)(i), (ii) 200(1)(f)(ii) 260(1), (3)	200(1)(c)(i), (ii) – Warming allowance in freshwater 200(1)(d) – 9.5mg/L DO criteria 210(1)(c)(i), (ii) – Warming allowance in marine water
Coho	Lower Columbia R.	Not currently designated	200(1)(c)(v) 200(1)(d)(i), (ii) 200(1)(f)(ii) 260(1), (3)	200(1)(c)(i), (ii) – Warming allowance in freshwater 200(1)(d) – 9.5mg/L DO criteria 210(1)(c)(i), (ii) – Warming allowance in marine water
Sockeye	Snake R.	58 FR 68543	200(1)(c)(v) 200(1)(d)(i), (ii) 260(1), (3) 200(1)(d)	200(1)(c)(i), (ii) – Warming allowance in freshwater 200(1)(f)(ii) – Total dissolved gas exception for Columbia/Snake R 210(1)(c)(i), (ii) – Warming allowance in marine water
Sockeye	Ozette Lake	70 FR 52630	200(1)(c)(v) 200(1)(d)(i), (ii) 200(1)(f)(ii) 260(1), (3), 200(1)(d)	200(1)(c)(i), (ii) – Warming allowance in freshwater 210(1)(c)(i), (ii) – Warming allowance in marine water
Steelhead	Puget Sound	no C.H. designation	200(1)(c)(v) 200(1)(d)(i), (ii) 200(1)(f)(ii) 260(1), (3)	200(1)(c)(i), (ii) – Warming allowance in freshwater 200(1)(d) – 9.5mg/L DO criteria 210(1)(c)(i), (ii) – Warming allowance in marine water

Table 5- 22 continued. Summary of Effects Determinations for other WQS provisions discussed in sections 5.H.9 through 5.H.18. These effects determinations are the same for the critical habitat associated with each species as listed in the table. Note: columns 3 and 4 contain the WAC 173-201A provision.

Species	ESUs	Critical Habitat	NE/NLAA	LAA
Steelhead	Snake R.	70 FR 52630	200(1)(c)(v) 200(1)(d)(i), (ii) 260(1), (3) 200(1)(d)	200(1)(c)(i), (ii) – Warming allowance in freshwater 200(1)(f)(ii) – Total dissolved gas exception for Columbia/Snake R 210(1)(c)(i), (ii) – Warming allowance in marine water
Steelhead	Upper Columbia R.	70 FR 52630	200(1)(c)(v) 200(1)(d)(i), (ii) 260(1), (3)	200(1)(c)(i), (ii) – Warming allowance in freshwater 200(1)(d) – 9.5mg/L DO criteria 200(1)(f)(ii) – Total dissolved gas exception for Columbia/Snake R 210(1)(c)(i), (ii) – Warming allowance in marine water
Steelhead	Middle Columbia R.	70 FR 52630	200(1)(c)(v) 200(1)(d)(i), (ii) 260(1), (3)	200(1)(c)(i), (ii) – Warming allowance in freshwater 200(1)(d) – 9.5mg/L DO criteria 200(1)(f)(ii) – Total dissolved gas exception for Columbia/Snake R 210(1)(c)(i), (ii) – Warming allowance in marine water
Steelhead	Lower Columbia R.	70 FR 52630	200(1)(c)(v) 200(1)(d)(i), (ii) 200(1)(f)(ii), 260(1), (3)	200(1)(c)(i), (ii) – Warming allowance in freshwater 200(1)(d) – 9.5mg/L DO criteria 210(1)(c)(i), (ii) – Warming allowance in marine water
Bull trout	Coastal/Puget Sound	50 FR 56212	200(1)(c)(v) 200(1)(d)(i), (ii) 200(1)(f)(ii), 260(1), (3) 200(1)(d)	200(1)(c)(i), (ii) – Warming allowance in freshwater 210(1)(c)(i), (ii) – Warming allowance in marine water
Bull trout	Columbia R. Basin	50 FR 56212	200(1)(c)(v) 200(1)(d)(i), (ii) 260(1), (3) 200(1)(d)	200(1)(c)(i), (ii) – Warming allowance in freshwater 200(1)(f)(ii) – Total dissolved gas exception for Columbia/Snake R 210(1)(c)(i), (ii) – Warming allowance in marine water

6.0 Cumulative Effects

Cumulative effects include the effects of future state, tribal, local, or private actions on endangered or threatened species or critical habitat that are reasonably certain to occur in the action area considered in this BE. Future federal actions or actions on federal lands that are not related to the proposed action are not considered in this section.

