UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Region
7600 Sand Point Way N.E., Bldg. 1
Seattle, WA 98115

January 15, 2002

David J. Kaumheimer
Environmental Programs Manager
U.S. Bureau of Reclamation
Upper Columbia Area Office
1917 Marsh Road
P.O. Box 1749
Yakima Washington 98907-1749

Re: Biological Opinion for Keechelus Dam Safety of Dams (SOD) Modification (WSB-00-577)

Dear Mr. Kaumheimer:

In accordance with Section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq*.) and the Magnuson Stevens Fishery Conservation and Management Act (MSA), as amended by the Sustainable Fisheries Act of 1996, the attached document transmits the National Marine Fisheries Service's (NMFS) Biological Opinion (BO) and MSA consultation on construction activities necessary for the SOD replacement of Keechelus Dam on the upper Yakima River in Kittitas County about 10 miles northwest of the town of Easton, Washington. The U.S. Bureau of Reclamation (BOR) determined that the proposed action may affect, but was not likely to adversely affect the Middle Columbia River steelhead (*Oncorhynchus mykiss*) Evolutionarily Significant Unit (ESU). The NMFS was unable to concur with this determination, and recommended formal consultation.

This BO reflects the results of a formal ESA consultation and contains an analysis of effects covering Middle Columbia River steelhead in the upper Yakima River, Washington. The BO is based on information provided in the Biological Assessment (BA) sent to NMFS by the BOR, Addenda to the BA, and additional information transmitted via telephone conversations, meetings, and e-mail. A complete administrative record of this consultation is on file at the Washington Habitat Branch Office.

The NMFS concludes that implementation of the proposed project is not likely to jeopardize the continued existence of Middle Columbia River steelhead, or result in destruction or adverse modification of their Critical Habitat. In your review, please note that the incidental take statement, which includes Reasonable and Prudent Measures and Terms and Conditions, was designed to minimize take.

The MSA consultation concluded that the proposed project may adversely impact designated Essential Fish Habitat (EFH) for chinook and coho salmon. The Reasonable and Prudent Measures of the ESA consultation, and Terms and Conditions identified therein, would address the negative effects resulting from the proposed BOR actions. Therefore, NMFS recommends that they be adopted as EFH conservation measures.

If you have any questions, please contact Dale Bambrick or Kale Gullett of the Washington Habitat Branch Ellensburg Field Office at (509) 962-8911.

Sincerely,

For Michael R Crouse

D. Robert Lohn
Regional Administrator

Enclosure

Endangered Species Act - Section 7 Consultation
and
Essential Fish Habitat Consultation

Biological Opinion

Keechelus Dam Safety of Dams Modification

WSB-00-577

Action Agency: U.S. Department of the Interior, U.S. Bureau of Reclamation

Consultation Conducted by: National Marine Fisheries Service, Northwest Region, Washington Habitat Branch

Issued by: ______________________ Date Issued: 1/15/2002

D. Robert Lohn
Regional Administrator

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I. BACKGROUND AND DESCRIPTION OF THE PROPOSED ACTION

A. Background/Consultation History

This Biological Opinion (BO) is the product of an Endangered Species Act (ESA) Section 7 formal consultation between the National Marine Fisheries Service (NMFS) and the US Department of the Interior, Bureau of Reclamation (BOR or Reclamation) on construction activities necessary for rebuilding Keechelus Dam (a component reservoir of the larger Yakima Project) on the Yakima River in Kittitas County, Washington. This BO analyzes the biological effects of construction activities related to the rebuilding of Keechelus Dam. Keechelus Dam operations and maintenance (O&M) issues will be addressed in a separate, forthcoming BO on O&M of the entire BOR Yakima Project. Throughout this document, the terms "dam" and "embankment" are used interchangeably.

Keechelus Dam was deemed unstable and subject to failure, in 1998. The authorization for this project is the Safety of Dams Act (SOD) of 1978 (Public Law (P.L.) 95-578) as amended by P.L. 98-404. This act authorizes the Secretary of the Interior (Secretary) to analyze existing Reclamation dams, changes in the state-of-the-art criteria, and additional hydrologic and seismic data developed since a given dam was constructed. For dams where a safety concern exists, the Secretary is authorized to modify the structure to ensure its continued safety. The construction authorized by the SOD act will be for dam safety and not for purposes of providing additional benefits over and above the original authorized purpose of the dam and reservoir (BOR 2001). Consequently, the purpose of the proposed project is to correct safety deficiencies identified at Keechelus Dam in an environmentally sound manner and in accordance with the SOD Act, as amended.

The BOR requested informal consultation on December 28, 2001, through submission of a Biological Assessment (BA) with an effect determination of "may affect, not likely to adversely affect (NLAA)" for ESA listed (Threatened) Middle Columbia River (MCR) steelhead (*Oncorhychus mykiss*). After analysis and review of the proposed action as amended and presented, NMFS was unable to concur with this determination and recommended in a March 22, 2001 letter that formal consultation be undertaken for the Keechelus Dam project. In addition, the March 22nd letter pointed out deficiencies in the BA that must be addressed as part of the formal consultation process. BOR replied to NMFS' substantive BA concerns in a May 17, 2001 letter, again requesting concurrence with their NLAA determination. Again, after review of information contained in the May 17th letter, NMFS remained unable to concur with the NLAA determination and notified BOR in a letter dated May 30, 2001. After a series of meetings, formal consultation was initiated. Both the informal and formal consultation process involved reviewing information contained in the BA, its subsequent addenda, and correspondence and communication between the U.S. Fish and Wildlife Service (FWS), BOR and NMFS (phone calls and electronic mail (e-mail)).

The objective of this BO is to determine whether the proposed project is likely to jeopardize the continued existence of the MCR steelhead Evolutionarily Significant Unit (ESU), or result in the destruction or adverse modification of their designated Critical Habitat.

The NMFS reviewed the following information and engaged in the following steps to reach its determination and prepare this BO:

1. December 28, 2000 receipt of letter and final BA from BOR requesting informal consultation (WSB-00-577).

2. January 25, 2001 phone call from NMFS to BOR identifying BA deficiencies and informing BOR of pending nonconcurrence letter.

3. March 22, 2001 nonconcurrence letter sent to BOR outlining BA deficiencies and recommending formal consultation.

4. April 6, 2001 meeting between BOR and NMFS in Ellensburg, Washington to discuss substantive BA issues.

5. May 17, 2001 letter from BOR addressing March 22nd substantive deficiencies and subsequent second request for NLAA concurrence

6. May 30, 2001 second nonconcurrence letter sent to BOR recommending options for formal consultation.

7. September 21, 2001 meeting between BOR and NMFS in Sea-Tac, Washington to discuss Keechelus Dam consultation.

8. October 26, 2001 formal consultation coordination meeting between FWS and NMFS in

Ellensburg, Washington.

9. November 1, 2001 meeting between BOR, FWS, and NMFS in Yakima, Washington to discuss substantive BA issues. BOR submitted BA Addendum #1 (Best Management Practices (BMP) to Protect Water Quality).

10. November 13, 2001 receipt via e-mail of BA Addendum #2 (Site Clearing, Grubbing Revegetation and Rehabilitation Procedures).

11. November 20, 2001 formal consultation meeting between BOR and NMFS in Ellensburg, Washington.

12. December 7, 2001 formal consultation meeting between BOR, NMFS, and FWS in Yakima, Washington. Irrigation entities also in attendance.

In addition to the key events listed above, other information was informally transferred via email, meetings, and phone calls between the FWS, NMFS, and BOR during the preparation of this BO. These documents and a record of communications are part of the consultation history on file at NMFS.

B. Description of the Proposed Action

BOR proposes to rebuild Keechelus Dam under the authority of the SOD Act (as amended). In general terms, Keechelus Dam will be rebuilt on its existing footprint of both recycled and borrowed or quarried materials. The control tower, inlet channel, outlet gates, outlet channel, and spillway will remain in their present configuration. A 20-foot section of the outlet conduit within the maximum section will be modified, and a bridge to the outlet works gatehouse will be removed and replaced after the embankment crest is replaced. BOR has withdrawn the original proposal to raise the right spillway wall six feet after it was determined that the existing spillway was sufficient to handle the probable maximum flood (PMF).

Water has been stored for irrigation purposes in Keechelus Lake since the turn of the last century, beginning with a crib dam built around 1906 and used until 1914 (Kinnison and Sceva 1963). Keechelus Dam as it is known today was built between 1913 and 1917 as part of Reclamation's Yakima Project, storing a maximum content of 157,800 acre-feet (ac-ft, reservoir elevation 2517 feet) in Keechelus Reservoir at full pool. The dam is located on the headwaters of the Yakima River, about 10 miles northwest of Easton, Washington (Latitude 47.33N, Longitude 121.34W), at an elevation of around 2,500 feet. Although the dam is more than 100 feet high at the maximum section (point on the dam where maximum width and depth occur; also the location of the outlet works), most of the structure is less than 40 feet high. The crest of the dam is approximately 6,550 feet long and 20 feet wide, while the entire embankment consists of about 684,000 cubic yards (yd^3) of material. The outlet works, located about 2,000 feet from the north (downstream left) abutment, are designed to release 3,000 cubic feet per second (cfs) when the reservoir is at elevation 2,519 feet (two feet higher than normal full pool). These works consist of a 400 foot-long inlet channel, an intake structure with six unscreened emergency gates, an unscreened regulating gate, a control house, an outlet conduit, and an outlet channel. The spillway, located on the north abutment, has an uncontrolled side-channel inlet structure about 302 feet long with a design capacity of 11,800 cfs at reservoir elevation 2,522 feet. The concrete-lined chute empties into a man-made channel which directs spills to the Yakima River below the outlet channel. There are no fish passage facilities, either upstream or downstream, at Keechelus Dam.

Keechelus Dam was founded on Quaternary-age glacial moraine and outwash deposits, and was sited to take advantage of a morainal ridge crest that formed historic Keechelus Lake. The floodplain consists of alluvial sands and gravels and glacial boulders and cobbles (Kinnison and Sceva 1963). The southern (downstream right) third of the dam is built on superimposed alluvial fan sediments deposited by Meadow Creek, while the northern end of the dam abuts against a small hill that exhibits scattered exposures of hard, lightly jointed, moderately to lightly weathered volcanic rocks. The outlet works of Keechelus Dam were placed to fill a section of the morainal ridge downcut by the pre-development Yakima River (BOR 2001), and dropped the base level of the River by about 30 feet.

Keechelus Dam consists of two zones of earthen fill, an impermeable upstream layer (Zone E1) and a downstream shell of supporting material (Zone E2), each consisting of locally mined alluvium. At the time of construction, wooden trestles were used support a rail system that delivered earthen materials along the length of the dam. Most of the rail system was dismantled as construction progressed and the embankment grew. However, the vertical pilings of the wooden trestles were left in place, buried within the downstream shell of the dam (Zone E2).

A void was found in a utility trench in the crest of the dam during the installation of monitoring and communication instruments in the spring of 1998. Further geotechnical investigations (test wells, test pits, and ground-penetrating radar (GPR)) found numerous other voids and determined that portions of the remnant trestle have either partially rotted or completely deteriorated. Geotechnical analyses have shown that the vertical paths of the deteriorated or rotted trestle beams have formed voids within the dam, which, in turn, have allowed seepage paths to develop. These seepage paths have caused the material within Keechelus Dam to be unstable and subject to failure, with an associated potential for loss of life and property downstream. Sudden failure of Keechelus Dam could produce an instantaneous maximum discharge of 200,000 cfs at the dam, with catastrophic downstream consequences (BOR 2001). Because of safety concerns, Keechelus Dam has been operated at a restricted pool elevation 7 feet below normal full pool (elevation 2,510; capacity 140,290 ac-ft) since November 1998, with increased monitoring and surveillance at the dam. This elevation restriction has a surcharge pool allowing the reservoir to temporarily fill to elevation 2,517 feet for flood control purposes (BOR 2001).

The new embankment will consist of an impervious barrier of highly compacted fine-grained soils armored with large rock riprap extending along the entire upstream length of the dam. A downstream shell of rock and gravel will support the upstream layers. Chimney drains, a filter curtain and blanket filter will be constructed within the downstream shell and remnant moraine to conduct seepage safely away from the base of the dam into a downstream (toe) drain running along the entire downstream side of the embankment, on both sides of the outlet channel. Seepage waters collected by this drain will discharge directly into the outlet channel that feeds the Yakima River.

Ideally, construction will occur over two years, in two general phases. The first year (Phase 1) will mainly consist of site preparation, the construction of the downstream drain and, possibly, the partial removal of a section of the far right abutment. The second year (Phase 2) will entail removal and replacement of the remainder of the wing sections and maximum section of the dam, modifications to the outlet works, a possible alteration of flow releases pursuant to meeting construction milestones, and other associated construction activities. However, unforeseen circumstances (*e.g.,* permitting, weather, contractor problems) may cause certain activities to overlap between and among years, and could force a third construction season.

In both phases of construction activities, the work window is constrained by weather and access problems to a period of time between May 1st and November 15th. Work will begin each year as soon as weather permits, and will extend into the fall until snowfall and increasing reservoir elevations preclude construction activities.

