**UNITED STATES DEPARTMENT OF COMMERCE**
**National Oceanic and Atmospheric Administration**
NATIONAL MARINE FISHERIES SERVICE
Northwest Region
7600 Sand Point Way N.E., Bldg. 1
BIN C15700
Seattle, WA 98115-0070

Refer to:
2002/00177

July 17, 2002

Ms. Nancy Weintraub
Bonneville Power Administration
P.O. Box 3621
Portland, Oregon 97208-3621

Re: Endangered Species Act Section 7 Formal Consultation and Magnuson-Stevens Act Essential Fish Habitat Consultation for the McCoy Meadows Restoration Project, Upper Grande Ronde River Subbasin, Union County, Oregon.

Dear Ms. Weintraub:

Enclosed is a biological opinion (Opinion) prepared by the National Marine Fisheries Service (NOAA Fisheries) pursuant to section 7 of the Endangered Species Act (ESA) on the effects of the proposed McCoy Meadows Restoration Project in Union County, Oregon. In this Opinion, NOAA Fisheries concludes that the proposed action is not likely to jeopardize the continued existence of ESA-listed Snake River (SR) steelhead *(Oncorhynchus mykiss)* or SR spring/summer chinook salmon *(O. tshawytcha)*, or destroy or adversely modify designated critical habitat. As required by section 7 of the ESA, NOAA Fisheries includes reasonable and prudent measures, with nondiscretionary terms and conditions, that NOAA Fisheries believes are necessary to minimize the impact of incidental take associated with this action.

The attached biological opinion contains an analysis of the effects of the proposed action on designated critical habitats. Shortly before the issuance of this opinion, however, a federal court vacated the rule designating critical habitat for the Snake River steelhead, but not for Snake River spring/summer chinook salmon. The analysis and conclusions regarding critical habitat remain informative for our application of the jeopardy standard to Snake River steelhead even though they no longer have independent legal significance for that ESU. Also, if critical habitat is redesignated for Snake River steelhead before this action is fully implemented, the analysis will be relevant when determining whether a reinitiation of consultation will be necessary at that time. For these reasons and the need to timely issue this opinion, our critical habitat analysis for Snake River steelhead has not been removed from this opinion.

This Opinion also serves as consultation on essential fish habitat for chinook salmon under Public Law 104-267, the Sustainable Fisheries Act of 1996, as it amended the Magnuson-Stevens Fishery Conservation and Management Act.

If you have any questions regarding this consultation, please contact Catherine Broyles, of my staff, in the Oregon Habitat Branch at 541.975.1835 x223.

Sincerely,

for Michael R Crouse

D. Robert Lohn
Regional Administrator

cc: Mark Robertson, USFWS
Allen Childs, CTUIR
Vance McGowan, ODFW

Endangered Species Act - Section 7 Consultation
&
Magnuson-Stevens Act
Essential Fish Habitat Consultation

# BIOLOGICAL OPINION

McCoy Meadows Restoration Project
Union County, Oregon

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|---|---|
| Agency: | Bonneville Power Administration |
| Consultation Conducted By: | NOAA Fisheries,<br>Northwest Region |
| Date Issued: | July 17, 2002 |
| Issued by: | for Michael R Course<br>D. Robert Lohn<br>Regional Administrator |
| **Refer to:** | **OHB2002-0071-FEC** |

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# 1. ENDANGERED SPECIES ACT

## 1.1 Background

On March 25, 2002, the National Marine Fisheries Service (NOAA Fisheries) received a letter dated March 21, 2002, and an attached biological assessment (BA), from the Bonneville Power Administration (BPA) requesting Endangered Species Act (ESA) section 7 formal consultation regarding the potential effects of the actions associated with the third and final phase of the McCoy Meadows Restoration Project on Snake River (SR) steelhead and SR spring/summer chinook salmon and their designated critical habitat. The project area is approximately 20 miles southwest of La Grande, Oregon, near Starkey, in Union County. The action area is located on the privately-owned 2,500 acre McCoy Meadows Ranch within the Upper Grande Ronde River (UGRR) drainage, in the upper portion of the UGRR subbasin (USGS HUC 17060104). This project is funded by the BPA, and administered by the Confederated Tribes of the Umatilla Indian Reservation (CTUIR), with technical assistance from the Oregon Department of Fish and Wildlife (ODFW) and the National Resource Conservation Service (NRCS).

The BPA has determined that SR steelhead and SR spring/summer chinook salmon may occur within the project area. The SR steelhead were listed as threatened on August 18, 1997 (62 FR43937) and SR spring/summer chinook salmon were listed as threatened on April 22, 1992 (57 FR 14653). Protective regulations for SR steelhead were issued under section 4(d) of the ESA on July 10, 2000 (65 FR 42422). The proposed project is within critical habitat for SR spring/summer chinook salmon, designated on December 28, 1993 (58 FR 68543).