Future anticipated nonfederal actions that may occur in or near surface waters in the state of Washington include timber harvest, grazing, mining, agriculture, water withdrawal, urban development, municipal and industrial wastewater discharges, road building, sand and gravel operations, introduction of nonnative fishes, off-road vehicle use, fishing, hiking, and camping. These nonfederal actions are likely to continue having adverse effects on the endangered and threatened species, and their habitat.

There are also nonfederal actions likely to occur in or near surface waters in the state of Washington that are likely to have beneficial effects on the endangered and threatened species. These include implementation of riparian improvement measures, best management practices associated with timber harvest, grazing, agricultural activities, urban development, road building and abandonment, recreational activities, and other nonpoint source pollution controls.

This BE does not address those Washington water quality standards that have not been revised because EPA is not taking an action on those provisions. Additionally, EPA's approval of Washington's antidegradation provision is not addressed in this BE because EPA has determined it has no discretionary authority and therefore EPA's approval is not an action under ESA Section 7(a)(2). Although EPA is not addressing these provisions in the BE, they are related to EPA's action and may have effects on endangered or threatened species or critical habitat. It should also be noted that while EPA recognizes adverse effects to listed species may occur through implementation of these existing water quality standard provisions, EPA is not making a finding that they do not protect designated uses or do not meet Clean Water Act requirements. These standards are discussed below:

- **Mixing Zone Provision (WAC 173-210A-400)** - a mixing zone is an area where an effluent discharge undergoes dilution. Within a mixing zone the water quality criteria may be exceeded as long as acutely toxic conditions are prevented. Washington restricts the allowable size of a mixing zone to the more stringent of the following: (1) 300 feet downstream of the discharge and no more than 25% of the width of the river, or (2) 25% of the river flow. This restriction allows for fish passage. Future actions for wastewater discharges to a waterbody may include a mixing zone which may allow some adverse impacts to listed and endangered species to occur within the specified mixing zone area.

- **Dissolved Oxygen Criteria (WAC 173-201A200-(1)(d), Table 200(1)(d))-** Table 200(1)(d) lists the dissolved oxygen criteria applicable for each aquatic life use designation. The BE examines the effects to listed species for those waterbodies where EPA proposes to approve the DO criteria, specifically where the DO criterion changed from 8.0 mg/L to 9.5 mg/L (See Section 5.H.12). EPA is not acting on or examining the effects associated with the DO criteria in Table 200(1)(d) generally or for waterbodies other than those noted in Section 5.H.12. Since EPA concluded its approval of the 9.5 mg/L for the specific waters where the DO criteria did change is likely adversely effect listed salmonids, its logical to conclude that implementation of the 8.0 mg/L and 9.5 mg/L DO criteria in other waters in the State would result in adverse impacts to listed salmonids. However, implementation actions that serve to improve currently degraded DO levels would be beneficial to listed salmonids, even if residual adverse effects may remain at the criteria levels.

- **Special Temperature Criteria (WAC 173-210A-602, Table 602) –** Table 602 lists waterbody segments and the designated uses applicable to these segments. Table 602 also contains special temperature criteria that are applicable to specific stream segments. These special temperature criteria are:
  - Columbia River from the mouth to the Grand Coulee dam - 20° C;
  - Snake River from mouth to the Washington/Idaho/Oregon border - 20° C; and
  - Yakima River from the mouth to the Cle Elum River - 21° C
  - Skagit river from Gorge Dam to Gorge Powerhouse - 21° C
  - Palouse River from South Fork to Idaho border - 20° C
  - Pend Oreille from Canadian border to Idaho border -20° C
  - Spokane River from mouth to Long Lake and from Nine mile bridge to Idaho border - 20° C

Each of these temperature criteria are at levels where adverse effects to listed ESA salmonids would be expected. Therefore, any future actions which implements these criteria may adversely affect listed salmonid species.