Keechelus Dam and reservoir will be operated to store and supply water for downstream uses during both phases of construction. The existing dam will be excavated in stages as the reservoir pool decreases according to construction phase reservoir restriction levels. Water deliveries will continue, and limited protection against floods will be provided during construction. A change in release schedules could occur during the second year of construction as the reservoir is aggressively evacuated to meet level restrictions for excavation and replacement of the maximum section and a 20-foot section of the outlet conduit. This element of the proposed action is dependent on runoff forecasts for the year in which it occurs. Because Keechelus Dam was constructed on a glacial feature that once formed a natural lake, minimum pool elevations in Lake Keechelus are held by native topography. However, certain impervious portions of the existing embankment will be left in-place to serve as a protective cofferdam during construction.

The proposed project incorporates several conservation measures and best management practices (BMPs) to minimize project effects on the species under review. Additionally, because the construction area is greater than 5 acres in total size, a Stormwater Management Plan and Permit are required. These permits and practices are described within the BA either textually or as addenda or have been agreed upon during the consultation process. In conducting the analysis presented in this BO, NMFS assumes that these measures will be implemented in project design, staging, construction, operation, revegetation, and rehabilitation procedures. The following sections describe site preparation, pre-construction, major construction, revegetation, and rehabilitation activities associated with the Keechelus Dam reconstruction project.

1. <u>Phase 1: Pre-Construction and Site Preparation Activities</u>

a. Outlet Channel Bridge. The present road system in the vicinity of Keechelus Dam is inadequate to facilitate the large amount of material that must be removed from the existing embankment or carried to the new dam structure. An existing road crosses the outlet channel atop the dam and wraps around on the downstream left side of the embankment. However, this road is too narrow and sharply curved to accommodate haul trucks and other large construction equipment. To facilitate construction traffic in a way that is both economically and environmentally feasible, a bridge will be built on the downstream side of the dam over the existing outlet channel. This 75 foot-long bridge will be sized to accommodate vehicles and machinery necessary for construction activities, and will sit on concrete abutments founded on compacted material at the edges of the existing outlet chute. This will be a permanent structure left in place at the end of construction to connect the ends of the dam via a new main road along the base of the embankment.

The outlet channel below Keechelus Dam constitutes the functional headwaters of the Yakima River. At the point where the new bridge will be constructed, the outlet channel consists of a concrete rectangular flume. The abutments will be built behind the concrete walls of the outlet channel, and will therefore be directly isolated from the upper Yakima River. However, construction activities will occur directly adjacent to and above the Yakima River, and a sudden rainfall or other runoff-producing event at a critical construction juncture could introduce fine sediments and construction-related petroleum products or other chemical constituents into the aquatic environment. To minimize these construction effects, BOR will use the water quality protection procedures described in BA Addendum #1 (Best Management Practices to Protect Water Quality).

b. Spillway Channel Bridge. The existing bridge over the spillway channel is too small to accommodate the size and weight of machinery necessary for project construction activities. A new bridge will be constructed over the spillway channel, in concert with the new outlet channel bridge connected to the new main haul road. The existing bridge will be pulled off or dismantled, and the existing abutments will be capped with concrete to accommodate placement of a new, larger bridge deck.

The spillway channel originates at the base of the dam spillway located on the far left abutment of the Keechelus embankment. This channel is approximately 3,300 feet long to where it enters Price Creek, a left-bank tributary to the Yakima River whose confluence is about 4,000 feet downstream of the Keechelus outlet works. Discharge in the spillway channel is ephemeral (down to Price Creek), responding to spillway operations, precipitation and runoff events. Because the channel is connected to the Yakima River, construction activities have the potential to impact listed fish and downstream Critical Habitat. To minimize these construction effects, BOR will use the water quality protection procedures described in BA Addendum #1 (Best Management Practices to Protect Water Quality).

c. Far Right Abutment. If possible, the far right side of the embankment abutment will be partially excavated the first year to provide a head start on major construction activities in Phase 2, year 2. This will also prepare the site for installation of the right abutment cutoff wall, explained in further detail in Section 2(d), below. The far right abutment is well above Keechelus Reservoir, and SOD pool elevation restrictions allow this work to take place without impact to flood control or storage capacity.

The far right abutment is primarily built atop alluvium deposited by Meadow Creek, a tributary to the Yakima system that probably fed directly into historic Lake Keechelus, dammed by glacial moraine deposits. There exists the possibility for high runoff events to discharge from the Meadow Creek watershed into the construction area. As such, turbid water, high in suspended sediments, could ultimately discharge into the Yakima River, although moderated by the Keechelus embankment. This construction element will take place behind Keechelus Dam, and while the possibility for water-quality related impacts to aquatic biota and their habitat exists, the likelihood is small. To minimize these construction effects, BOR will use the water quality protection procedures described in BA Addendum #1 (Best Management Practices to Protect Water Quality).

***d. Borrow and Contractor Staging Areas*.** The magnitude and scope of the construction under the proposed action requires numerous borrow, stockpile, and staging areas. There are four contractor use sites throughout the construction area at which vehicle maintenance, refueling, and storage will occur. In addition, temporary construction buildings will be moved onsite to better facilitate construction activities.

Of the 640,000 yd^3 of material presently contained in the Keechelus embankment, roughly half will be suitable for reuse in the replaced dam. Reusable materials will be stockpiled in any one of several locations near the dam as the old embankment is removed. In addition, borrow sites (gravel pits and quarries) for new rock, sand, and gravel have been identified. The primary borrow and quarry area for additional embankment replacement material will come from a source located directly downstream of the of dam, on the left side of the outlet channel (Borrow Area #1). This 36 acre borrow site was used during the construction of the original dam, and is presently wooded with early (19 acres) and mid-seral (17 acres) coniferous species replanted after a U.S. Forest Service (USFS) timber sale in the 1980s (USFS 1999).

During the first phase of construction, sands and gravels will be processed from onsite aggregates and stockpiled for addition to the new embankment in Phase 2. Larger rock for slope protection and dam riprap will be produced in Phase 2, as needed. If Borrow Area #1 does not contain suitable quantity and quality of embankment materials, then other quarry sites will be mined. The BOR anticipates that the next logical borrow site is the Crystal Springs Sno-Park area, a disturbed, barren locale approximately 1.4 miles downstream of Keechelus Dam about 0.3 mile from the right bank of the Yakima River. The Washington State Parks and Recreation Commission has approved use of this site for borrow materials, contingent upon the request that excavation activities take place after April 1st, to allow for winter recreational use. Use of an alternate source in addition to or in replacement of either of the two previously mentioned will require additional review by NMFS.

Stockpile and borrow materials will be stored only in designated storage areas. Stockpiled material will be surrounded by straw bales, visqueen dams and/or other similar configurations to fully contain sluffing, turbid, and/or sediment-laden runoff from precipitation events. In addition, stormwater or other turbid waters generated from stockpile or borrow areas will discharge into settling ponds that are isolated from all surface waters in the project area. If settling ponds are not available, sediment-laden or turbid waters will be pumped across upland sites away from native surface waters, or into "dirtbags"–filter devices that capture fine sediments and exhaust cleaned water. Hydraulic fluids, fuels, solvents, or other non-organic materials will not be introduced into surface waters or the water table. In addition to those practices outlined in this paragraph to minimize construction effects, BOR will use the water quality protection procedures described in BA Addendum #1 (Best Management Practices to Protect Water Quality) .

e. Clear Vegetation Below Dam. To facilitate haul routes, access roads, and the downstream drain, a strip of forested area about 200 feet wide along the entire downstream side of the dam will be cleared, and the landscape will be grubbed and cleaned of materials that will interfere with construction of elements further described in this and the following sections. This area, including an area below the far right abutment of the dam, is about 34 acres in size and is vegetated by mid-seral forest vegetation. In addition, light trees (early and mid-seral coniferous species) will be removed from Borrow Area #1 before the site is processed for embankment borrow materials. Merchantable trees will be removed from the construction area in cooperation with the USFS.

Although clearing 34 acres of late-seral forest will impact the floodplain of the Yakima River in the Action Area, this element of the proposed action is unavoidable and necessary for the proper reconstruction of Keechelus Dam. Most of the affected area is some distance from the Yakima River itself, and the effects to MCR steelhead habitat are largely unquantifiable in both the short and long term. However, the disturbed area will be replanted with grasses, shrubs, and trees, and should recover appreciably. To mitigate for lost organic material in the floodplain of the Yakima River, BOR will salvage 40 large trees with intact rootwads available for future terrestrial and aquatic habitat improvement projects. It is anticipated that a number of these tree/rootwad members will be incorporated into created wetlands constructed pursuant to wetland mitigation activities described in Section 2(h), below. To minimize adverse impacts from this construction element, BOR will implement activities as described in BA Addendum #2 (Site Clearing, Grubbing, Revegetation and Rehabilitation Procedures).

f. Downstream Drain. A downstream (toe) drain is required to collect seepage and reduce water pressure downstream from the dam. Natural wetlands exist along portions of the downstream side of Keechelus Dam and contribute to high water pressures within the dam itself. The toe drain will be constructed to limit the passage of seepage water from the wetland into the drain while freely collecting seepage passing under the dam. To accomplish this, the downstream or wetland side of the drain trench will be backfilled with impervious material to act as a cutoff barrier, and limit the exchange of seepage water between the drain and adjacent wetlands.

The drain will be aligned along the downstream side of the dam, approximately 150 to 200 feet downslope of the embankment base on both sides of the outlet channel. This drain will be approximately 6,600 feet long, and will consist of a perforated plastic pipe (6 to 24 inch diameter) buried in filter material (pea gravel and sand) at the bottom of an 8 to 15 foot deep trench requiring removal of about 100,000 yd^3 of material. The drain will be built with access points and weirs to enable water quality (water chemistry and flow) and dam performance data collection. Waters collected by the drain will discharge directly to the Yakima River.

The toe drain will collect seepage flowing through the dam, and shallow alluvial aquifer flow under the dam. Water quality concerns are not anticipated to be detrimental to the biota of the Yakima River, but a monitoring regime to provide feedback is necessary to further evaluate the effects of this construction element. BOR will develop a water quality monitoring plan to include discharge in the drain, as well as water quality parameters such as pH, dissolved oxygen, temperature, turbidity and phosphorous concentration. The sampling frequency and duration of this monitoring regime will be described in the plan, and submitted to NMFS following its completion. Water quality data will be compiled and communicated to NMFS.

2. Phase 2: Major Construction Activities

a. Reservoir Evacuation and Flow Release. As previously stated, Keechelus Reservoir will be operated to store and supply water for downstream use throughout reconstruction. The BA proposed increasing daily discharge in the Yakima River below Keechelus Dam by 200 cfs from June to July to decrease water levels in Keechelus Reservoir to the point where maximum section and outlet conduit construction activities could begin. However, through the formal consultation process, BOR has agreed to restrict the elevation in Keechelus Reservoir based on monthly runoff forecasts beginning in March and extending through May (Table 2). Consequently, according to monthly forecasted runoff during the year in which Phase 2 occurs, discharge in the Yakima River below Keechelus Dam will only increase above normal regulated flow from late March through the end of May. This augmented discharge regime will only occur in average to wet years, or when Reclamation's March through May runoff forecast is above 2.9 million acre-feet (MAF). In intermediate water years (2.65 to 2.90 MAF), increased discharge will extend from mid-March only through April. In below average to dry water years (2.65 to 2.40 MAF), regulated flow below Keechelus Dam will track normal releases.

Runoff Forecast (MAF)			**Keechelus Reservoir Elevation Restriction (feet)**
March	**April**	**May**	
> 3.20	> 3.20	> 2.90	2500
2.90 - 3.20	2.90 - 3.20	2.65 - 2.90	2505
2.65 - 2.90	2.65 - 2.90	2.40 - 2.65	2510

< 2.65	< 2.65	< 2.40	2510

Table 2. Phase 2 construction-related Keechelus Reservoir elevation restrictions expressed as a function of March through May runoff forecasts (values in million acre-feet (MAF)).

Table 2 reflects Keechelus Reservoir restriction levels that, based on forecasted runoff, are necessary to keep discharge in the Yakima River below the Dam within the normal range of regulated flow, and meet the construction-related reservoir elevation for excavation and replacement of the maximum section (2,460 feet). The reservoir must be further drafted to elevation 2,444 feet before excavation and replacement of a 20-foot section of the outlet conduit can occur. This storage and release schedule differs from normal operations intended to maximize demand-based deliveries during the second half of the irrigation season (July through mid-September) and provide maximum carry-over for the following irrigation season. Consequently, in an average to wet water year (*i.e.*, 2.90 MAF and greater), Reclamation will increase discharge in the Yakima River below Keechelus Dam from mid-March through the end of May to meet the construction timeline. Mid-March through May regulated discharge will increase from average flows of approximately 100 to 500 cfs (period of record 1984-1999 (BOR 2001)), respectively, to flows that more closely approximate natural, unregulated flow (300 to 700 cfs). In an intermediate water year (2.65 to 2.90 MAF), flow below Keechelus Dam will also increase, but the duration will most likely extend only from mid-March through April. However, in intermediate to wet water years (2.65 to 3.20 MAF), managing releases from Keechelus Reservoir to more closely mimic unregulated discharge will have a corresponding positive effect on aquatic and riparian species assemblages, including MCR steelhead, in the Yakima River below the Dam.

b. Excavate and Replace Dam Wings. As Keechelus reservoir is drawn down, those portions of the dam lateral to the maximum section will be excavated. Material suitable for reuse will be stockpiled onsite, and additional materials necessary for rebuilding will be trucked from quarry and borrow areas for placement into the new embankment. Work will progress from the lateral margins of the dam toward the center and maximum section.