The attached biological opinion contains an analysis of the effects of the proposed action on designated critical habitats. Shortly before the issuance of this opinion, however, a federal court vacated the rule designating critical habitat for the Snake River steelhead, but not for Snake River spring/summer chinook salmon. The analysis and conclusions regarding critical habitat remain informative for our application of the jeopardy standard to Snake River steelhead even though they no longer have independent legal significance for that ESU. Also, if critical habitat is redesignated for Snake River steelhead before this action is fully implemented, the analysis will be relevant when determining whether a reinitiation of consultation will be necessary at that time. For these reasons and the need to timely issue this opinion, our critical habitat analysis for Snake River steelhead has not been removed from this opinion.

This consultation process involved a site visit on November 19, 2001, follow-up correspondence, and verbal communications to clarify information provided in the BA, all of which are included herein as reference. The purpose of this Opinion is to determine whether the actions involved in the McCoy Meadows Restoration Project in Union County are likely to jeopardize the continued existence of SR steelhead, SR spring/summer chinook salmon, or result in the destruction or the adverse modification of chinook salmon critical habitat.

## 1.2 Proposed Action

This Opinion addresses the actions associated with the final phase of the McCoy Meadows Restoration Project. Resource restoration activities originally began in the McCoy Meadows area in 1988, with the construction of approximately eight miles of livestock exclusion fence along Meadow Creek and the channelized McCoy Creek. Livestock have not been permitted to enter riparian areas since the fence was constructed, and will continue to be excluded in years to come. The overall objective of the project is to restore the natural character and function of the meadow complex, along with its accompanying wetlands, flood plains, and meandering stream channel. Habitat restoration work completed under the first phase of the project included: Relocation of a segment of McCoy Creek, at river mile 1.5, from its previous channelized configuration to its pre-1977 meander channel; placement of woody debris; and extensive riparian shrub and tree planting. This first phase resulted in the restoration of approximately 1,500 linear feet of stream channel, increased stream channel sinuosity, reduced width/depth ratio, improved instream structural diversity, increased riparian shrub and wetland obligate herbaceous species, and improved water quality.

During July-September 2000, the majority of the second phase of the project was completed. Habitat restoration work completed during this time included: Construction of 6,500 feet of new channel; installation of twelve grade-control structures within the channelized reach of McCoy Creek; and the planting of willows and grass/forb seeds along the streambanks. In October 2001, a bridge was constructed on the McIntyre Creek road to accommodate the McCoy Creek restoration channel. During this same time period, six miles of fence were relocated and/or constructed in order to define a permanent conservation easement, secured through the Federal Wetland Reserve Program, on the privately owned McCoy Meadows Ranch. The following activities are associated with Phase 3 of the project, scheduled to begin July 15, 2002, with completion scheduled for late September/early October 2002.

### 1.2.1 Construction of the Remaining Restoration Channel Segments

Approximately 300 linear feet of restoration channel remains to be constructed to connect the restoration channel network. The constructed channel will have variations in width and depth to create pool and riffle sequences according to a specific geomorphic template that is included as a part of the McCoy Creek Restoration Design Report (NRCS 2000). Variations in channel geometry are designed to dissipate energy, transport anticipated sediment loads, and erode channel banks at rates similar to historic rates. Specific channel design criteria include: Average depth of 2.4 feet, velocity 4.9 feet/second, channel gradient 0.005, channel forming flow (bank full channel) of 270 cubic feet per second (cfs), width/depth ratio of 9:1, channel width of 23 feet, cross-sectional area of 56 $ft^2$, and a sinuosity of 1.5.

Channel excavation work will be completed prior to the diversion of McCoy Creek. The majority of the work will be conducted under dry channel conditions, with the exception of two locations where the restoration channel crosses the existing channelized reach. The exact location of these two sites can be seen on the maps on pages 3 and 4 of the BA. Specific actions

involved in channel construction include: Excavation of soil and gravel (23-foot channel width cross-sectional area of 56 ft²), shaping point bars, cutting and shaping outside meanders, riffle/channel cross-over sections, channel thalweg, and shaping terraces and/or streambank slopes (generally a 3:1 ratio). Excavated materials will be loaded and hauled in dump trucks to designated stockpile locations for installation in the abandoned stream reach.

### 1.2.2 Fish Salvage Operations and Channel Diversion

Trap-and-haul operations will be initiated in the middle of July 2002, and completed by July 31, 2002. ODFW and CTUIR crews will conduct population surveys to assess population numbers in the project area before trapping fish. Three 50-meter index sites will be surveyed within the 4,000-foot stream reach. Data provided through this effort will allow biologists to assess the magnitude of the effort and setup requirements for the trap-and-haul. Following completion of index site surveys, ODFW/CTUIR crews will initiate trap-and-haul efforts along the entire 4,000-foot reach until all fish are removed.

The upper and lower reaches of the project area will be block-netted to prevent movement of fish into the Phase 3 project reach. Seine nets will be used where possible to capture and remove fish. A Smith-Root Model 12A POW electroshocker will be used to capture the remaining fish. Fish transport will be conducted using two six-wheel all-terrain vehicles (ATVs) with integrated utility beds for secured storage of the aerated 64-quart coolers that will be used to hold the fish during transport. Water temperatures will be monitored continuously to ensure that fish avoid thermal stress during transport. All fish salvaged from the channel will be relocated to designated sections upstream of the area being dewatered.