- **Temperature Criteria for Marine waters (WAC 173-201A-210(1)(c), Table 210(1)(c)) –** Table 210(1)(c) provides the temperature criteria for each category of marine aquatic life use. The temperature criteria associated with "Good quality" marine water is 19°C, and the temperature criteria associated with "Fair quality" marine water is 22°C. These temperatures may adversely adverse affect FMO for bull trout as well as rearing and migration for other listed salmonid species.

- **Antidegradation (WAC 173-210A-300) –** Washington has adopted an antidegration policy and implementation procedures that are consistent with EPA requirements. The State has adopted three antidegradation tiers that can be used to protect water quality. Tier I protects "existing uses" and provides the absolute floor of water quality in all waters. Tier II applies to waters whose quality exceeds that necessary to protect the section 101(a)(2) goals of the CWA (i.e., fishable/swimmable goals). For Tier II waters, water quality may not be lowered to less than the level necessary to fully protect "fishable/swimmable" uses and other existing uses, and may be lowered even to those levels *only* after following all the implementation procedures provided in Washington's water quality standards (e.g., providing the public an opportunity to comment, evaluating different technological alternatives). Tier III applies to waters designated as "outstanding resource waters." This Tier prohibits any future degradation for waters designated as Tier III (A) waters, and only allows de minimus degradation for waters designated as Tier III(B).

  The antidegradation provision is beneficial to listed species because it provides a layer of protection for waters colder than the criteria. Waters designated as Tier III for temperature would not be allowed to be degraded (except for de minimus amounts for Tier III(B). Additionally, a Tier II analysis as described in WAC 173-201A-320 would be required for certain types of new and expanded actions in Tier II waters.

7.0 Conclusions

EPA has concluded that its approval of the 2006 Washington's Water Quality standards may result in indirect effects to all threatened or endangered listed fish species, two bird species, and three marine mammal species and their critical habitat in Washington State because the standards influence how various Clean Water Programs are implemented, which can directly affect these species. Generally, implementation of CWA programs consistent with the 2006 standards will be beneficial to these listed species insofar as the environmental baseline is improved. EPA has concluded that although its approval of significant portions of the 2006 standards are Not Likely to Adversely Effect listed fish species, there are several provision that are Likely to Adversely Effect listed fish species and their critical habitat. Except for two bird species and three marine mammal species, all other listed species in Washington had no route of exposure resulting in a No Effect determination. The two bird species; bald eagles and marbled murrelets, and the three marine mammals; Stellar sea lions, humpback whales, and killer whales, were found to be Not Likely to be Adversely Affected for all of the water quality provisions being approved by EPA.

- EPA’s approval of most of the temperature criteria [WAC 173-201A-200; Table (1)(c)] and the use designations [WAC 173-201A-602] is either No Effect or Not Likely to Adversely Affect for most listed fish species and their Critical Habitat. Three of the salmon species/ESUs and their Critical Habitat are Likely to be Adversely Affected in a limited number of stream reaches due the temperature standards. The two bull trout ESUs and their Critical Habitat are Likely to be Adversely Affected in several streams in several WRIAs due to application of temperature standards. See Table 5-21.

- EPA’s approval of the warming allowance provisions in both freshwater [WAC 173-201A-200(1)(c)(i), (ii)] and marine water [WAC 173-201A-210(1)(c)(i), (ii)] are Likely to Adversely Affect all of the listed fish species and their critical habitat. See Table 5-22.

- EPA’s approval of the total dissolved gas exceptions provision for the Columbia/Snake River [WAC 173-201A- 200(1)(f)(2)] is Likely to Adversely Affect the listed fish species and Critical Habitat that use this system including certain Chinook, sockeye, steelhead, and bull trout ESUs. See Table 5-22.

- EPA’s approval of the dissolve oxygen 9.5 mg/L criterion provision [WAC 173-201A-200(1)(d)] is Likely to Adversely Affected about half of the listed fish species and their critical habitat including certain Chinook, chum, coho, and steelhead ESUs. See Table 5-22.