As with other construction elements related to this activity, there exists the possibility for water quality concerns should precipitation or runoff events produce large volumes of water in the project area. To minimize these construction effects, BOR will use the water quality protection procedures described in BA Addendum #1 (Best Management Practices to Protect Water Quality).

c. Right Abutment Cutoff Wall. After the existing embankment is removed from the right side of the dam, a 1,700 foot-long cutoff wall will be constructed into the foundation material along the centerline of the dam. This wall, formed of compacted soil and bentonite, will be approximately 60 feet deep and will subsequently be buried by the new embankment. The purpose of this wall is to lengthen the seepage path under the dam built on Meadow Creek alluvium, and relieve uplift underneath the embankment. At present, the existing dam exhibits high downstream water pressures associated with seepage passing through pervious alluvial foundation material.

The cutoff wall will depress the phreatic (groundwater) water surface and force seepage to pass through various foundation strata away from the dam, or through foundation material into the downstream drain. Bedrock is much deeper, and no impervious strata has been located in drill tests. The intent of the cutoff wall is to reduce downstream water pressures rather than cutoff all seepage in the affected reach of the dam. Because of reduced downstream water pressures, it is anticipated that there will be an overall reduction in seepage collected in the toe drain compared to that amount of seepage observed under the present dam. The amount of seepage passing through deeper foundation strata and remaining in the groundwater system would be only slightly reduced.

This construction element, in concert with the Downstream Drain identified and explained in Section 1(f) above (as well as more efficient internal embankment drainage systems), will produce a functional change in the timing, delivery, and cycling of shallow alluvial groundwater flow in the project area. In a natural configuration, shallow groundwater would return to the Yakima River through numerous preferential flow paths along that length of the river in contact with glacial and alluvial aquifer material (*i.e.*, porous, unconsolidated boulders, cobbles and gravels). Hyporheic flow and seepage through the dam will now be conducted to the downstream drain and vented directly to the Yakima River at two effluent points–one on either side of the outlet channel at the terminal ends of the downstream drain. The magnitude of discharge is expected to slightly decrease, but the temporal delivery of these waters should progress much faster than under natural conditions. Groundwater storage insulates water from temperature extremes and recharges adjacent rivers, often providing the greatest portion of summer baseflow. In essence, the cutoff wall will focus and direct groundwater to a point away from the dam where downstream water pressures are less, and seepage occurs at a decreased rate although directly into the downstream drain. Instead of flowing into the Yakima River via much slower groundwater paths in the late summer, these waters will enter the drain primarily during the spring, discharging quickly to the river. Although adverse water quality impacts from drain effluents to the Yakima River are not anticipated, the effect to the hyporheic food web of the area is unknown. The magnitude, timing, and quality of groundwater flow exchanged with the Yakima River associated with this construction element will be indirectly gaged by monitoring activities described in Sections 1(f) and 2(g).

d. Excavate and Replace Maximum Section. Work will focus on removal and replacement of the maximum section of the dam after the embankment wings are excavated, the cutoff wall is constructed and the embankment wings are replaced. This effort is scheduled to begin around August 1st, concurrent with construction-related reservoir elevation and release targets (see Section 2(a), above). This construction element, as well as 2(e), are dependent on achieving reservoir elevations and therefore could shift temporally by as much as 2 weeks.

Construction crews will work 7 days a week with two 10-hour shifts per day. Approximately 500 truckloads of material will be moved onsite each day, hauling either excavated materials to stockpiles, or stockpiled and borrow material for placement into the new embankment. This pace will continue until mid-October, when excavation and replacement of the maximum section should be completed. Construction may extend into the middle of November, dependent on weather and other variables. Any work not completed on all other sections of the dam when winter shutdown occurs will be completed the following year after snowmelt when the site once again becomes accessible.

A portion of the upstream impervious shell will remain in place to serve as a cofferdam during construction activities attendant to this element of the proposed action. Construction timing will coincide with a period of the year when precipitation falls mostly in the form of summer thunderstorms, and early winter rain and snow in November. While the maximum section is exposed, only a small measure of protection against short duration, high magnitude flow events will exist. However, construction timing and scheduling will focus on a time of the year when the possibility for such events is small if not all together discountable.

Excavation of the maximum section will entail construction activities near and around the inlet channel and outlet conduit, which directly feeds the Yakima River. Consequently, there exists the possibility for sediment and chemical constituent introduction into the aquatic system. To minimize these construction effects, BOR will use the water quality protection procedures described in BA Addendum #1 (Best Management Practices to Protect Water Quality).

e. Outlet Conduit. In addition to voids in the wing and maximum sections of the Keechelus embankment, voids have developed along the existing outlet works conduit. A 20-foot section of the outlet works conduit will be removed within the maximum section so that it can be encased in a sand filter to better control seepage. In addition, this section must be removed and replaced to assure compaction within the maximum cross section under and along the outlet works conduit. This construction activity is expected to begin in mid-September and will take approximately 20 days.

To complete this construction element, the outlet conduit will be dewatered by locking out the regulating and emergency gates on the control tower. Discharge to the Yakima River will be provided as described in Section 2(f). However, construction will be sequenced such that work in the outlet conduit will proceed only after it no longer drains into the Yakima River. Temporary coffer dams will be constructed at the downstream end of the outlet conduit to isolate turbid water from the Yakima River. However, throughflow and drainage may continue as work proceeds. To minimize these construction effects, BOR will use the water quality protection procedures described in BA Addendum #1 (Best Management Practices to Protect Water Quality).

f. Provision of Fall Spawning Flow. Excavation, removal and replacement of a section of the outlet conduit will eliminate the ability to control releases from Keechelus Reservoir using the inlet chute, control tower release gates and outlet conduit. Additionally, the construction-related mid-September target reservoir elevation (2,444 feet) will preclude access to existing bypass flow pipes. The inlet chute will be blocked off at the reservoir control tower to dry up the outlet conduit such that work can proceed. During the time this work is under way, the Yakima River will be totally cut off from its upper watershed (as well as Keechelus Lake) and primary source of streamflow. As such, discharge must be provided to the upper Yakima River below Keechelus Dam by other means. The anticipated work window for this element of the proposed action coincides with the peak spawning period of spring chinook (*O. tshawytscha*) salmon that exhibit high densities in the Action Area.

BOR will supply 100 cfs to the Yakima River from Keechelus Reservoir through either pumping stations, gravity-fed diversions, or a combination thereof. Failure of facilities designed to supply water to the Yakima River could produce catastrophic consequences to salmonids and the aquatic ecosystem downstream of Keechelus Dam. Therefore, sufficient supply redundancy (backup pumps and/or additional gravity-fed pipes) will safeguard against any failure to provide flow to the Yakima River below Keechelus Dam. In addition, pump stations and/or diversions will be monitored around the clock for the entire period of operation, until such time the control structures and outlet conduit of the dam become operational. Reclamation will decrease pumped or gravity-fed discharge to 70 cfs for a period of time not to exceed 24 hours during the installation and removal of those facilities required provide flow from the Keechelus pool.

Following construction, Keechelus Reservoir will be operated to continue to provide at least 100 cfs to the Yakima River throughout the winter, until reservoir storage reaches the point where discharge must be increased to provide extra storage space in anticipation of spring runoff. If snowpack and precipitation do not allow the reservoir to achieve full pool (*i.e.*, low water year), discharge will be ramped down from 100 cfs to match reservoir inflow, which will be maintained until releases begin for irrigation purposes.

g. Install Instrumentation. Instrumentation will be installed throughout the Keechelus embankment, foundation, and toe drain to monitor water quality and quantity, as well as dam integrity. Piezometers, devices that measure water pressures, will be used to measure dam performance (*i.e.*, monitor for leaks). Flumes will be installed within the toe drain to allow BOR to gage seepage discharge and water quality. A discussion of fisheries impacts analysis relative to this construction element can be found in Section 1(f).

h. Wetland Mitigation Plans. Approximately 1.5 acres of natural and 2.3 acres of manmade wetland built on Meadow Creek alluvium on the far right downstream side of the existing dam will be filled to accommodate the new embankment and downstream drain. Within the created wetland but below that area to be filled, an existing drainage channel will be abandoned and check structures placed at critical points to restore native surface hydrology. Currently, this drainage channel dewaters the created wetland in mid to late-summer. Earlier in the year (spring), alluvial aquifer flow through the Meadow Creek fan and Keechelus embankment produce hydric conditions in the created wetland.

At present, BOR is exploring land acquisition options from private parties in the project Action Area to mitigate for lost wetland habitats. Properties under consideration include a 230 acre parcel near Keechelus Dam that is a mixture of mid to late-seral forest and wetland. Although the parcel is not immediately threatened with development, the uplands portion could be developed or harvested, thus affecting the ecological value of adjacent wetlands. Acquisition and preservation of these properties would preclude future development, encourage ecosystem connectivity and potentially offset effects from the action under consultation. Other parcels of similar ecological value in the vicinity of the Action Area are also under investigation.

Reclamation anticipates that excavation and removal of materials from Borrow Area #1 will reach the water table. Consequently, onsite wetland mitigation is planned for Borrow Area #1, a 36 acre site located below the dam on the left side of the outlet channel. Prior to processing this borrow area, the existing topsoil will be removed and stored. After removal of embankment materials and the end of construction activities, the site will be graded to slowly drain to a control point near the Yakima River. Using natural wetlands on the far right side of the dam as a template, the stored topsoil will be replaced and revegetated with scrub-shrub wetland species (sedges, reedgrass, willow, alder, dogwood). This created wetland will be approximately 22 acres in size, and will be monitored concurrent with the new embankment to evaluate establishment of native vegetation and wetland hydrologic function.

i. Rehabilitation and Revegetation. The new embankment will consist of an impervious barrier of highly compacted fine-grained soils armored with large rock riprap extending along the entire upstream length of the dam. A downstream shell of rock and gravel will support upstream layers. Most of the disturbed area produced by the construction activities of the proposed action will not be suitable for revegetation. The establishment of any vegetation other than surficial grasses and forbs would produce deep root systems that could endanger the structural integrity of the embankment. Consequently, BOR will reseed native grasses but avoid growth of other vegetation the new embankment.

Revegetation of other disturbed areas such as the shoulders of the new road below the dam, contractor staging areas, and disturbed bridge abutments will be accomplished as described in BA Addendum #2 (Site Clearing, Grubbing, Revegetation and Rehabilitation Procedures).

3. Interrelated and Interdependent Activities

Prior to initiating consultation, the BOR framed the proposed action narrowly, as a construction action under the SOD Act. Construction authorized under this federal law is limited specifically to the purposes of dam safety. The purposes of further dam storage or other benefits over and above those provided in the original dam and reservoir (Public Law 95-578, November 2, 1978, as amended by Public Law 98-404, August 28, 1984) are precluded. Therefore, the BOR's Biological Assessment for the present action did not consider the effects of operating of Keechelus Dam as activities that are interrelated and interdependent to the SOD Act action. Furthermore, the Biological Assessment did not consider the effects of separately adding fish passage at Keechelus Dam as a part of the SOD Act action.

Interrelated actions are those that are a part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration (50 C.F.R. §402.02). We must ask whether the associated action, here the dam's ongoing operation, would not occur "but for" the proposed larger action. See *ESA Consultation Handbook*, U.S. Fish & Wildlife Service and NMFS, March 1998, pages 4-26 through 4-28. For this consultation, the "larger action" is the SOD Act construction. The question is whether the ongoing effects of the dam's operation should be considered part of the proposed action. The dam has already been constructed, and its existence is an element of the environmental baseline. The ongoing effects of this dam will continue regardless of the proposed SOD Act project and therefore do not satisfy the "but for" test. Thus, the maintenance and operations of the existing dam are not interrelated and interdependent with the SOD Act action.

The BOR submitted a draft Biological Assessment for the maintenance and operation of the entire Yakima Project in September 2000. Maintenance and Operation of Keechelus Dam is an element of the maintenance and operation of the Yakima Project. NMFS and BOR have been working cooperatively since the submission of the draft Biological Assessment to ensure that it contains all of the information to necessary to initiate formal consultation. The process of gathering all of the necessary information is nearly complete. Additionally, a study of fish passage feasibility at each of its facilities in the Yakima Project, including Keechelus Dam. The Safety of Dams Act construction would not preclude later construction of fish passage facilities at Keechelus Dam. Therefore, NMFS expects that the issues of Keechelus Dam operations and fish passage considerations will be covered as elements of the forthcoming consultation on the maintenance and operation of the Yakima Project.

C. Action Area

Under the ESA, the "Action Area" is defined as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area of the action (50 C.F.R.§ 402.02 and 402.14(h)(2)). For the purposes of this BO, the Action Area includes all aquatic and riparian habitat along the Yakima River extending from Keechelus Dam at River Mile (RM) 214.5, downstream to Easton Dam located at RM 202.5.

II. STATUS OF THE SPECIES AND CRITICAL HABITAT

The listing status, biological information, and Critical Habitat elements or potential Critical Habitat for the NMFS listed species are described in Table 1.

Species (Biological Reference)	Listing Status Reference	Critical Habitat Reference
Steelhead from Washington, Idaho, Oregon and California, (Busby, *et al.* 1996).	The MCR ESU is listed as Threatened under the ESA by the NMFS, (64 Fed. Reg. 14517, March 25, 1999).	Critical Habitat for MCR ESU, (65 Fed. Reg. 7764, Feb. 16, 2000).

Table 1. References to Federal Register Notices containing additional information concerning listing status, biological information, and Critical Habitat designations for listed and proposed species considered in this biological opinion.

The proposed action will occur within the designated Critical Habitat of MCR steelhead. Essential features of this Critical Habitat include substrate, water quality/quantity, water temperature, water velocity, cover/shelter, food, riparian vegetation, space, and safe passage conditions (65 Fed. Reg.7764, February 16, 2000).