Following completion of initial trap-and-haul efforts, McCoy Creek will be diverted into the restoration channel. The diversion will be done in two steps, beginning with the lower diversion located in the meadow downstream of McIntyre Road, followed by the diversion in the upper meadow. Diversions will be accomplished by initially constructing a small, earthen plug to divert water into the restoration channel, followed by complete installation of earthen plugs and rootwad revetments. As soon as the diversion structure is constructed and McCoy Creek is diverted into the restoration channel, ODFW and CTUIR crews will continue with trap-and-haul operations in the abandoned reaches of the stream in order to salvage any remaining fish that were not captured during initial efforts. If necessary, staff will conduct snorkeling in the abandoned channel to determine whether any fish remain. Following completion of trap-and-haul in the lower reach, crews will move to the upper reaches and follow the same procedures that are described above.

### 1.2.3 Reclamation Activities in the Abandoned Channel

Following the removal of fish and the completion of the channel diversion, reclamation activities in the abandoned channel will be initiated. Reclamation activities will include filling approximately 50% of the abandoned channel with earthen material and decommissioning a

culvert that runs beneath McIntyre Road. Construction associated with these activities would begin in early August, and be completed by October 2002.

Filling the Abandoned Channel

Material acquired from restoration channel excavation will be used to construct compacted, earthen plugs and blended terraces at several strategic locations. Specific sites are indicated in figure 4 on page 11 of the BA. Compaction of fill material will be accomplished by backfilling 12- to16-inch layers, and operating heavy equipment over individual lifts. In conjunction with earthen plugs and backfilling, the existing floodplain ponds will be shaped into oxbows and meanders with bulldozers and track-mounted excavators to develop macrotopographic basins. Pond location and shape will take advantage of existing channel swales where possible, in order to minimize equipment operation and maximize integration of the existing native floodplain/hydrophytic vegetation (*i.e.* rushes, sedges, and willows). Blended terraces will be utilized to control floodplain flood-flow and to minimize entrance into reclaimed channelized reaches. Terraces will generally be constructed with an elevation approximately one-foot higher than the surrounding floodplain, and consist of compact fill material. Terraces will be developed into upland inclusions with respective native grassland communities.

Decommissioning the McIntyre Road Culvert

The existing concrete triple culvert structure on the McIntyre Road will be decommissioned. This will entail caving in the concrete culverts and plugging them with soil, gravel, and rock. No concrete or other fill material will be used. Construction will be performed with a track-mounted excavator.

## 1.3 Biological Information and Critical Habitat

The listing status and critical habitat designation of SR spring/summer chinook salmon and SR steelhead are outlined in section 1.4 of this Opinion. Biological information for SR steelhead is found in Busby *et al.* (1996). Information for SR spring/summer chinook salmon may be found in Mathews and Waples (1991), and summarized in Myers *et al.* (1998).

The proposed actions discussed within this Opinion are within designated critical habitat for SR spring/summer chinook salmon. Critical habitat for SR spring/summer chinook salmon was designated on December 28, 1993 (58 FR 68543). Critical habitat for SR spring/summer chinook salmon encompasses the major Columbia River tributaries known to support this evolutionarily significant unit (ESU), including the Salmon, Grande Ronde, Imnaha, Deschutes, John Day, Klickitat, Umatilla, Walla Walla, and Yakima Rivers, as well as the Columbia River and estuary. Critical habitat consists of all river reaches below impassable natural falls and all riparian areas within 300 feet, therefore includeing the McCoy Creek project area. The riparian zone adjacent to these waterways is also considered critical habitat. This zone is defined as the area that provides the following functions: Shade, sediment, nutrient/chemical regulation, stream bank stability, and input of large woody debris/organic matter.

Essential features of the adult spawning, juvenile rearing, and adult migratory habitat for the SR steelhead and chinook salmon are: Substrate, water quality, water quantity, water temperature, water velocity, cover/shelter, food, riparian vegetation, space, and safe passage conditions. The essential features that this project may affect are: Substrate, water quality, water temperature, water velocity, cover/shelter, food, and riparian vegetation.

## 1.4 Evaluating Proposed Actions

The standards for determining jeopardy are set forth in section 7(a)(2) of the ESA as defined by 50 CFR Part 402 (the consultation regulations). NOAA Fisheries 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.

Subsequently, NOAA Fisheries 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, NOAA Fisheries must consider the estimated level of 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 salmonid's life stages that occur beyond the action area. If NOAA Fisheries finds that the action is likely to jeopardize, NOAA Fisheries must identify reasonable and prudent alternatives for the action.

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

For the proposed action, NOAA Fisheries' analysis considers direct or indirect mortality of fish attributable to the action. NOAA Fisheries' critical habitat analysis considers the extent to which the proposed action impairs the function of essential elements necessary for juvenile and adult migration, spawning, and rearing of the SR spring/summer chinook salmon and SR steelhead under the existing environmental baseline.