- EPA’s approval of the other provisions including the Allowable Temperature Increase for Lakes [WAC 173-201A-200(1)(c)(v)], Narrative Dissolved Oxygen [WAC 173-201A-200(1)(d)(i) and (ii)], Natural and Irreversible Human Condition [WAC 173-201A-260(1)], and the Procedure for Applying Water Quality Standards [WAC 173-201A-260(3)] are either No Effect or are Not Likely to Adversely Affect all of the listed fish species and their Critical Habitat. See Table 5-22.

Although EPA has concluded that its approval of some of the above provision would likely lead to adverse effects to certain listed fish species, EPA has concluded that the scope and extent of these adverse effects will be limited. The extent of the adverse effects to or “take” of listed species fish species is expected to occur to a limited number of individual fish in a) a few river segments and b) near the vicinity of point source discharges with sizable thermal mixing zones.

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9.0 ESSENTIAL FISH HABITAT (EFH)

9.A. Description of Proposed Action

An analysis of EFH, in consultation with NOAA Fisheries, is required for any federal agency action that may adversely affect EFH, including actions that occur outside EFH, such as certain upstream and upslope activities. The objectives of this EFH analysis are to determine whether the EPA action described in sections I and II of this BE would adversely affect designated EFH. For the purpose of this EFH analysis, EPA defines the Action Area as all river basins in Washington with anadromous fish use or designated critical habitat.

According to the Magnuson-Stevens Fishery Conservation and Management Act (MSA§3), EFH means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth and maturity. For the purpose of interpreting this definition of EFH: “waters” include aquatic areas and their associated physical, chemical, and biological properties that are used by fish; “substrate” includes sediment, hard bottom, structures underlying the waters, and associated biological communities; “necessary” means the habitat required to support a sustainable fishery and the managed species’ contribution to a healthy ecosystem; and “spawning, breeding, feeding, and growth to maturity” covers a species’ full life cycle (50 CFR 600.01). “Adverse effect” means any impact which reduces quality and/or quantity of EFH, and may include direct (e.g. physical disruption), indirect (e.g. loss of prey), site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810).

9.B. Address EFH for appropriate Fish Management Plans

Pursuant to the Magnusen Stevenson Act (MSA) the Pacific Fisheries Management Council (PFMC) has designated EFH for three species of federally managed Pacific salmon Chinook (O. tshawytscha), coho (O. kisutch), and Puget Sound pink salmon (O. gorbuscha). Freshwater EFH for Pacific salmon includes all those streams, lakes, ponds, wetlands, and other waterbodies currently, or historically accessible to these salmon species in Washington, Oregon, Idaho, and California. The exceptions to this range of waterbodies are any waters upstream of a limited list of impassable human caused barriers as identified by the PFMC (1999), and natural impassible barriers that have existed for a long period of time, such as waterfalls,.

Marine EFH are the aquatic areas used by marine EFH species including the following habitats: inland sea, slope rise plain, abyssal plain, estuarine, coastal intertidal, near shore, and shelf. Detailed descriptions and identifications of EFH are in the fishery management plans for ground fish (PFMC 2006), coastal pelagic species (PFMC 1998), and Pacific salmon (PFMC 1999). The list of EFH species within Washington State are in **Table 9- 1**.

Table 9- 1. Pacific salmon and marine species with designated EFH in the State or Washington (data provided by NOAA, Thom Hooper, Pers. Comm. 3/15/07). Designated EFH for Chinook, coho, and pink salmon includes the historic freshwater extent of the species.