Middle Columbia River steelhead have been negatively affected by a combination of habitat alteration and hatchery management practices. The four downstream, mainstem dams on the Columbia are perhaps the most significant source of habitat degradation for this ESU. The dams act as a partial barrier to passage, kill out-migrating smolts in their turbines, raise temperatures throughout the river system, and have created lentic refugia for salmonid predators. In addition to dams, irrigation systems have had a major negative impact by diverting large quantities of water, stranding fish, and acting as barriers to passage. Other major habitat degradation has occurred through urbanization and livestock grazing practices (WDF *et al.* 1993; Busby *et al.* 1996; NMFS 1996; 63 Fed. Reg. 11798, March 10, 1998).

Habitat alterations and differential availability impose an upper limit on the production of naturally spawning populations of salmon. The National Research Council Committee on Protection and Management of Pacific Northwest Anadromous Salmonids identified habitat problems as a primary cause of declines in wild salmon runs (NRCC 1996). Some of the habitat impacts identified were the fragmentation and loss of available spawning and rearing habitat, migration delays, degradation of water quality, removal of riparian vegetation, decline of habitat complexity, alteration of streamflows and streambank and channel morphology, alteration of ambient stream water temperatures, sedimentation, and loss of spawning gravel, pool habitat and large woody debris (NMFS 1998, NRCC 1996, Bishop and Morgan 1996).

Hatchery management practices are suspected to be a major factor in the decline of this ESU. The genetic contribution of non-indigenous, hatchery stocks may have reduced the fitness of the locally adapted native fish through hybridization and associated reductions in genetic variation or introduction of deleterious (non-adapted) genes. Hatchery fish can also directly displace natural spawning populations, compete for food resources, or engage in agonistic interactions (Campton and Johnston 1985; Waples 1991; Hilborn 1992; NMFS 1996; 63 Fed. Reg. 11798, March 10, 1998).

Middle Columbia River steelhead population sizes are substantially lower than historic levels, and at least two extinctions are known to have occurred in the ESU. In larger rivers (John Day, Deschutes, and Yakima), steelhead abundance has been severely reduced: it is estimated that the Yakima River had annual run sizes of 100,000 fish prior to the 1960's; more recently (early 1990's), natural escapement has been about 1,200 fish (WDF *et al.* 1993). Across the entire ESU, the wild fish escapement has averaged 39,000 and total escapement 142,000 (includes hatchery fish). The large proportion of hatchery fish, concurrent with the decline of wild fish, is a major risk to the MCR ESU (WDF *et al.* 1993; Busby *et al.* 1996; 63 Fed. Reg. 11798, March 10, 1998).

Within the Yakima River Basin, adult steelhead returns have averaged 1,256 fish (range 505 (1996) to 2,840 (1988)) over brood years 1985-2000 as monitored at Prosser Dam (RM 47.1; YSS 2001). Steelhead spawning varies across temporal and spatial scales in the Yakima Basin as well, although the current spatial distribution is significantly decreased from historic conditions. The NMFS has identified the following spawning populations within the Yakima Basin: upper Yakima River above Ellensburg, Teanaway River, Swauk Creek, Taneum Creek, Roza Canyon, mainstem Yakima River between the Naches River and Roza Dam, Little Naches River, Bumping River, Naches River, Rattlesnake Creek, Toppenish Creek, Marion Drain, and Satus Creek. Typically, steelhead spawn earlier at lower, warmer elevations than higher, colder waters. Overall, most spawning is completed within the months of January through May (Hockersmith *et al.* 1995), although steelhead have been observed spawning in the Teanaway River (RM 176.1), a tributary to the Upper Yakima into July (Todd Pearsons, Washington Department of Fisheries and Wildlife (WDF&W), personal communication). These steelhead spawn later in the year at higher elevations in the Yakima basin, and face lethal conditions (in most years) as down-migrating kelts (spawned-out adults returning to the ocean) in the lower Yakima River. MCR steelhead that spawn in the Yakima basin at lower elevations potentially meet the same fate, however earlier spawn timing and emigration may provide increased survival because kelts traverse the lower Yakima River before water quality becomes lethal. High temperatures, low flows, and degraded water quality from irrigation effluents (*i.e.*, high temperature, turbidity and pollutant concentrations), contribute to extremely low survival during summer months (Vaccaro 1986; Lichatowich and Mobrand 1995; Lichatowich *et al.* 1995; Pearsons *et al.* 1996; Lilga 1998).

Four genetically distinct spawning populations of wild steelhead have been identified in the Yakima basin, one of which spawns in the upper Yakima River and its tributaries (Phelps *et al.* 2000). Hockersmith *et al.* (1995) found that 3% of radio-tagged steelhead from 1990 to 1992 utilized the upper mainstem Yakima River and its tributaries for spawning, beginning in early March and extending into late May. Busack *et al.* (1991) analyzed scale samples from smolts and adult steelhead and found, generally, that smoltification occurs after two years in the Yakima system, with a few fish maturing after three years and an even smaller proportion reaching the smolt stage after one year. This means that listed steelhead are in the action area during every day of the calendar year. Within the Yakima River basin, the Upper Yakima subpopulation of steelhead contributes to the run as a whole, both in terms of numbers and genetic diversity.

The upper Yakima steelhead population was undoubtedly adversely affected by operations at Roza Dam (RM 128) between 1941 and 1959. Although fitted with a ladder, the pool at Roza

Dam was kept down from the end of one irrigation season (mid-October) to the beginning of the next (mid-March) for these 18 years. Hockersmith *et al.* (1995) found that steelhead passed Roza Dam from November through March, and more recent data suggest that passage occurs from the end of September through May (Mark Johnston, Yakama Nation Fisheries Program, personal communication). Consequently, operations at Roza Dam virtually eliminated fish passage for most of the steelhead migration season, and excluded most steelhead bound for the upper Yakima from reaching their destination. A new ladder was installed at Roza Dam in 1989 that allows better passage, but only when the pool is completely up or down. However, the ladder is inoperable at levels between maximum and minimum pool when the reservoir is manipulated to facilitate operational activities such as screen maintenance at the end of October and early November.

III. EVALUATING THE PROPOSED ACTION

The standards for determining jeopardy are set forth in section 7(a)(2) of the ESA and 50 C.F.R. Part 402 (the consultation regulations). The NMFS must determine whether the action is likely to jeopardize the listed species and/or whether the action is likely to destroy or adversely modify Critical Habitat. This analysis involves the initial steps of (1) defining the biological requirements and current status of the listed species, and (2) evaluating the relevance of the environmental baseline to the species' current status.

From that, NMFS evaluates whether the action is likely to jeopardize the listed species by determining if the species can be expected to survive with an adequate potential for recovery. In making this determination, NMFS must consider the estimated level of injury or mortality attributable to: (1) collective effects of the proposed or continuing action, (2) the environmental baseline, and (3) any cumulative effects. This evaluation must take into account measures for survival and recovery specific to the listed species' life stages that occur beyond the action area. If NMFS finds that the action is likely to jeopardize, NMFS must identify reasonable and prudent alternatives for the action.

In addition, NMFS evaluates whether the action, directly or indirectly, is likely to destroy or adversely modify the listed species' designated Critical Habitat. The NMFS must determine whether habitat modifications appreciably diminish the value of Critical Habitat for both survival and recovery of the listed species. The NMFS identifies those effects of the action that impair the function of any essential element of Critical Habitat. The NMFS then considers whether such impairment appreciably diminishes the habitat's value for the species' survival and recovery. If NMFS concludes that the action will adversely modify Critical Habitat it must identify any reasonable and prudent alternatives available.

Guidance for making determinations on the issue of jeopardy and adverse modification of habitat are contained in *The Habitat Approach, Implementation of Section 7 of the Endangered Species Act for Actions Affecting the Habitat of Pacific Anadromous Salmonids*, August 1999.

For the proposed action, NMFS' jeopardy analysis considers direct or indirect mortality of fish attributable to the action. The NMFS' Critical Habitat analysis considers the extent to which the proposed action impairs the function of essential elements necessary for migration and spawning of the listed salmon under the existing environmental baseline.

A. Biological Requirements

The first step in the methods NMFS uses for applying the ESA Section 7(a)(2) to listed salmon is to define the species' biological requirements that are most relevant to each consultation. The NMFS also considers the current status of the listed species; taking into account population size, trends, distribution and genetic diversity. To assess the current status of the listed species, NMFS starts with the determinations made in its original decision to list the species (*i.e.*, MCR steelhead) for protection under the ESA. Additionally, the assessment will consider any new information or data that are relevant to the determination (see Table 1 for references).

The relevant biological requirements are those necessary for salmon in each ESU to survive and recover to naturally reproducing population levels, at which time protection under the ESA would become unnecessary. Adequate population levels must safeguard the genetic diversity of the listed stock, enhance their capacity to adapt to various environmental conditions, and allow them to become self-sustaining in the natural environment.

The biological requirements of MCR steelhead include food, flowing water (quantity), high quality water (cool, free of pollutants, high dissolved oxygen concentrations, low sediment content), clean spawning substrate, and unimpeded migratory access to and from spawning and rearing areas (adapted from Spence *et al.* 1996). Even slight modifications of these habitat elements can produce deleterious effects to MCR steelhead and their Critical Habitat.

The NMFS has related the biological requirements for listed salmonids to a number of habitat attributes, or pathways, in the Matrix of Pathways and Indicators (MPI). These pathways (Water Quality, Habitat Access, Habitat Elements, Channel Condition and Dynamics, Flow/Hydrology, and Watershed Conditions) indirectly measure the baseline biological health of listed salmon populations through the health of their habitat. Specifically, each pathway is made up of a series of individual indicators (*e.g.*, indicators for Water Quality including temperature, sediment/turbidity, and chemical contamination/nutrients) that are measured or described directly (see, NMFS 1996). Based on the measurement or description, each indicator is classified within a category of the properly functioning condition (PFC) framework: (1) *properly functioning*, (2) *at risk*, or (3) *not properly functioning*. Properly functioning condition is defined as "the sustained presence of natural habitat forming processes in a watershed that are necessary for the long-term survival of the species through the full range of environmental variation."

B. Factors Affecting the Species at the Population Level

In other Biological Opinions, NMFS assessed life history, habitat and hydrology, hatchery influence, and population trends in analyzing the effects of the underlying action on affected species at the population scale (see, for example, Reinitiation of Consultation on Operation of the Federal Columbia River Power System, Including the Juvenile Fish Transportation Program, and 19 Bureau of Reclamation Projects in the Columbia Basin. NMFS 2000.) A thumbnail description of each of these factors is provided below.

1. Life History

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). 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 nonanadromous 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.

2. Habitat and Hydrology

The only substantial habitat blockage now present in this ESU is at Pelton Dam on the Deschutes River, but minor blockages occur throughout the region. Water withdrawals and overgrazing have seriously reduced summer flows in the principal summer steelhead spawning and rearing tributaries of the Deschutes River. This is significant because high summer and low winter temperatures are limiting factors for salmonids in many streams in this region (Bottom et al. 1985).

3. Hatchery Influence

Continued increases in the proportion of stray steelhead in the Deschutes River basin is a major concern. The ODFW and the Confederated Tribes of the Warm Springs Reservation of Oregon (CTWSRO) estimate that 60% to 80% of the naturally spawning population consists of strays, which greatly outnumber naturally produced fish. Although the reproductive success of stray 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. The populations of steelhead in the Deschutes River basin include the following:

- Steelhead native to the Deschutes River

- Hatchery steelhead from the Round Butte Hatchery on the Deschutes River

- Wild steelhead strays from other rivers in the Columbia River basin

- Hatchery steelhead strays from other Columbia River basin streams

Regarding the latter, CTWSRO reports preliminary findings from a tagging study by T. Bjornn and M. Jepson (University of Idaho) and NMFS suggesting that a large fraction of the steelhead passing through Columbia River dams (e.g., John Day and Lower Granite dams) have entered the Deschutes River and then returned to the mainstem Columbia River. A key unresolved question about the large number of strays in the Deschutes basin is how many stray fish remain in the basin and spawn naturally.

4. Population Trends and Risks

For the MCR steelhead ESU as a whole, NMFS estimates that the median population growth rate (lambda) over the base period 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 (McClure et al. 2001). NMFS has also estimated the risk of absolute extinction for four of the spawning aggregations, using the same range of assumptions about the relative effectiveness of hatchery fish. At the low end, assuming that hatchery fish spawning in the wild have not reproduced (i.e., hatchery effectiveness = 0), the risk of absolute extinction within 100 years ranges from zero for the Yakima River summer run to 1.00 for the Umatilla River and Deschutes River summer runs (McClure et al. 2001). Assuming that the hatchery fish spawning in the wild have been as productive as wild-origin fish (hatchery effectiveness = 100%), the risk of absolute extinction within 100 years ranges from zero for the Yakima River summer run to 1.00 for the Deschutes River summer run (McClure et al. 2001).

C. Factors Affecting the Species within the Action Area

Section 4(a)(1) of the ESA and NMFS listing regulations (50 C.F.R. § 424) set forth procedures for listing species. The Secretary of Commerce must determine, through the regulatory process, if a species is endangered or threatened based upon any one or a combination of the following factors; (1) the present or threatened destruction, modification, or curtailment of its habitat or range; (2) overutilization for commercial, recreational, scientific, or educational purposes; (3) disease or predation; (4) inadequacy of existing regulatory mechanisms; or (5) other natural or human-made factors affecting its continued existence.