### 1.4.1. Biological Requirements

The first step NOAA Fisheries uses for applying the ESA section 7(a)(2) to listed salmon and steelhead is to define the species' biological requirements that are most relevant. NOAA Fisheries 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, NOAA Fisheries starts with the determinations made in its decision to list SR chinook salmon and SR steelhead for ESA protection, and also considers new data available that is relevant to the determination.

The relevant biological requirements are those necessary for SR spring/summer chinook salmon and SR steelhead 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.

For this consultation, the biological requirements are improved habitat characteristics that function to support successful adult and juvenile migration, spawning and rearing. SR spring/summer chinook salmon and SR steelhead's survival in the wild depends upon the proper function of certain ecosystem processes, including habitat formation and maintenance. Restoring functional habitats depends largely on allowing natural processes to increase their ecological function, while at the same time removing adverse impact of current practices. In conducting analysis of habitat altering actions and essential habitat elements, NOAA Fisheries defines the biological requirements in terms of a concept called Properly Functioning Condition (PFC) and uses a "habitat approach" to its analysis (NMFS 1999).

### 1.4.2 Environmental Baseline

The current status of SR spring/summer chinook salmon ESU has improved somewhat since being listed as threatened in 1992. In 1994, the species was proposed for listing as endangered, due to very low numbers of adults observed at Lower Granite Dam on the lower Snake River. However, an improvement in the adult return levels, as seen in 1997, promoted the withdrawal of the proposed listing in 1998. Recent returns show continuing improvements in adult returns, at least for some portions of the ESU. The counts at Lower Granite for spring/summer chinook salmon were 14,320 in 1998, 6,556 in 1999, 37,755 in 2000, and 18,972 in 2001 (http://www.nwp.usace. army.mil/op/fishdata/lwrgrant.htm). Lower Granite Dam is located at river mile 107.5, on the mainstem of the Snake River, about 70 miles downstream of its confluence with the Grande Ronde River.

The current range-wide status of the identified ESUs may be found in Busby *et al.* (1996) and Myers *et al.* (1998). The identified action will occur within the range of SR steelhead and SR spring/summer chinook salmon. The defined action area is the area that is directly and indirectly affected by the proposed action. The direct effects occur at the project site, and may extend upstream or downstream based on the potential for fish passage impairment, hydraulics,

sediment and pollutant discharge, and the extent of riparian habitat modifications. Indirect affects may occur throughout the watershed, where actions described in this Opinion lead to additional activities, or affect ecological functions, contributing to stream degradation. As such, the action area for the proposed activities includes the immediate portions of the watershed containing the project, and those areas upstream and downstream that may reasonably be affected, temporarily or in the long term. For the purposes of this Opinion, the action area is defined as the lower two miles of McCoy Creek and the surrounding riparian and stream areas that will be impacted by the construction activities.

McCoy Meadows historically contained a large wetland meadow complex with sinuous stream channels, wetlands, backwater areas, and beaver ponds. Alteration of wetland hydrology probably began in the early 1800's with extensive beaver trapping. By the early 1900's , livestock grazing, road and railroad construction, logging, and farming had severely altered the character and function of the meadow complex. During the late 1960's, aggressive efforts were made to further drain emergent wetlands. The lower portion of McCoy Creek in the project area was channelized, straightened, and relocated in two phases, the first in 1968, and again in 1977. In addition, the meadow downstream of what is now McIntyre Road was land-leveled in the late 1970's. Channelization and the subsequent widening and deepening resulted in near elimination of out-of-bank stream flow during flood events, as well as a significant decrease in meadow storage capacity.

The project was funded by the BPA and administered by ODFW. In 1995, a cooperative watershed restoration project with the landowners began to take form, with the goals of restoring water quality, fish and wildlife habitat, and wetland function. A restoration analysis completed in early 1997 by the landowner and multi-agency team, identified and evaluated project objectives and restoration actions. The analysis included a plan to divert McCoy Creek in the upper portions of McCoy Meadows into the channel occupied by McCoy Creek prior to 1977, and laid the framework for additional project phases.

Historical evidence suggests that Meadow Creek once had an adult chinook salmon population. In the journals of Robert Stuart, 1812, it was noted that an expedition party speared seven salmon in a deep pool in Meadow Creek, near its confluence with McCoy Creek. No adult chinook salmon have been documented in recent years. United States Forest Service (USFS) and ODFW fisheries surveys indicate that chinook salmon do not spawn or rear in Meadow Creek. Annual surveys indicate that juvenile chinook salmon presence is also rare.