Scientific Name	**Common Name**	**Scientific Name**	**Common Name**
Atheresthes stomias	Arrowtooth flounder	Citharichthys sordidus	Pacific sanddab
Sebastes aurora	Aurora rockfish	Eopsetta jordani	Petrale sole
Raja binoculata	Big skate	Sebastes maliger	Quillback rockfish
Sebastes melanops	Black rockfish	Sebastes babcocki	Redbanded rockfish
Sebastes melanostomus	Blackgill rockfish	Sebastes proriger	Redstripe rockfish
Sebastes mystinus	Blue rockfish	Glyptocephalus zachirus	Rex sole
Sebastes paucispinis	Bocaccio	Lepidopsetta bilineata	Rock sole
Sebastes auriculatus	Brown rockfish	Sebastes helvomaculatus	Rosethorn rockfish
Isopsetta isolepis	Butter sole	Sebastes rosaceus	Rosy rockfish
Scorpaenichthys marmoratus	Cabezon	Sebastes aleutianus	Rougheye rockfish
Raja inornata	California skate	Anoplopoma fimbria	Sablefish
Sebastes pinniger	Canary rockfish	Psettichthys melanostictus	Sand sole
Sebastes goodei	Chilipepper	Sebastes zacentrus	Sharpchin rockfish
Sebastes nebulosus	China rockfish	Sebastes jordani	Shortbelly rockfish
Sebastes caurinus	Copper rockfish	Sebastes borealis	Shortraker rockfish
Pleuronichthys decurrens	Curlfin sole	Sebastolobus alascanus	Shortspine thornyhead
Sebastes crameri	Darkblotched rockfish	Sebastes brevispinis	Silvergray rockfish
Microstomus pacificus	Dover sole	Galeorhinus galeus	Soupfin shark
Sebastes variabilis	Dusky rockfish	Squalus acanthias	Spiny dogfish
Parophrys vetulus	English sole	Sebastes diploproa	Splitnose rockfish
Hippoglossoides elassodon	Flathead sole	Hydrolagus colliei	Spotted ratfish
Sebastes chlorostictus	Greenspotted rockfish	Platichthys stellatus	Starry flounder
Sebastes elongatus	Greenstriped rockfish	Sebastes saxicola	Stripetail rockfish
Sebastes variegatus	Harlequin rockfish	Sebastes nigrocinctus	Tiger rockfish
Hexagrammos decagrammus	Kelp greenling	Sebastes miniatus	Vermilion rockfish
Ophiodon elongatus	Lingcod	Sebastes entomelas	Widow rockfish
Raja rhina	Longnose skate	Sebastes ruberrimus	Yelloweye rockfish
Sebastolobus altivelis	Longspine thornyhead	Sebastes reedi	Yellowmouth rockfish
Gadus macrocephalus	Pacific cod	Sebastes flavidus	Yellowtail rockfish
Antimora microlepis	Pacific flatnose	**Pacific Salmon Species**	
Merluccius productus	Pacific hake	Chinook Salmon	Oncorhynchus tshawytcha
Sebastes alutus	Pacific ocean perch	Coho Salmon	Oncorhynchus kisutch
Coryphaenoides acrolepis	Pacific rattail (grenadie)r	Pink Salmon (Puget Sound)	Oncorhynchus gorbuscha

9.C. Effects of Proposed Action

EPA's proposed action is the approval of certain Washington water quality standards, mostly addressing water temperature and dissolved oxygen regulations. The indirect effects of the EPA's approval of these standards are analyzed in the BE sections listed in **Table 9- 2**.

Table 9- 2. Effects sections of the BE relevant to each of the new/revised Washington water quality standards considered for approval by EPA.

BE section	New/revised Washington WQS regulations being considered by USEPA
N/A	Definitions - WAC-173-201A-020
5.H.3-5.H.8.	Fresh water numeric temperature criteria, WAC 173-201A -200(1)(c), Table 200(1)(c)
5.H.3-5.H.8.	Fresh water aquatic life designated uses WAC 173-201A-200(1)(a)
5.H.9.-5.H.11.	Fresh water narrative temperature criteria, WAC 173-201A -200(1)(c)(i), (ii)(A), (iv),and (v)
5.H.12.	Fresh water numeric dissolved oxygen criteria, WAC 173-201A-200(d)
5.H.13.	Fresh water dissolved oxygen narrative criteria, WAC 173-201A -200(1)(d)(i) - (ii)
5.H.14.	Fresh water total dissolved gas narrative criteria, Special fish passage exemption for the Snake and Columbia Rivers, WAC 173-201A -200(1)(f)(ii)
5.H.15-5.H.16.	Marine water narrative temperature criteria, WAC 173-201A-210(1)(c)(i),(ii)
5.H.17.	Natural and irreversible human conditions , WAC-173-201A-260(1)(a)
5.H.18.	Procedures for applying criteria, WAC 173-201A-260(3)(a)
5.H.18.	Upstream actions, WAC 173-201A-260(3)(b)
5.H.18.	Multiple criteria, WAC 260(3)(c)
5.H.3.-5.H.8.	Aquatic life use designations in WAC 173-201A-600(1) and in Table 602