The proposed action includes activities that would have some level of effects with short-term impacts from category (1) in the above paragraph, and the potential for long-term impacts as described in category (5). The characterization of these effects and a conclusion relating the effects to the continued existence of MCR steelhead is provided below, in Section IV.

The major factors affecting steelhead within the action area include instream flows, channel conditions and dynamics, and riparian habitat. The NMFS uses the MPI to analyze and describe the effects of these factors on listed steelhead. As described above, the MPI relates the biological requirements of listed species to a suite of habitat variables. In the MPI analysis presented here, each factor is considered in terms of its effect on relevant pathways and associated indicators (*properly functioning, at risk, or not properly functioning*).

1. Instream Flows

Instream flows in the Yakima River within the Action Area are mostly controlled by natural watershed processes (snowmelt runoff and rain-on-snow events), but more significantly by the operation of Keechelus Dam. In an unregulated condition, the Yakima River below Keechelus Dam would exhibit the hydrograph of a snowmelt-dominated system where discharge peaked in May concurrent with melting snow, and reached baseflow in late July. Discharge would have increased in early winter, as precipitation in the form of rainfall and, to some degree snowmelt, augmented summer baseflow (BOR 2001).

Presently, the Yakima River below Keechelus Dam is manipulated to maximize winter reservoir storage and summer irrigation deliveries that are synchronized with the seasonal needs of irrigators. Large volumes of water are released throughout the summer months (irrigation season), peaking in mid to late August. In early September, through a process known as "flip-flop," releases from Keechelus Dam and other reservoirs (primarily Cle Elum and Kachess Reservoirs) in the "Yakima Arm" (the Yakima River above the Naches River confluence) of the system are ramped down to a fraction of their August discharge levels in an attempt to minimize the dewatering of spring chinook redds during winter storage operation (downstream to Roza Dam). Downstream irrigation deliveries are then primarily met from Rimrock and Bumping Reservoirs on the "Naches Arm" (the Naches River and its tributaries) of the system, which equates to abnormally high discharge levels in the Tieton and Naches Rivers thorough the middle of October–the traditional end of the irrigation season.

The flip-flop operation involves a radical flow manipulation in the reach of the Yakima River below Keechelus Dam. August discharge levels can range from approximately 1,200 cfs in late August to less than 100 cfs by the first week of September (BOR 2000). After spring chinook finish spawning, incubation flows are further reduced from those flows released in September. Minimal discharge is released from Keechelus Reservoir into the Yakima River in an effort to maximize reservoir storage. Generally, inflow exceeds outflow throughout the winter until the reservoir reaches that elevation where releases are made per flood rule curves. The reservoir is operated to maximize storage levels in May, just before deliveries for irrigated agriculture begin, usually in late June or early July.

The operation of Keechelus Reservoir has produced a river that is out of phase with its natural hydrograph, and the biota of the upper Yakima River have suffered accordingly. This storage-and-release pattern is at best suboptimal for adult and juvenile steelhead (Fast *et al.* 1991). In the MPI analysis, instream flows fall under the Flow/Hydrology pathway, and Change in Peak/Base flow indicator. Currently, for the reasons described above, this indicator is *not properly functioning*. In this instance, *not properly functioning* is defined as "pronounced changes in peak flow, base flow and/or flow timing relative to an undisturbed watershed of similar size, geology and geography."

2. Riparian Habitat

Forest practices, agriculture, urbanization, and flood control have adversely affected riparian habitat in the Yakima River watershed. In the action area of this project, numerous anthropogenic features or activities (*e.g.*, channelized reach below Keechelus Dam, Bonneville Power Administration (BPA) transmission line crossings, levees, local roads (both parallel to and across the Yakima River), old railroad operations, tie drives, and campgrounds) have become permanent fixtures on the landscape and have displaced and altered native riparian habitat to some degree. Consequently, the potential for normal riparian processes (*e.g.*, shading, bank stabilization and LWD recruitment) to occur is diminished, and aquatic habitat has become simplified (Ralph *et al.* 1994; Young *et al.* 1994; Fausch *et al.* 1994; Dykaar and Wigington 2000).

In the MPI analysis, the alteration of riparian vegetation affects several pathways and indicators. The Watershed Conditions pathway and Riparian Reserves indicator is functioning *at risk*: there has been a moderate loss of connectivity or function (shade, LWD recruitment, etc.) of the riparian reserve system, or incomplete protection of habitats and refugia for sensitive aquatic species. In addition, the Temperature and Large Woody Debris indicators, from the Water Quality and Habitat Elements pathways, are also functioning *at risk* because of impaired riparian function.

3. Channel Condition and Dynamics

Alluvial channel patterns adjust by lateral planform migration and longitudinal profile changes through aggradation and degradation (Leopold *et al.* 1964; Alabyan and Chalov 1998). As such, the river has a natural tendency to respond to flood events by occupying distributary channels, dissipating excessive erosive energy, rebuilding floodplain habitats, and recharging the shallow alluvial aquifer. The action area of this project is in a braided, alluvial floodplain reach of the Yakima River, that, in comparison to other areas of the Yakima basin, is relatively undeveloped although not without damage.

After the construction of Keechelus Dam a 2,640 foot reach of the Yakima River below the reservoir outlet works was channelized to expediently convey large volumes of water away from the embankment and increase storage capacity in the reservoir by dropping the historic base level of the Yakima River approximately 30 feet. This trenched reach greatly inhibited the exchange of hyporheic waters, and greatly simplified salmonid and macroinvertebrate habitats. In addition, the Keechelus embankment itself served to alter the natural exchange of waters between the shallow alluvial aquifer of glacial deposits and the Yakima River. As human development progressed, numerous human emplacements and/or activities on the landscape (*e.g.*, channelized reach below Keechelus Dam, Bonneville Power Administration (BPA) transmission line crossings, levees, local roads (both parallel to and across the Yakima River), old railroad operations, tie drives, and campgrounds) became features that either intentionally or unintentionally restricted interaction between the Yakima River and its floodplain.

Such floodplain developments were undertaken to protect the local infrastructure. However, these floodplain revetments also had a negative impact on fisheries resources through simplification and homogenization of littoral and riverine habitat, disconnecting the Yakima River from its floodplain, reducing channel complexity, and altering the flow regime under which aquatic species and riparian vegetation evolved (Dykaar and Wigington 2000). As a result, the Floodplain Connectivity and Width/Depth Ratio indicators (Channel Condition and Dynamics pathway) are functioning *at risk*. In this instance, *at risk* is defined as "reduced linkage of wetland, floodplains and riparian areas to main channel; overbank flows are reduced relative to historic frequency, as evidenced by moderate degradation of wetland function, riparian vegetation/succession."

4. Habitat Access

In its natural condition, Lake Keechelus was known to support sockeye salmon ((*O. nerka)* Fulton 1970; Nehlsen, *et al.* 1991; Tuck 1995), and likely harbored steelhead, chinook and coho (*O. kisutch*) salmon in tributaries to the Lake such as Meadow, Gold, Cold, Mill and Coal Creeks (BOR 2000). Obviously, historic Lake Keechelus did not pose a passage barrier to these salmonids. However, early crib dams circa 1906 and the completion of Keechelus Dam (without fish passage facilities) in 1917 effectively extirpated anadromous salmonids from habitats above the embankment (Bryant and Parkhurst 1950; Davidson 1953; Fulton 1970; Mullan 1986; Gustafson *et al.* 1997; Snyder and Stanford 2001). As a result, the Habitat Access indicator of the MPI is *not properly functioning*. Manmade barriers present in the watershed prevent upstream and/or downstream fish passage at a range of flows.

C. Environmental Baseline

The environmental baseline represents the current basal set of conditions to which the effects of the proposed action would be added. The term "environmental baseline" means "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 " (50 C.F.R.§ 402.02). The proposed action involves replacing an existing piece of infrastructure with another occupying the existing footprint. Because the effects of a proposed action are determined by what that action adds to the environmental baseline, the effects of this action consist of the effects of the activities involved in removing the existing structure and replacing it with a new one.

As described above, the action area for this consultation extends along the Yakima River from approximately RM 214.5 downstream to RM 202.5. The headwaters of the Yakima River (5^{th} order) emerge from the crest of the Cascade Mountains above Keechelus Lake. From there, the Yakima River flows 214 miles downstream to Richland, Washington where it enters the Columbia River at RM 335.2. Total drainage basin area is roughly 6,155 mi^2, encompassing over 1,900 miles of perennial streams. Major tributaries in the basin include the Kachess, Cle Elum and

Teanaway Rivers in the upper basin, the Naches River in the mid part of the basin, and Ahtanum, Toppenish, and Satus Creeks further downriver.

The Yakima basin occupies two physiographic provinces (the Columbia Plateau and Cascade Mountains), and 3 major ecoregions (Cascades, Eastern Cascades Slopes and Foothills and Columbia Basin (Omernik 1987)). Consequently, climate, topography, precipitation, and

vegetative cover are highly variable. In addition, the distribution and type of aquatic and terrestrial habitat is quite variable, supporting a wide range of species. With respect to anadromous fishery resources, the Yakima Basin once supported abundant and diverse runs of salmon and steelhead that now return in just a fraction of their historic numbers (Nehlsen *et al.* 1991; Tuck 1995; Busby *et al.* 1996; NMFS 1996).

At the downstream end of the Action Area, the Yakima River drains approximately 182 mi^2 of predominately forested, mountainous terrain of the Cascades. Pacific silver fir, western hemlock, western red cedar, Douglas fir, lodgepole and white pine inhabit the upland portions of the area. Riparian species include cottonwood, Douglas fir, western hemlock and red cedar, alder, and willow. Wetland areas are vegetated by sedges, rushes, and mannagrass; scrub-shrub wetlands support willow, alder, and/or spirea while marsh areas exhibit cattails and bulrushes. There are wetland ponds with emergent and submerged aquatic vegetation of various species downstream of the dam, primarily associated with the Meadow Creek alluvial fan (BOR 2001).

The Yakima River flows 12 miles through the Action Area, responding to a gradient of approximately 1%. The morphology of the river in this reach is largely composed of numerous braided side channels that constitute some of the best, intact floodplain habitats in the Yakima Basin. Two main tributaries contribute discharge to the reach, Cabin Creek and the Kachess River. The Kachess River is fed by Kachess Reservoir, a 239,000 ac-ft component impoundment of the larger Yakima Project. There are numerous other small, ephemeral and perennial tributaries that enter the Yakima River in this reach, including Price, Noble, Swamp, Mosquito, Toll, Cedar, Stampede, Telephone, and Hudson Creek (Cupp 1997). The downstream terminus of the Action Area is Lake Easton Dam, a structure that serves as the headworks for the Kittitas Reclamation District's (KRD) main canal. The primary land use in the area is timber harvest, the effect and extent of which is evident in Cabin Creek, which exhibits a channel that is severely downcut and degraded because of clear cuts in the upper watershed. Secondary land uses include recreation, winter sports, and grazing.

Water quality in the Action Area is generally excellent, primarily because of its location in the watershed and relatively low levels of other development in the area (BOR 2001). Additionally, because of the general lack of development, chemical contamination levels are extremely low if not altogether nonexistent. Land-use activities (grazing and forest practices) below Keechelus Dam have deteriorated factors such as sediment cycling and nutrient delivery. With respect to water temperature, bottom-draw release structures like those used at Keechelus Dam provide thermally homogeneous, cold discharge to the Yakima River, and may interfere with certain aspects of salmonid ecology in the Action Area (*e.g.*, migration cues, spawn timing, and growth). However, the effect of this mechanism on salmonid ecology has not been empirically evaluated.

Threatened MCR steelhead are currently affected by a number of habitat modifications within the Action Area. The most prominent and deleterious modifications are the result of reservoir storage and irrigation activities, as well as development in the floodplain, riparian, and upland areas. Specifically, irrigation and development have had the following effects on the environmental baseline: (1) adversely affected instream flows, (2) degraded streambank morphology and function, (3) detached portions of the Yakima River and its tributaries from their historical floodplains creating impaired floodplain function, and (4) passage barriers that prohibit migratory anadromous fish from reaching former habitats.

Instream flow related BOR Yakima Project operations, pursuant to delivery of irrigation demands, have greatly impacted biotic and abiotic conditions in the Yakima River below Keechelus Reservoir. Generally, instream flow problems stem from chronically low discharge levels during reservoir refill periods to inordinately high flows out of phase with the ecology of steelhead when downstream demands are being met. Steelhead spawning flows in the upper Yakima River can be depressed by low discharge levels if low snowpack and runoff extend reservoir refill periods. Incubation, fry, and juvenile rearing conditions can be problematic as high discharge levels produce high velocity habitats that can displace individuals downstream. In addition, high discharge levels during the summer months can produce rearing conditions that are energetically stressful to juvenile fish, stunting their growth and maturity to smoltification. Spring chinook salmon spawn below Keechelus Dam during high irrigation delivery flows (August to Mid-September) that are cut by more than 90% for incubation discharge levels (mid-October through the winter). These incubation flows also dewater side-channel habitats that are important to the juvenile life-stage of all salmonids.

Floodplain development and revetments, the channelization of the Yakima River below Keechelus Dam, and the Keechelus embankment itself have altered natural processes that served to (1) promote exchange of water and sediments between the Yakima River and its overbank habitats, (2) provide lateral habitat heterogeneity for MCR steelhead, and (3) maintain riparian habitat communities dependent on natural streamflow dynamics. As described in the preceding paragraph, flow management scenarios have served to exacerbate floodplain function problems.