SR steelhead spawning occurs primarily upstream of the project area. Limited spawning has been documented within the project area, but none was observed in 2001. Based on the densities of juveniles found within the project area, some spawning has probably occurred in the area, but there is no direct evidence to confirm steelhead spawning in this reach. Since 1967, ODFW has been surveying a two-mile reach of McCoy Creek upstream of the project area on the Wallowa-Whitman National Forest System lands for steelhead redds. Within that two-mile reach, counts have ranged from 31 (in 1967) to 0 (in 1974, 1976, 1981, 1982, and 1994). Redd counts in recent years (1995-98) have ranged from 1.5 to 5.5 redds per mile. In preparation for a

restoration project in 1988, ODFW conducted a fish survey downstream of the action area. Juvenile steelhead averaged 6% of all species present; 94% were nongame species. Of the steelhead surveyed, 0+, 1+, and 2+ age classes were found, with 0+ and 1+ being the most abundant. Juvenile steelhead densities measured at ODFW monitoring stations within the project area continue to be moderate to low (0.35 to 0.06 fish/m²). Juvenile steelhead make up 16.4%, 10.5%, 4.0%, and 5.6% of the total fish population in 1997-2000, respectively.

Based on the best available information on the current status of SR steelhead and SR spring/ summer chinook salmon range-wide; the population status, trends, and genetics; and the poor environmental baseline conditions within the action area, NOAA Fisheries concludes that the biological requirements of the identified ESU within the action area are not currently being met. Numbers of steelhead and chinook salmon are substantially below historic numbers. Recovery trends show no clear pattern, due to the lack of long-term data. Degraded freshwater habitat conditions, which include the effects of agricultural and residential use, have contributed to the decline. The NOAA Fisheries Matrix of Pathways and Indicators (MPI) was used to assess the current condition of various steelhead and salmon habitat parameters. Use of the MPI identified the following habitat indicators as either at risk, or not properly functioning within the action area: Temperature, sediment, substrate, large woody debris, pool frequency, pool quality, off channel habitat, width/depth ratio, streambank condition, floodplain connectivity, peak/base flows, road density and location, disturbance history, and riparian reserves. Actions that do not maintain or restore properly functioning aquatic habitat conditions have the potential to jeopardize the continued existence of SR steelhead and SR spring/summer chinook salmon.

## 1.5 Analysis of Effects

### 1.5.1 Effects of Proposed Actions

The effects determination in this Opinion was made using a method for evaluating current aquatic conditions, the environmental baseline, and predicting effects of actions on them. This process is described in the document, *Making ESA Determinations of Effect for Individual or Grouped Actions at the Watershed Scale* (NMFS 1996). The effects of proposed actions are expressed in terms of the expected effect (restore, maintain, or degrade) on aquatic habitat factors in the project area. For the proposed actions, all conditions within the McCoy Creek watershed will be improved, with the exception of chemical contaminants/nutrients, physical barriers, and peak/base flows. These three indicators will be maintained. The first two, chemical contaminants/nutrients and physical barriers are currently rated as properly functioning while the third is listed as not properly functioning.

Impacts of the proposed project to stream habitat and fish populations can be separated into direct and indirect affects. Direct effects are those that contribute to the immediate loss or harm to individual fish or embryos (*e.g.*, heavy equipment directly crushing a fish, crushing or destabilizing a redd that results in the actual destruction of embryos, or dislodging the embryos from the protective nest and ultimately destroying the eggs).

Indirect effects are those impacts which occur at a later time, causing specific habitat features (*e.g.* undercut banks, sedimentation of spawning beds, or loss of pools), localized reductions in habitat quality (*e.g.* sedimentation, loss of riparian vegetation, or changes in channel stability and structure), and which ultimately cause loss or reduction of populations of fish, or reductions in habitat quantity and/or quality.

In the short term, implementation of the actions associated with the project could adversely affect SR steelhead, SR spring/summer chinook salmon, and designated critical habitat in the following ways:

Elevated Turbidity and Sediment Levels

A flood event during or soon after channel construction could result in failure of the new channel, with sediment releases extending beyond the project area. If channel failure due to a flood event does occur, the fact that the site will be restored to its historic flat gradient with the extensive available floodplain of McCoy Meadows should minimize the effects so that increases in sedimentation downstream from the action area would be negligible. The potential for channel failure and/or the restoration channel recapturing the abandoned channel has also been minimized by project design features including: Channel form and dimension, hardening outside-meander streambanks, streambed elevation control at the lower end of the restoration reach, and abandoned channel reclamation measures such as earthen plugs, blended terraces, and floodplain ponds.

There will be a temporary increase in turbidity and redistribution of fine sediment when McCoy Creek is diverted into the restoration channel. Project activities will be conducted during the in-water work window, and will therefore avoid any potential impact to spawning adults, redds, or alveins. The restoration channel with its designed form, in conjunction with diverse channel features such as pools and riffles, along with the low gradient floodplain will sort suspended sediment and bedload more efficiently and, as such, will be resilient to increases in sediment and turbidity. In addition, since channel construction in 2000, vegetative recovery has been moderate with substantial development of native rushes and sedge communities. Vegetative recovery will help minimize the duration and intensity of increases in sedimentation and turbidity.

Trap-and-Haul Operations

Juvenile salmonid fish could be adversely affected by trap-and-haul operations. The ODFW/CTUIR plan is to conduct trap-and-haul prior to channel diversion, and follow up with additional electrofishing/seining/dip netting as necessary as the existing channel is dewatered to capture and relocate remaining fish. Electrofishing, netting, and handling increase the risks of injury or stress-related mortality to juvenile salmonids. Measures outlined in the Terms and Conditions (section 2.3) and Appendix A of this Opinion will help ensure that potential adverse effects are minimized.