Most of the standards that are being considered for approval by EPA are standards that only applied to freshwater areas. Species that use freshwater for at least some portion of their life history would potentially be affected by these actions. Outflow from these rivers and streams influences water quality of nearshore and estuarine areas of the marine system. Marine EFH species could be affected but the likelihood is decreased as these areas have varying levels of saltwater dominance. Two narrative temperature criteria, WAC 173-201A-210(1)(c)(i),(ii), apply exclusively to Marine areas: 1) Marine water allowable 0.3°C temperature increase in marine waters warmer than the criteria and 2) Allowable warming when marine waters are cooler than the criteria.

EPA believes that a 0.3°C or less temperature increase above the natural condition temperature is insignificant because monitoring measurement error for recording instruments typically used in field studies is about 0.2°C to 0.3°C. This level of a temperature increase is considered within the error band associated with typical temperature monitors. However, EPA recognizes that temperatures within the mixing zone of some National Pollutant Discharge Elimination System (NPDES) discharges may result in temperatures near the vicinity of the discharge that may adversely affect essential fish habitat in marine areas. Because this provision would allow human caused authorized thermal discharges that may result in potential adverse affects near the vicinity of the discharge, EPA has concluded that its approval of this provision may adversely affect Essential Fish Habitat for marine species.

For allowable warming when marine waters are cooler than the criteria, EPA proposes to approve the allowable temperature increase of 12/(T-2), at the edge of a mixing zone, for point source dischargers when the natural condition of a waterbody is cooler than the numeric temperature criteria contained in Table 200(1)(c) of the Washington water quality standards. Table 210(1)(c) establishes the temperature criteria protective of aquatic life. The incremental temperature increase limits the temperature increase a point source can cause to a waterbody which is cooler than the established temperature criterion, and it does not allow the temperature to increase above the criteria established in the table to protect aquatic life uses.

Washington's anti-degradation policy requires that a Tier II analysis be completed for any State regulated new or expanded action, such as point source discharges, that would warm temperatures by 0.3°C or more at the edge of the mixing zone. Therefore, a Tier II analysis would have to be completed if the incremental temperature increase of 12/T-2 resulted in an increase of 0.3°C or more at the edge of the mixing zone for point sources. Provision WAC 173-210A-210(1)(c)(ii)(A) may be used to preserve cooler waterbodies, however, it does not preclude cooler waterbodies from heating up to the criterion established in Table 210(1)(c). This provision does not allow either point or non-point sources to exceed the criteria established in Table 210(1)(c).

Because this provision limits the warming of a waterbody after mixing to levels at or below the criterion, EPA has concluded that the allowable incremental warming of the marine waters associated with this provision will not adversely affect Essential Fish Habitat for marine species. However, EPA recognizes that temperatures within the mixing zone of some National Pollutant Discharge Elimination System (NPDES) discharges may result in temperatures near the vicinity of the discharge that may adversely affect salmonids. Because this provision would allow human-caused authorized thermal discharges that may result in potential adverse effects near the vicinity of the discharge, EPA has concluded that its approval of this provision: **is likely to adversely affect** Essential Fish Habitat for marine species in very limited areas.

EPA's approval of the Washington Water Quality Standards related to dissolved oxygen may affect EFH. Substantial changes to the application of Dissolved Oxygen Criteria across Washington from the newly proposed standards include the following:

--EPA is proposing to approve the 9.5 mg/L DO (lowest 1-day minimum) criteria for waterbodies with a "new" Core Summer Habitat use designation that were previously designated Class A (with a 8.0 mg/L DO).
--EPA is proposing to approve the 8.0 mg/L for two small waterbodies with a 'new' Salmon Spawning, Rearing and Migration use designation (Palouse River in WRIA 34 and Mill Creek in WRIA 32).
--EPA is proposing to approve the 9.5 mg/L DO criteria for the "new" Summer Habitat use designation waters and the 2 other small waterbodies noted above. There is no action for the 9.5 mg/L DO criteria for the other Core waters because the criteria for theses waters are unchanged. Thus, the approval action would be for about 10% of the waters in the state (mostly in Puget Sound and lower Columbia River regions.