Throughout the upper Yakima River, riparian habitat has been degraded through a variety of activities. Among them, timber harvest, roading (both parallel to and across the river), diking, grazing, urban development, and flood control have had the greatest effect. These activities have degraded riparian habitat by direct canopy removal, covering the ground with materials that preclude plant growth, reducing the widths of riparian zones, and altering the riparian species composition in favor of nonnative plants. For MCR steelhead, the lack of properly functioning riparian habitat contributes to instream temperatures that may seasonally exceed physiological tolerances and streambank erosion that increases sedimentation of spawning habitat. Although the Yakima River in the Action Area exhibits some of the finest, intact floodplain habitats in the entire Yakima basin, flow management practices provide discharge out of phase with the natural hydrograph that is temporally incompatible with salmonid life stage, riparian, and hyporheic species' requirements.

The development of Keechelus Lake to store water for irrigation has affected salmonids that previously utilized the lake and its tributary habitats for completion of their life cycle (*e.g.*, steelhead, coho, sockeye, and spring chinook salmon). The first crib dam in 1906 may have hindered anadromous fish passage, but the completion of Keechelus Dam in 1917 effectively extirpated these salmonids from areas above the dam (Bryant and Parkhurst 1950; Davidson 1953; Fulton 1970; Mullan 1986; Gustafson *et al.* 1997; Snyder and Stanford 2001).

Based on the above information, NMFS concludes that not all of the biological requirements of listed steelhead for freshwater habitat in general are being met under the environmental baseline in this watershed. The status of the species is such that there must be significant improvement in the environmental conditions they experience over those presently available under the environmental baseline to meet the biological requirements for survival and recovery of this species. Further degradation of these conditions could significantly reduce the likelihood of survival and recovery of this species due to the amount of risk listed steelhead already face under the current environmental baseline.

IV. EFFECTS OF THE PROPOSED ACTION

The NMFS' ESA implementing regulations define "effects of the action" as "the direct and indirect effects of an action on the species or Critical Habitat together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline." Direct effects are immediate effects of the project on the species or its habitat, and indirect effects are those that are caused by the proposed action and are later in time, but are still reasonably certain to occur (50 C.F.R.§ 402.02).

A. Direct Effects

Direct effects result from the agency action and may include the effects of interrelated and interdependent actions. Future Federal actions that are not a direct effect of the action under consideration (and not included in the environmental baseline or treated as indirect effects) are not evaluated. The direct effects resulting from the proposed Keechelus Dam SOD project include (1) possible increase in turbidity pursuant to construction activities, (2) possible aquatic (riverine and groundwater) introduction of petroleum-based hydrocarbons from construction machinery and staging areas, (3) altering the discharge regime by increasing reservoir release to meet construction milestones, and (4) impact to aquatic species assemblages by failure of pumping and/or gravity-fed diversions while the outlet conduit is removed and replaced.

1. Keechelus Dam Reconstruction

a. Turbidity. Near and/or above stream excavation and construction, embankment stockpiling, processing borrow areas, and other activities associated with replacing the Keechelus embankment could create and/or mobilize sediments, temporarily increasing downstream turbidity levels. In the immediate vicinity of construction activities (near the Yakima River and at satellite stockpile and borrow areas), the level of turbidity could likely exceed natural background levels by a significant margin and potentially affect listed MCR steelhead.

For salmonids, turbidity has been linked to a number of behavioral and physiological responses (*i.e.*, gill flaring, coughing, avoidance, increase in blood sugar levels) which indicate some level of stress (Bisson and Bilby 1982; Sigler *et al.* 1984; Berg and Northcote 1985; Servizi and Martens 1992). The magnitude of these stress responses is generally higher when turbidity is increased and particle size decreased (Bisson and Bilby 1982; Servizi and Martens 1987; Gregory and Northcote 1993). Although turbidity may cause stress, Gregory and Northcote (1993) have shown that moderate levels of turbidity accelerate foraging rates among juvenile chinook salmon, likely because of reduced vulnerability to predators (camouflaging effect).

When the particles causing turbidity settle out of the water column, they contribute to sediment on the riverbed (sedimentation). When sedimentation occurs, salmonids may be negatively affected: (1) buried salmonid eggs may be smothered and suffocated, (2) prey habitat may be displaced, and (3) future spawning habitat may be displaced (Spence *et al.* 1996)

The proposed action could cause elevated turbidity levels during those construction elements near and/or above the Yakima River, or other channels tributary to the Yakima River (*i.e.*, spillway channel and downstream drain). However, the effects of this turbidity on listed fish will be minimized through water quality protection procedures outlined in BA Addendum #1 (Best Management Practices to Protect Water Quality). In response to temporary increases in turbidity, it is expected that listed fish present would temporarily move avoid harm. Additionally, major construction elements producing sediment will occur from August to mid-November, when spawning steelhead or redds are not present, and adult fish are most likely migrating in small numbers. Water quality protection procedures should serve to minimize impacts to spring chinook that will be spawning in the Yakima River below the construction area.

Turbidity and sedimentation caused by this action should be short lived, returning to baseline levels soon after construction is over, with no long term effects. Other than the short term inputs mentioned above, this project would not change or add to the existing baseline turbidity or sedimentation levels within the Yakima River.

b. Construction Machinery Fuel and Lubricants. The scope and magnitude of the action under consultation involves large numbers and kinds of heavy machinery necessary to process, remove, transport, and replace materials for the new embankment. As such, there will be a large volume of petroleum-based fuels and lubricants stored in the four contractor staging and storage areas spread across the construction area. Distribution and use of these materials, if done improperly, can have deleterious effects to salmonids.

Petroleum-based products are composed of thousands of compounds, including polynuclear aromatic hydrocarbons or PAH (Heintz *et al.* 1999; Carls *et al.* 1999). Although there is a paucity of literature on the effects of PAH to inland freshwater salmonids, the work of Carls *et al.* (1999) on Pacific herring (*Clupea pallasi*), and the work of Heintz *et al.* (1999) on pink salmon (*O. gorbuscha*) in Prince William Sound after the Exxon Valdez oil spill in 1989 suggests that responses to PAH are generally applicable to other species of fish because the mechanisms of harm are much the same. PAH, either weathered (in the system for a long period of time) or in an aqueous solution, increased embryo mortality (Heintz *et al.* 1999; Carls *et al.* 1999). In addition, Bue *et al.* (1996) compared embryo mortality rates of streams traversing oiled and unoiled beaches and found that pink salmon eggs deposited in the intertidal sections of oiled-beach streams had higher mortality rates. Furthermore, oil pollution appears to have much longer effects at much lower concentrations than previously thought. Heintz *et al.* (1999) also determined that PAH levels as low as one part per billion (ppb) can harm both pink salmon and Pacific herring, causing death, impaired reproductive ability, and decreased growth rates.

Although the previously cited literature references the largest oil spill in American history, the effects of very small concentrations of PAH, in both the fresh (aqueous) and/or weathered form, are well understood. Diesel fuel, gasoline, hydraulic fluids, and motor oils are all PAH that will be present in the Action Area with the potential to adversely impact salmonids during all life stages, both immediately and in the long-term. Proper handling of these materials will protect the anadromous fish resources of the Yakima River below the Keechelus Dam construction area from these effects.

It is expected that all water quality protection procedures described in BA Addendum #1 (Best Management Practices to Protect Water Quality) will minimize short or long-term effects to MCR steelhead or their Critical Habitat. With respect to the Water Quality pathway (Chemical Contamination/Nutrients Indicator) of the MPI analysis, this element of the proposed action should maintain the existing functional condition of water quality in terms of contaminants.

c. Reservoir Evacuation and Flow Release. As previously described in Section I (B)(2)(a), releases from Keechelus Reservoir may differ from normal operations during Phase 2 to achieve the construction-related reservoir elevation restrictions for removal and replacement of the maximum section and a 20-foot segment of the outlet conduit. Consequently, in an average to wet water year (*i.e.*, 2.90 MAF and greater), Reclamation will increase discharge in the Yakima River below Keechelus Dam from mid-March through the end of May to meet the construction timeline. Mid-March through May regulated discharge will increase from average flows of approximately 100 to 500 cfs (period of record 1984-1999 (BOR 2001)), respectively, to flows that more closely approximate natural, unregulated (*i.e.*, in the absence of Keechelus Dam) flow (300 to 700 cfs). In an intermediate water year (2.65 to 2.90 MAF), flow below Keechelus Dam will also increase, but the duration will most likely extend only from mid-March through April. Therefore, during the second construction season, discharges will more closely mimic natural streamflow in the Yakima River below Keechelus Dam, unless the runoff forecast is less than 2.65 MAF.

The natural, unregulated flow regime of the Yakima River below Keechelus Dam was the master variable that limited the distribution and abundance of riverine species and regulated the ecological integrity of the ecosystem via physicochemical processes that provide riverine structure and function (Leopold *et al.* 1964; Resh *et al.* 1988; Allan 1995; Power *et al.* 1995; Poff *et al.* 1997). Flow variability provides positive ecological benefits to floodplain ecosystems and the aquatic and terrestrial organisms that depend upon them (Williams and Hynes 1977; Chapman *et al.* 1982; Closs and Lake 1996). With respect to fisheries resources, the natural timing of variable flows provides numerous environmental cues such as spawning, egg hatching, rearing, movement to off-channel floodplain habitats for feeding or reproduction, and upstream or downstream migration (Seegrist and Gard 1978; Montgomery *et al.* 1983; Nesler *et al.* 1988; Junk *et al.* 1989; Welcomme 1992; Naesje *et al.* 1995; Sparks 1995; Trepanier *et al.* 1996, Poff *et al.* 1997). As the literature suggests, manipulating discharge from Keechelus Reservoir in a manner that more closely approximates the natural flow regime will promote physical, chemical, and biological mechanisms that benefit aquatic and floodplain species assemblages (including MCR steelhead). Furthermore, mimicking natural runoff during the second phase of reconstruction will promote a more normative ecosystem in the Action Area, as recommended for the entire Yakima Basin by SOAC (1998), if only for a few weeks. NMFS intends that this operational scenario will occur only in intermediate to wet water years, as described in Section I(B)(2)(a) and Table 2. Otherwise, operations below Keechelus Dam will approximate normal, regulated releases, and will therefore have no effect on the Flow/Hydrology pathway of the MPI, as compared to the environmental baseline.

d. Provision of Fall Spawning Flow. As described in Section I (B)(2)(f) of this BO, excavation and replacement of the maximum section and a 20-foot segment of the outlet conduit of Keechelus Dam will totally cutoff the Yakima River from its primary source of streamflow. Reclamation will install pumping plants and/or gravity-fed diversions to provide 100 cfs to the Yakima River for an estimated 20 days while the outlet conduit is replaced, with the caveat that no less than 70 cfs will be provided to the river while said discharge facilities are installed. Failure of this installation, resulting in the desiccation of the Yakima River, could produce catastrophic consequences to the salmonids below Keechelus Dam and the aquatic organisms on which they rely.

MCR steelhead and spring chinook are known to inhabit the reach of the Yakima River below Keechelus Dam (BOR 2000; Cupp 1997). Juvenile steelhead and spring chinook, adult spring chinook, and spring chinook embryos in newly deposited redds will be present during the period of time BOR must pump or divert water to the Yakima River below Keechelus Dam (mid-September to early October). As discussed in Section III (A), these salmonids, including MCR steelhead, have basic biological requirements. The most basic of these requirements is cool, flowing water (Spence *et al.* 1996). Should discharge cease for any period of time, acute and chronic effects including death, increased susceptibility to predators, physical damage (*e.g.*, descaling and dessication), and physiological damage (*e.g.*, gill damage, impaired liver function, exposure to warmer ambient temperatures) would endanger the entire aquatic species assemblage (including MCR steelhead) in the reach of the Yakima River directly below Keechelus Dam. The next tributary that contributes appreciable discharge to the Yakima River (Cabin Creek, RM 205) is 9.5 miles below the outlet works of Keechelus Dam, and it is not expected that tributary flow from other smaller streams and groundwater recharge would provide sufficient enough discharge to buffer the effects of a pump and/or gravity-fed diversion failure.

Reclamation will provide sufficient redundancy to those installations that will provide discharge to the Yakima River to prevent its dewatering. In addition, pumping and/or gravity-fed diversions will be monitored around the clock during replacement of a segment of the outlet conduit to ensure that secondary back ups will be initiated immediately, if needed. This operational plan should ensure there that there will be no short or long-term effects on MCR steelhead or their Critical Habitat from these activities.

2. Geomorphic Floodplain Alteration

The reconstruction of Keechelus Dam and its attendant construction elements (*i.e.*, downstream drain and right abutment cutoff wall) will produce a change in the structure and function of the floodplain of the Yakima River both at the construction site and downstream. Keechelus Dam will alter the timing and magnitude of runoff, disrupt and redirect shallow alluvial groundwater flow, and, over time, disrupt the natural cycling of sediments (further described in Section B(2)(b), below) and organic materials through the ecosystem.

Riverine structure and function are determined by the changing temporal interaction of the physical, chemical, and biological components of a river, along three physical dimensions: longitudinal (headwaters to downstream), vertical (water circulation into bed sediments of the channel and floodplain), and horizontal (water circulation onto and from floodplains) (Hynes 1983; Ward and Stanford 1995b). Floodplains, their riparian wetlands, and interconnected mosaics of aquatic and semi-aquatic habitats are integral components of rivers (Stanford and Gonser 1998), and the species that depend upon them for survival (Minshall *et al.* 1985; Stanford *et al.* 1996). Disconnecting river channels from their floodplain habitats by flow regulation and/or revetment can compromise the ecological integrity of riverine ecosystems (Sedell *et al.* 1990; Stanford and Hauer 1992; Ward and Stanford 1995a). Altering the runoff regime under which streams developed can produce channel forms that are dissimilar to the natural condition (Leopold *et al.* 1964), which can have corresponding detrimental effects to the organisms that coevolved within the same river system (Vannote *et al.* 1980; Wallace *et al.* 1982; Minshall *et al.* 1983).