Floodplain Ponds

The potential for fish to become trapped in floodplain ponds associated with the abandoned channel during flood flow events is minimized by measures incorporated into the design. These measures include construction of blended terraces in the lower meadow that will prevent the majority of flood flows from entering the abandoned stream reach, and floodplain pond network. Available material will dictate the amount of the channel that can actually be filled, as well as the size of the blended terraces. Conceptually, blended terraces would be most strategically located in the lower meadow at two locations between the abandoned channel and restoration channel, near the point where the new restoration channel crosses over the abandoned channel. These two locations are considered the most likely points where flood flows have the potential of entering the floodplain pond network. The intent is to maximize the amount of floodplain available for McCoy Creek to interact with, not constrain it, as has been its current condition since the mid-1960s. As such, terraces would be developed as close as possible to the floodplain pond network. The concept of the design is to mimic natural floodplains using associated old meander oxbows and cut-off channels that would be interconnected during periods of flood flows and drawdown periods. The lower end of the network would be interconnected to Meadow Creek in the lower portion of McCoy Creek Meadows.

Fish that are swept or swim out to the main channel and onto the floodplain during flood events, a naturally-occurring event in meadow ecosystems, would be expected to search out deeper water in swales and historic channels, and eventually navigate back into the stream network. Based on the life history of anadromous fish, it can be predicted that juvenile salmonids within the project area during spring flow events will not be searching out long-term holding water, but rather initiating their migration to the Pacific Ocean. Juvenile salmonids would therefore likely key in on downstream surface currents, and follow gradual drawdown of the peak in the hydrograph. In the event that juvenile fish do become trapped in floodplain ponds developed as a part of this restoration project, sufficient deep-water habitat and perennial water will be available to support salmonids during the summer until peak flow events occur again during the following season.

Potential Loss of Perennial Streamflow

Potential for the restoration reach to "sub-out" and provide intermittent streamflow versus perennial flow is minimal for the following reasons:

1. Subsurface soil conditions consist of mixed loam/sandy loam in the upper profile (2-3 feet in depth) with gravel lenses (varying 2-3 inches to upwards of 12 inches thick) and a clay base underneath (normally within 4 feet of the existing meadow surface).

2. Fine sediment particles will more efficiently sort and begin to seal the channel bottom in key areas to maintain surface flow.

3. The Phase 1 channel with similar subsurface characteristics has maintained perennial streamflows during the summer base flow periods from 1997 to the present.

4. Temporary irrigation initiated during 2001 resulted in at least 50% of the channel maintaining water in the pools throughout the restoration channel.

In the long term, actions associated with the project will improve water quality, reduce streambank erosion, restore floodplain function, enhance instream habitat diversity and complexity, double channel length, and decrease water temperatures. Consequently, NOAA Fisheries does not expect that the effects of the actions associated with the project will diminish the long-term value of the habitat for the survival of SR steelhead and SR spring/summer chinook salmon.

### 1.5.2 Cumulative Effects

Cumulative effects are defined in 50 CFR 402.02 as "those effects of future State or private activities, not involving federal activities, that are reasonably certain to occur within the action area of the federal action subject to consultation." The action area is defined as the streambed and riparian habitat throughout the action area. The project actions consist of construction of the remaining restoration channel segments, fish salvage operations, channel diversion, the filling of the abandoned channel. These activities are described in detail in the project description, section 1.2 above. NOAA Fisheries is not aware of any significant change in non-federal activities that are reasonably certain to occur within the action area. NOAA Fisheries assumes that future private and state actions will continue at similar intensities as in recent years.

## 1.6 Conclusion

NOAA Fisheries has determined that, when the effects of the subject actions addressed in this Opinion are added to the environmental baseline and cumulative effects occurring in the action area, they are not likely to jeopardize the continued existence of SR spring/summer chinook salmon or SR steelhead. Additionally, NOAA Fisheries concludes that the subject actions would not cause adverse modification or destruction of designated critical habitat for SR spring/summer chinook salmon. NOAA Fisheries believes that the proposed action will cause some minor short-term increases in stream turbidity and sedimentation rates in McCoy Creek. These conclusions were reached because the actions will: (1) Improve fish passage; (2) improve the condition of riparian vegetation, stream shading, substrate embeddedness, and streambank stability, (3) improve instream habitat by increasing the amount of large woody debris in the channel, and (4) increase pool frequency and quality in the long term in McCoy Creek. Thus, the proposed action is not expected to impair properly functioning habitats, appreciably reduce the functioning of already impaired habitats, or retard the long-term progress of impaired habitats toward proper functioning condition essential to the long-term survival and recovery at the population or ESU level.