Salmon using waters of the Puget Sound and lower Columbia River have the highest potential for any effects from changes to the Dissolved Oxygen water quality standards because of the significant overlap of the "new Core" waters and the spawning distribution of these species. Only a few waterbodies will have revised DO criteria in the Hood Canal region (Hood Canal summer chum), the eastside of the cascades (mid-Columbia steelhead, upper Columbia Chinook). The revised DO criteria for these waters will be more stringent changing from 8.0 mg/L to 9.5 mg/L.

The proposed action could adversely affect habitat for Chinook and coho salmon and pink salmon species due to localized reduction in growth and survival of some Chinook, coho, and pink salmon embryos and alevins due to approval of the DO criteria that may not, at all times, provide optimal levels of intergravel DO.

9.D. Conclusions

Overall, the EPA believes the approval of the Washington water quality standards will improve conditions of freshwater EFH (coho, Chinook, and Puget Sound pink salmon). In freshwater areas, temperature requirement of the new standard is lower in many areas due to the conversion of waters from Class B to use designations that have an associated 17°C; conversion of some waters from Class A to use designation that requires a 16°C; and the temporal application of the more stringent 13°C during the spawning period (**Table 9- 3**). As Washington completes TMDLs designed to meet the revised standards, issues or reissues permits in conjunction with those TMDLs, and incorporates nonpoint source controls adequate to meet the water quality standards, the condition of impaired waters is likely to improve. Some short-term, localized adverse effects may occur from approval and subsequent implementation of the standards. However, in some localized areas and a certain times the action may adversely affect EFH for Chinook, coho, and pink salmon and groundfish species.

Table 9- 3. Temperature changes resulting from the new use designations and associated temperature criteria for trout and salmon.

1997 Water Quality Standards		**2003/2006 Water Quality Standards**		
Class	**Temperature criterion[1] (7DADMax)**	**Use designation**	**Temperature criterion (7DADMax)**	**Temperature change as a result of revised Water Quality Standards**
Class AA	15°C	Core summer salmonid habitat	16 °C 13 °C (part of year)	+1 °C - 2 °C (part of year)
Class A	17°C	Salmonid spawning, rearing and migration	17.5 °C 13 °C (part of year)	+ 0.5 °C - 4.0 °C (part of year)
Class A	17°C	Core summer salmonid habitat	16 °C 13 °C (part of year)	- 1.0 °C - 4.0 °C (part of year)
Class B	20 °C	Salmonid rearing and migration only	17.5 °C	- 2.5 °C
Class B	20 °C	Salmonid spawning, rearing and migration	17.5 °C	- 2.5 °C
Lake Class	No measurable change from natural condition	Core summer salmonid habitat	Temperature increase can't exceed 0.3 °C above natural conditions	No change from how Ecology implemented their 1997 standard

1. The temperature standards in the 1997 Water Quality Standards were expressed as a 1-day maximum temperature. Class AA had a temperature criterion of 16 °C which is approximately equal to a 7DADMax of 15°C; Class A had a temperature criterion of 18°C which is approximately equal to a 7DADMax of 17°C; Class B had a temperature criterion of 21°C which is approximately equal to a 7 DADMax of 20°C.

9.E. Literature Cited for EFH

Pacific Fishery Management Council. (PFMC). 2006 (Nov.). Pacific coast Groundfish Fishery Management Plan for the California, Oregon, and Washington groundfish fishery as amended through amendment 19. Pacific Fishery Management Council, Portland, Oregon.

Pacific Fishery Management Council (PFMC). 1999. Appendix A - Identification and Description of Essential Fish Habitat, Adverse Impacts, and Recommended Conservation Measures for Salmon. Amendment 14 to the Pacific Coast Salmon Plan. August 1999.

Pacific Fishery Management Council PFMC. 1998 (Dec). The Coastal Pelagic Species Fishery Management Plan. Amendment 8 (to document former named the Northern Anchovy Fishery Management Plan).   Pacific Fishery Management Council, Portland, Oregon.