As a matter of the environmental baseline, the existing dam disrupts the longitudinal (*e.g.*, capture of headwater discharge, organic and inorganic constituents), vertical (*e.g.*, flow regulation, structural control of the Yakima River by Keechelus Dam), and lateral (*e.g.*, flood control reduces seasonal timing and magnitude of discharge) connectivity of the Yakima River within the Action Area. In addition, the right abutment cutoff wall and downstream drain presently alter the distribution and delivery of shallow alluvial groundwater recharge to the Yakima River. This would be the case whether the existing dam remains in place or is replaced. Since the proposed action merely replaces the existing structure, it adds nothing to the environmental baseline and the functional condition of the Channel Condition and Dynamics pathway will remain the same in the Action Area.

B. Indirect Effects

Indirect effects are caused by the proposed action, are later in time, and are reasonably certain to occur (50 C.F.R. § 402.02). Indirect effects may occur outside of the area directly affected by the action. Indirect effects may include the effects of other Federal actions that have not undergone section 7 consultation, but will result from the action under consultation. These actions must be reasonably certain to occur, or be a logical extension of the proposed action. The indirect effects resulting from the proposed Keechelus Dam SOD project include (1) changing floodplain function by altering the sediment regime and disrupting shallow alluvial groundwater flow and (2) impacting fisheries and riparian habitat through manipulating flow and altering nutrient and sediment cycling.

1. Floodplain Function

a. Alteration of the Sediment Regime. Generally, sediment movement in streams is dependent upon two factors: (1) the availability of sediment in the drainage, and (2) the competency with which a stream transports sediment. Sediments (primarily fines and gravels) settle out in reservoirs where they remain trapped, unavailable to downstream reaches. Additionally, reservoirs release “hungry” water cleaned of suspended sediments that readily scours and erodes the stream channel below the impoundment (Reiser *et al.* 1989a). These effects are further expressed in downstream reaches, where erosion without sediment replacement can degrade streambank and floodplain structure and function (Lane 1955; Simons and Senturk 1977; Minshall *et al.* 1985; Heede 1986). These processes can inhibit channel and floodplain formation, often to the detriment of riparian and aquatic species. Floodplain processes dependent on sediment and chemical constituent delivery are disconnected, and the floodplain ecosystem often responds negatively (Stanford and Ward 1993). Correspondingly, the availability and cycling of sediment has a controlling influence on channel morphology, floodplain and channel complexity, and riparian species assemblages (Leopold *et al.* 1964; Gregory *et al.* 1991).

As a baseline matter, Keechelus Dam alters the sediment regime of the Yakima River in the Action Area. Headwater streams, such as that portion of the Yakima River and its tributaries impounded by Keechelus Dam, serve as the primary source for bank and bed materials within a watershed. Downstream recruitment of these particles is cutoff at Keechelus Dam, and must be supplied by tributaries in the Action Area. The magnitude and extent to which these tributaries contribute sediments is unknown, however, judging from the fact that MCR steelhead and spring chinook currently spawn in the Action Area, some contribution must exist. Additionally, as described above, alteration of the sediment regime affects channel and floodplain complexity, structure, and function. This would be the case whether the existing dam remains in place or is replaced by the proposed structure. Since the proposed action merely replaces the existing structure, it adds nothing to the environmental baseline and the functional condition of the Channel Condition and Dynamics, Habitat Elements, and Watershed Conditions pathways will remain the same in the Action Area.

b. Alteration of Shallow Alluvial Groundwater Flow. Historically, the hydrologic cycle in the Action Area was characterized by extensive exchange between surface waters and the shallow alluvial groundwater aquifer (Kinnison and Sceva 1963). Spring runoff, spread across the floodplain, would have recharged the alluvial aquifer and come back into the Yakima River as baseflow later in the season after the cessation of snowmelt runoff. This process was quantified in a similar alluvial valley of the unregulated Middle Fork Flathead River, Montana (Bansak 1998). Floodplain riparian species evolved under this mechanism, dependent on overbank recharge of the alluvial aquifer and easily accessible water (*i.e.*, high water table) flowing through the shallow aquifer itself (Ward and Stanford 1995b).

As a baseline matter, the existing dam alters the timing and magnitude of shallow alluvial aquifer flow associated with the Yakima River in the Action Area. The Keechelus embankment and its attendant construction elements (*e.g.*, right abutment cutoff wall, downstream drain and outlet conduit) disrupts groundwater flow across the floodplain and channels it into one of two discharge points: the outlet conduit or the ends of the downstream drain. This mechanism alters the timing and delivery of groundwater flow to the floodplain habitats of the Yakima River by delivering aquifer flow faster and in different locations than under natural conditions. This would be the case whether the existing dam remains in place or is replaced by the proposed structure. Since the proposed action merely replaces the existing structure, it adds nothing to the environmental baseline and the functional condition of the Channel Condition and Dynamics, Habitat Elements, and Watershed Conditions pathways will remain the same in the Action Area.

2. Riparian and Fisheries Habitat

a. Flow Manipulation. Flow regulation below reservoirs can substantially alter riparian and fisheries habitat. In a natural condition, river ecosystems experience a range of flows that serve to promote floodplain riparian ecosystems, provide habitat for aquatic species assemblages, and protect vital ecosystem linkages and channel structure (Leopold *et al.* 1964; Ward and Stanford 1995a; 1995b; Fisher *et al.* 1998). Reservoir management scenarios can differentially affect fisheries habitat by manipulating discharge such that there is too much or conversely, too little flow, thus providing the impetus for instream flow-related issues (Reiser *et al.* 1989b). Flow regimes that deviate from the natural condition are well understood to produce a diverse array of negative ecological consequences (Hill *et al.*1991; Richter *et al.* 1996; Stanford *et al.* 1996). Periodic flooding redeposits silts, provides passage for biota to and from floodplain habitats, leads to extensive nutrient transformations, promotes channel maintenance, facilitates floodplain storage and enhances floodplain biodiversity and production (Bayley 1991; Junk *et al.* 1989; Sedell *et al.* 1989; Power *et al.* 1995).

As previously discussed in Section III (C), the operation of Keechelus Dam has a profound and controlling effect on discharge levels in the upper Yakima River. The magnitude and frequency of floods, habitat availability, and ecologic integrity of the river and its adjacent floodplain are greatly impacted. This would be the case whether the existing dam remains in place or is replaced as proposed. Since the proposed action merely replaces the existing structure, it adds nothing to the environmental baseline and the functional condition of the Channel Condition and Dynamics, Habitat Elements, Flow/Hydrology, and Watershed Conditions pathways will remain the same in the Action Area.

b. Alteration of Nutrient, Sediment Cycling and Hyporheic Habitat. As previously described above in Section 1(a), alteration of the sediment regime of a river system can have deleterious effects to physical riverine habitat processes. Those same effects can correspondingly impact fisheries habitat via a number of different mechanisms. Altered flow regimes (from an unregulated condition) can impact hydraulic parameters with associated biologic components (*i.e.*, sediment transport, gravel recruitment and bank stability and morphology) that are important to riverine fish species (O'Brien 1984, Waters 1995). Gravels trapped behind a dam are no longer available to downstream reaches for bank and bed formation/maintenance, and can limit spawning substrate for salmonids (Moreau 1984; Ramey *et al.* 1987). Furthermore, as previously described above in Section (A)(2), disruptions in the longitudinal, vertical, and lateral connectivity of river systems can also impact nutrient cycling (*e.g.*, overbank flooding that provides floodplain nutrients) such that aquatic and riparian species are detrimentally impacted (Newbold *et al.* 1981; 1982; Green and Kauffman 1989; Gibert *et al.* 1994; Stanford *et al.* 1994; Fisher *et al.* 1998). Three-dimensional connectivity in alluvial rivers is also vital to supporting hyporheic habitats that support myriad biophysical processes (Stanford and Ward 1993).

As a matter of the environmental baseline, Keechelus Dam and its attendant construction elements (*i.e.*, downstream drain and right abutment cutoff wall) disrupts hyporheic habitat across the floodplain of the Yakima River, traps spawning gravels that are important substrates for salmonids, alters nutrient cycling in the Action Area, and impacts other hydraulic parameters that have important biological associations. This would be the case whether the existing dam remains in place or is replaced as proposed. Since the proposed action merely replaces the existing structure, it adds nothing to the environmental baseline and the functional condition of the Channel Condition and Dynamics, Habitat Elements, and Watershed Conditions pathways will remain the same in the Action Area.

C. Population Level Factors

Under the environmental baseline, life history diversity has been limited by the influence of hatchery fish, by physical barriers that prevent migration to historical spawning or rearing areas, and by water temperature barriers that influence the timing of emergence, juvenile growth rates, or the timing of upstream or downstream migration. The reconstruction of the existing barrier dam at Keechelus Dam is expected to add temporary, construction related effects to the existing environmental baseline. These effects, detailed above, are not expected to have any significance at the population level. Therefore, the Services believe the proposed action does not contain measures that are likely to adversely affect the population trends, habitat and hydrology, life-history diversity, or the influence of hatcheries on the ESU compared to conditions under the environmental baseline.

D. Effects on Critical Habitat

The NMFS designates Critical Habitat for a listed species based upon physical and biological features that are essential to that species. Essential features of Critical Habitat for the MCR steelhead ESU include substrate, water quality/quantity, water temperature, water velocity, cover/shelter, food, riparian vegetation, space, and safe passage conditions (65 Fed. Reg.7764, February 16, 2000).

The direct and indirect effects previously discussed include effects on Critical Habitat to a limited extent. The avenues in which Critical Habitat may be affected are apparent in the MPI analysis: specifically, in the Flow/Hydrology, Water Quality, Habitat Elements, Channel Condition and Dynamics, Watershed Conditions, and Habitat Access pathways. Within these pathways, and when considering the action under consultation in comparison to the environmental baseline, the functional quality of most indicators will be maintained. The exceptions are the temporary effects of turbidity/sediment and possible chemical contamination which could briefly degrade indicators in the Water Quality pathway (Sediment/Turbidity and Chemical Contamination/Nutrients indicators). Relating these indicators back to essential habitat elements, under the assumption that BOR effects all water quality, revegetation and rehabilitation procedures, the primary impact of this action could be a short-term decline in water quality and substrate conditions.

The long-term effects of the project are likely to maintain the environmental baseline. Accordingly, the proposed action is unlikely to diminish the value of the affected habitat elements to the survival and recovery of MCR steelhead.

V. CUMULATIVE EFFECTS

Cumulative Effects are defined in 50 C.F.R. § 402.02 as "those effects of future state or private activities, not Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation." For this analysis, cumulative effects for the general action area are considered. Future Federal actions, including the ongoing operation of hatcheries, irrigation projects, fisheries, and land management activities have been or will be reviewed through separate Section 7 consultation processes.

It is expected that a range of non-Federal activities would occur within the Yakima River Basin for the purposes of restoring and enhancing fish habitat. These activities would likely include installing fish screens, improving flow management and irrigation efficiency, restoring instream and riparian habitat, and removing barriers to passage. Although the specific details of individual projects are lacking, it is assumed that non-Federal conservation efforts would continue or increase in the near future.

In addition to potential beneficial projects, it is also likely that much of the private land management and water regulation will continue under existing conditions. Specific activities such as farming in or adjacent to sensitive riparian areas, allowing livestock to access Critical Habitat, and tributary diversions that (1) remove large volumes of water and (2) block access to quality habitats will continue to adversely affect listed MCR steelhead.

VI. CONCLUSION/OPINION

NMFS jeopardy analysis is based upon the current status of the species, the environmental baseline for the action area, and the effects of the proposed action. The analysis takes into account the species' status because determining the impact upon a species' status is the essence of the jeopardy determination. Depending upon the specific considerations of the analysis, actions that are found likely to impair currently properly functioning habitat, appreciably reduce the functioning of already impaired habitat, or retard the long-term progress of impaired habitat towards PFC at the population or ESU scale will generally be determined likely to jeopardize the continued existence of listed salmon, adversely modify their critical habitat, or both. Specific considerations include whether habitat condition was an important factor for decline in the listing decision, changes in population or habitat conditions since listing, and any new information that has become available (NMFS 1999).

The proposed action is the replacement of the Keechelus Dam embankment within its existing footprint. The construction activities that comprise the proposed action will cause direct effects of short duration. The identified effects of the action include (1) a temporary increase in turbidity that could occur during embankment excavation and replacement, (2) introduction of hydrocarbons to the Yakima River and its adjacent floodplain, and (3) failure of pumping plants and/or gravity-fed diversions that provide discharge to the Yakima River. Although these effects are reasonably certain to cause or equal take, the risk of take will be minimized by the implementation of conservation measures, WDFW HPA provisions, construction timing, and BA Addendums #1 and #2. Other than these temporary effects of construction, the proposed action adds nothing to the existing environmental baseline in the action area. Therefore, the proposed action is not likely to impair currently properly functioning habitat, appreciably reduce the function of already impaired habitat, or retard the progress of impaired habitat to properly functioning condition. Furthermore, and for the same reasons, NMFS concludes that the proposed action includes no activities that are likely to adversely affect the species at the population level. Accordingly, NMFS determines that the proposed action is not likely to jeopardize, nor adversely modify or destroy the critical habitat of middle-Columbia River Steelhead.