## 1.7 Conservation Recommendations

Section 7 (a)(1) of the ESA directs federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Conservation recommendations are discretionary measures suggested to minimize or avoid adverse effects of proposed actions on listed species, to minimize or avoid adverse modification of critical habitat, or to develop additional information. NOAA Fisheries has no additional conservation recommendations regarding the action addressed in this Opinion.

## 1.8 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, (3) the action is modified in a way that causes an effect on listed species that was not previously considered or, (4) a new species is listed or critical habitat is designated that may be affected by the action (50 CFR 402.16). To reinitiate consultation, BPA must contact the Oregon Habitat Branch of NOAA Fisheries, and refer to 2002/00177.

# 2. INCIDENTAL TAKE STATEMENT

Section 9 and rules promulgated under section 4(d) of the ESA prohibit 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. 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 breeding, feeding, and sheltering. Harass is defined as actions that create the likelihood of injuring listed species by annoying it to such an extent as to significantly alter normal behavior patterns which include, but are not limited to, breeding, feeding, and sheltering. Incidental take is take of listed animal species that results from, but is not the purpose of, the federal agency or the 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 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

## 2.1 Amount or Extent of Take

NOAA Fisheries anticipates that the proposed action is reasonably certain to result in the incidental take of the ESA-listed species in this Opinion because of detrimental effects from increased sediment levels (non-lethal) and the potential for incidental take during inwater work (lethal and non-lethal). Effects of actions such as these are not expected to have long-term effects on SR spring/summer chinook salmon and SR steelhead habitat or population levels. Based on the information in the BA, NOAA Fisheries anticipates that a minor amount of incidental take (up to ten SR steelhead and/or spring/ summer chinook salmon) could occur as a

result of the actions covered by this Opinion. If this threshold is exceeded, consultation must be reinitiated. The extent of the take is limited to the portion of McCoy Creek directly impacted by the activities associated with the project, as well as stream and riparian areas both upstream and downstream.

## 2.2 Reasonable and Prudent Measures

In this Opinion, NOAA Fisheries has determined that the level of anticipated take is not likely to jeopardize SR steelhead, SR spring/summer chinook salmon, or to destroy or adversely modify designated critical habitat when the following reasonable and prudent measures are implemented.

1. To minimize the amount and extent of incidental take from in-water construction activities, measures shall be taken to limit the duration and extent of in-water work, and to time such work when the fewest SR chinook salmon and SR steelhead are likely to be present.

2. To minimize the amount and extent of incidental take from construction activities in or near the creeks, effective erosion and pollution control measures shall be developed and implemented throughout the area of disturbance. The measures shall minimize the movement of soils and sediment both into and within the river, and will stabilize bare soil over both the short term and long term.

3. To minimize the amount and extent of take from loss of instream habitat and to minimize impacts to critical habitat, measures shall be taken to minimize impacts to riparian and instream habitat, or where impacts are unavoidable, to replace or restore lost riparian and instream function.

4. Minimize the likelihood of incidental take that may occur during the fish salvage (trap-and-haul) operations.

5. To ensure effectiveness of implementation of the reasonable and prudent measures, all erosion control measures and planting for site restoration shall be monitored and evaluated both during and following construction, and meet criteria as described below in the terms and conditions.

## 2.3 Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, BPA must comply with the following terms and conditions, which will implement the reasonable and prudent measures described above. These terms and conditions should be incorporated into construction contracts and subcontracts to ensure that the work is carried out in the manner prescribed. Implementation of the terms and conditions within this Opinion will further reduce the risk of impacts to fish habitat. These terms and conditions are non-discretionary.

1. To implement Reasonable and Prudent Measure #1 (in-water construction), the BPA shall ensure that:
    a. Project Design. The following overall design conditions are met
        i. Minimum area. Construction impacts will be confined to the minimum area necessary to complete the project. As much work as possible proposed for below the ordinary high water line will be completed during low flow periods and in the dry.
        ii. In-water work. All work within the active channel will be completed within the ODFW approved in-water work period for this area, July1 through July 31. Extensions of the in-water work period, including those for work outside the wetted perimeter or the stream but below the ordinary high water mark, must be approved by biologists from NOAA Fisheries

2. To implement Reasonable and Prudent Measure #2 (erosion and pollution control), the BPA shall ensure that:
    a. Isolation of in-water work area. The work area will be well isolated from the active flowing stream to minimize the potential for sediment entrainment. Sediment levels will be monitored to ensure compliance with state water quality standards. All project operations, except efforts to minimize sedimentation, will cease if sediment levels exceed state water quality standards.
    b. Pollution and erosion control plan. A Pollution and Erosion Control Plan (PECP) will be developed to prevent point-source pollution related to construction operations. The PECP will contain the pertinent elements listed below and meet requirements of all applicable laws and regulations:
        i. Methods that will be used to prevent erosion and sedimentation associated with access roads, stream crossings, construction sites, equipment and material storage sites, fueling operations and staging areas.
        ii. Methods that will be used to confine and remove and dispose of excess concrete, cement, and other mortars or bonding agents, including measures for washout facilities.
        iii. A description of the hazardous products or materials that will be used, including inventory, storage, handling, and monitoring.
        iv. A spill containment and control plan with notification procedures, specific clean up and disposal instructions for different products, quick response containment and clean up measures that will be available on site, proposed methods for disposal of spilled materials, and employee training for spill containment.
        v. Measures that will be taken to prevent construction debris from falling into any aquatic habitat. Any material that falls into a stream during construction operations will be removed in a manner that has a minimum impact on the streambed and water quality.
        vi. Equipment that is used for work shall be cleaned prior to entering the job site. External oil and grease shall be removed, along with dirt and mud.