VII. REINITIATION OF CONSULTATION

Consultation must be reinitiated if (1) the amount or extent of taking specified in the Incidental Take Statement is exceeded, or is expected to be exceeded; (2) new information reveals effects of the action may affect listed species in a way not previously considered; or (3) a new species is listed or Critical Habitat is designated that may be affected by the action (50 C.F.R.§ 402.16). The NMFS will be monitoring the listed reasonable and prudent measures and terms and conditions of the incidental take statement. The NMFS may reinitiate consultation if the above measures are not adequately completed, resulting in increased probability of take to listed species. To reinitiate consultation, the BOR must contact the Habitat Conservation Division (Washington Branch Office) of NMFS.

VIII. INCIDENTAL TAKE STATEMENT

Section 9 of the ESA prohibits any taking (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in any such conduct) of listed species without a specific permit or exemption. Section 4(d) enables the extension of this prohibition to animals listed as "Threatened" under the ESA. Harm is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as spawning, rearing, feeding, and migrating (50 C.F.R. § 222.106; 64 Fed. Reg. 60727; November 8, 1999). Incidental take is take of listed animal species that results from, but is not the purpose of, the Federal agency or applicant carrying out an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to, and is not intended as part of, the agency action is not considered prohibited taking provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are non-discretionary; in order for the exemption in section 7(o)(2) to apply, they must be implemented by the action agency so that they become binding conditions of any grant or permit issued to the applicant as appropriate. The BOR has a continuing duty to regulate the activity covered in this incidental take statement. If the BOR fails to retain the oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse.

An incidental take statement specifies the impact of any incidental taking of endangered or threatened species. The take statement also provides reasonable and prudent measures that are necessary to minimize impacts and sets forth terms and conditions with which the action agency must comply in order to implement the reasonable and prudent measures.

A. Amount or Extent of Take

As stated in section II, above, listed steelhead use the upper Yakima River for both spawning and rearing. Based on information reported in Phelps *et al.* (2000), Hockersmith *et al.* (1995), and Busack *et al.* (1991), MCR steelhead are in the action area every day of the year. Therefore, there exists at least a reasonable certainty that take of MCR steelhead will occur incidental to the proposed action. Accordingly, the following reasonable and prudent measures and terms and conditions are required to minimize the risk of take. Despite the use of the best scientific and commercial data available, NMFS cannot estimate a specific amount of incidental take of individual fish. However, the mechanisms of expected effects are summarized below. For a more detailed discussion of the mechanisms by which take could occur, the reader is encouraged to refer to Section IV (A) of this BO.

The NMFS believes that there are three primary mechanisms by which take could occur. Direct harm or injury may result from near-water construction (turbidity), machinery activities within the construction area, contractor staging and stockpile areas (fuels and lubricants), and failure of pumping plants and/or gravity-fed diversions (dewatering) that supply discharge to the Yakima River while a section of the outlet conduit is replaced. The extent to which these mechanisms can result in effects on listed steelhead or their habitat can be described qualitatively, enabling reinitiation of consultation if such effects are exceeded during the project: (1) turbidity increases will not extend further downstream than Lake Easton, (2) all hydrocarbons will be properly handled and disposed, and (3) sufficient redundancy will be in place to assure that at no time during replacement of a section of the outlet conduit will pumping and/or gravity-fed diversions fail to supply 100 cfs (or 70 cfs for 24 hours while pump and/or diversion facilities are installed) to the Yakima River below Keechelus Dam. The NMFS does not expect any additional take through the indirect effects of the proposed activities.

B. Reasonable and Prudent Measures

The NMFS believes that the following reasonable and prudent measures (RPMs) are necessary and appropriate to minimizing take of MCR steelhead. These RPMs are integrated into the BA and proposed project, and NMFS has included them here to provide further detail as to their implementation.

1. The BOR will minimize take by incorporating BMPs to reduce potential impacts of staging and construction activities within the defined construction area.

2. The BOR will minimize take by incorporating BMPs to reduce potential impacts of any construction activities that occur near wetlands, Keechelus Lake or the Yakima River.

3. The BOR will minimize take by incorporating appropriate construction timing restrictions.

4. The BOR will minimize take by drafting the reservoir to target elevation in a manner that does not exacerbate high flow problems between mid-June and July. If the March runoff forecast is greater than 2.9 MAF, the total discharge from mid-March to May will be up to 18,000 ac-ft greater than normal operations, more closely mimicking the natural hydrograph.

5. The BOR will minimize take by providing pumping and/or gravity-fed diversion facilities, with sufficient redundancy, that supply no less than 100 cfs to the Yakima River below Keechelus Dam while a 20-foot segment of the outlet conduit is removed and replaced.

C. Terms and Conditions

To be exempt from the prohibitions of section 9 of the ESA, the BOR must ensure compliance with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are non-discretionary.

1. Implement RPM #1 by conducting the following:

    a. A temporary erosion and sediment control (TESC) plan will be implemented.

b. A spill prevention, control, and containment (SPCC) plan will be implemented.

c. All heavy equipment will be clean and free of external oil, fuel, or other potential pollutants.

d. Constructed wetlands will mimic native conditions to the fullest extent possible.

e. Disturbed riparian and wetland areas will be replanted.

f. All planting will use native species appropriate for riparian and wetland use.

2. Implement RPM #2 by conducting the following:

   a. Heavy equipment will not enter Keechelus Lake, the Yakima River, or any wetlands that discharge to the Yakima River.

   b. Construction activities taking place near the Yakima River, spillway channel, outlet conduit, and control tower will take all precautions to eliminate sediment introduction to the Yakima River.

   c. Stockpile and borrow areas will be protected per BA Addendum #1 (Best Management Practices to Protect Water Quality).

   d. Construction-related fuels and lubricants (PAH) will be distributed and handled per BA Addendum #1 (Best Management Practices to Protect Water Quality).

3. Implement RPM #3 by conducting the following:

   a. Construction will only take place between May 15 and November 15 of any calendar year.

4. Implement RPM #4 by conducting the following:

   a. Pursuant to the March runoff forecast of the Phase 2 construction year, BOR will follow reservoir restrictions as outlined in Table 2 of this BO, and operate Keechelus Dam to release excess storage by increasing discharge in the Yakima River from mid-March through May.

b. RPM 4(a) will occur only when the March through May forecasted runoff is 2.9 MAF or higher.

5. Implement RPM #5 by conducting the following:

a. Pumping installations and/or gravity-fed diversions will be sufficient to provide at least 100 cfs to the Yakima River below Keechelus Dam during the estimated 20-day construction period necessary for removal and replacement of a 20-foot segment of the outlet conduit.

b. Sufficient redundancy in either pumping installations and/or gravity-fed diversions will be in place such that, in the event of failure, back up operations will be started immediately to provide no less than 100 cfs to the Yakima River below Keechelus Dam.

c. Pumping and/or gravity-fed diversions will be monitored 24 hours per day for their entire period of operation to ensure that no lapse in the provision of 100 cfs to the Yakima River below Keechelus Dam occurs.

IX. CONSERVATION RECOMMENDATIONS

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

BOR should follow through with their commitment to study the feasibility of fish passage at each of the five project impoundments (Keechelus, Kachess, Cle Elum, Rimrock, and Bumping Reservoirs). This effort could initiate the means by which extirpated salmonids can be reintroduced to their extant habitats. Such an action would increase the biodiversity of the Yakima River Basin, and could increase its ecological integrity.

The Keechelus to Lake Easton reach of the Yakima River should be surveyed and analyzed by BOR to determine the relationship between discharge released from Keechelus Reservoir and the subsequent availability of vital side-channel habitats. At present, this relationship has not been quantified and doing so would help to define discharge levels that promote more ecologically meaningful salmonid habitat in the Action Area.
At present, downstream floodplain are in danger of development due to a perceived amount of flood protection afforded by Keechelus Dam. BOR should survey the amount and extent of

floodplain acreage suitable for development pursuant to regulated flood flow, and provide an analysis of development potential based on their survey results. These data would provide insight for developers, and could preclude future exploitation of floodplain habitats that are vital ecosystem components of MCR Critical Habitat.

Furthermore, under the Yakima River Basin Water Enhancement Project (YRBWEP; P.L. 96-162), BOR should investigate opportunities to acquire intact floodplain properties that provide ecosystem connectivity. Additionally under YRBWEP, BOR should encourage exploration of mechanisms to increase irrigation efficiency and conservation, especially those that reduce KRD's reliance on Keechelus storage. This would serve to decrease the amount of detrimental flow manipulation that occurs in the Keechelus to Lake Easton reach of the Yakima River.

Finally, BOR should explore acquisition and/or improved management influence of tributary habitats in the Yakima Basin to mitigate for lost habitats upstream of Keechelus Dam. Tributary habitats provide valuable ecological functions to MCR steelhead and other salmonids, and increasing the number and extent of this type of habitat could promote the survival and recovery of listed species.

The NMFS must be kept informed of actions minimizing or avoiding adverse effects, or those that benefit listed species or their habitat. Accordingly, NMFS requests notification of the implementation of any conservation recommendations.

X. ESSENTIAL FISH HABITAT

A. Background

The Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), established procedures designed to identify, conserve, and enhance Essential Fish Habitat (EFH) for those species regulated under a Federal fisheries management plan. Pursuant to the MSA:

- Federal agencies must consult with NMFS on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH (§305(b)(2));

- NMFS shall provide conservation recommendations for any Federal or State activity that may adversely affect EFH (§305(b)(4)(A));

- Federal agencies shall within 30 days after receiving conservation recommendations from NMFS provide a detailed response in writing to NMFS regarding the conservation recommendations. The response shall include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with the conservation recommendations of NMFS, the Federal agency shall explain its reasons for not following the recommendations (§305(b)(4)(B)).

EFH means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (MSA §3). 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 and may include aquatic areas historically used by fish where appropriate; 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, or growth to maturity" covers a species' full life cycle (50 CFR 600.110). Adverse effect means any impact which reduces quality and/or quantity of EFH, and may include direct (*e.g.*, contamination or physical disruption), indirect (*e.g.*, loss of prey or reduction in species fecundity), site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810).

Any reasonable attempt to encourage the conservation of EFH must take into account actions that occur outside EFH, such as upstream and upslope activities, that may have an adverse effect on EFH. Therefore, EFH consultation with NMFS is required by Federal agencies regarding any activity that may adversely affect EFH, regardless of its location.

The objective of this Essential Fish Habitat (EFH) consultation is to determine whether the proposed action may adversely affect designated EFH, and to recommend conservation measures to avoid, minimize, or otherwise offset potential adverse impacts to EFH resulting from the proposed action.

B. Identification of EFH

Pursuant to the MSA, the Pacific Fisheries Management Council (PFMC) has designated EFH for federally-managed fisheries within the waters of Washington, Oregon, and California. Freshwater EFH for Pacific salmon includes all those streams, lakes, ponds, wetlands, and other water bodies currently, or historically accessible to salmon in Washington, Oregon, Idaho, and California, except areas upstream of certain impassable man-made barriers (as identified by the PFMC), and longstanding, naturally-impassable barriers (*i.e.*, natural waterfalls in existence for several hundred years). Detailed descriptions and identifications of EFH for salmon are found in Appendix A to Amendment 14 to the Pacific Coast Salmon Plan (PFMC 1999). Assessment of the impacts to these species' EFH from the proposed action is based, in part, on this information.

C. Proposed Actions

The proposed action and action areas are detailed above in Section I of this BO. These action areas contain habitats that have been designated as EFH for various life stages of chinook and coho salmon.

D. Effects of Proposed Action

As described in detail in Section IV of this BO, the proposed activities may result in detrimental short-term impacts to designated EFH. These impacts include increased turbidity, possible contamination by chemical constituents, flow manipulation, and the danger of dessication due to pump and/or gravity-fed diversion failure during the spring chinook spawning period.

E. Conclusion

NMFS believes that the proposed action may adversely affect designated EFH for chinook and coho salmon.

F. EFH Conservation Recommendations

Pursuant to Section 305(b)(4)(A) of the MSA, NMFS is required to provide EFH conservation recommendations to Federal agencies regarding actions which may adversely affect EFH. While NMFS understands that the conservation measures described in the BO will be implemented by the BOR, it does not believe that these measures are sufficient to address the adverse impacts to EFH described above. However, the Terms and Conditions outlined in Section VII are generally applicable to designated EFH for Pacific salmon and address these adverse effects. Consequently, NMFS recommends that they be adopted as EFH conservation measures. If implemented by the BOR, these measures will minimize the potential adverse impacts of the proposed project and conserve EFH.

G. Statutory Response Requirement

Please note that the Magnuson-Stevens Act and 50 CFR 600.920(j) require the Federal agency to provide a written response to NMFS' EFH conservation recommendations within 30 days of its receipt of this letter. The response must include a description of measures proposed to avoid, mitigate, or offset the adverse impacts of the activity. In the case of a response that is inconsistent with the EFH Conservation Recommendations, the response must explain the reasons for not following the recommendations, including the scientific justification for any disagreements over the anticipated effects of the proposed action and the measures needed to avoid, minimize, mitigate, or offset such effects.

H. Supplemental Consultation

The BOR must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a manner that may adversely affect EFH, or if new information becomes available that affects the basis for NMFS' EFH conservation recommendations (50 CFR 600.920(k)).

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