Untreated wash and rinse water will not be discharged into construction area without adequate treatment. Areas for fuel storage and servicing of construction equipment and vehicles will be located at least 300 feet away from any body of water.

vii. The contractor shall develop and implement a site-specific spill prevention, containment, and control plan (SPCCP) that includes notification procedures, and is responsible for containment and removal of any toxins released. The contractor will be monitored by the BPA to ensure compliance with the SPCCP.

viii. The person identified as the Erosion and Pollutant Control Manager (EPCM) shall also be responsible for the management of the contractors' SPCCP. In the event of a hazardous materials or petrochemicals spill, the EPCM shall be responsible for:

(1) Taking immediate action to recover toxic materials from further impacting aquatic or riparian resources.

(2) Documenting a detailed description of the quantity, type, source, reason for the spill, and actions taken to recover materials.

(3) Notifying necessary state officials that a spill has occurred.

(4) Ensuring that all refueling of equipment will take place 300 feet from any body of water and auxiliary fuel tanks will not be stored on bridges, roads or within the two-year flood plain.

(5) Inspecting all machinery for leaks prior to on-site use.

3. To implement reasonable and prudent measure #3 (riparian and instream habitat), the BPA shall ensure that:

a. Construction activities will be done in a way which minimizes disturbance of existing riparian vegetation. Where disturbance is necessary, native vegetation will be clipped by hand where feasible so that roots remain intact. In all areas that require removal or involve mortality of riparian vegetation, reseeding and/or replanting of vegetation with native species will occur.

b. Existing vegetation conditions shall be monitored.

c. Immediately implement re-vegetation procedures to replace any functional riparian components dying because of construction. Only native vegetation will be replanted. Soil erosion control fabric will be used in conjunction with seeding to reduce sedimentation releases for the disturbed areas.

d. The BPA shall monitor the success of planting within, and adjacent to, the construction area. The monitoring of any new planting should be done one year following construction and again at the third and the fifth year. The BPA will supply reports to NOAA Fisheries that shall include photos of the planting in the project area each year that monitoring is done.

e. Failed planting will be replaced yearly, for a period of five years.

4. To implement reasonable and prudent measure #4 (trap-and-haul operations), the BPA shall ensure that:

a. The fish salvage operation is conducted by qualified personnel familiar with and implementing NOAA Fisheries electrofishing or seining guidelines (Appendix A).
b. During electroshocking or seining, backpack electroshockers and other necessary equipment that meet NOAA Fisheries guidelines for use on ESA listed fish will be used. The number of passes through the stretch will be kept to a minimum.
c. No seining or electrofishing shall be conducted when water temperatures exceed 18˚ C. During periods of high water temperature, sampling shall occur early in the morning or in the evening before dark.
d. Surveyors shall observe the condition of sampled fish. If fish appear stressed or injured (dark bands, gulping air, excessive mucus, irregular swimming, or bucket predation), immediately halt sampling and decrease the frequency and voltage.
e. There shall be no fin-clipping or use of anaesthetics on salmonids.
f. Fish will be transported in aerated buckets or tanks to a safe, upstream area as soon as possible.

5. To implement reasonable and prudent measures #5 (monitoring and reporting), the BPA shall ensure that:
   a. Within one year of completing the project, the BPA will submit a monitoring report to NOAA Fisheries describing the BPA's success in meeting these terms and conditions.
   b. This report will consist of the following information:
      i. Project name,
      ii. Start and end dates of work completed for this project,
      iii. Name and address of the construction supervisor,
      iv. Narrative assessment of the project's effects on natural stream function,
      v. Photographic documentation of environmental conditions at the project site before, during and after project completion,
      vi. Summary of summer stream temperatures for the project area recorded by thermographs, and
      vii. Summary of a monitoring and maintenance activities carried out by the BPA and contractor;
   c. If a dead, injured, or sick endangered or threatened species specimen is located, initial notification must be made to:

      National Marine Fisheries
      Service Law Enforcement Office
      Vancouver Field Office
      600 Maritime, Suite 130
      Vancouver, Washington 98661
      telephone: 360.418.4246.

      Care should be taken in handling sick or injured specimens to ensure effective treatment and care or the handling of dead specimens to preserve biological material in the best possible state for later analysis of cause of death. In conjunction with the care of sick or injured endangered and threatened species or preservation of biological materials from a dead animal, the finder has the

responsibility to carry out instructions provided by Law Enforcement to ensure that evidence intrinsic to the specimen is not unnecessarily disturbed.

d. Monitoring reports will be submitted to:

National Marine Fisheries Service
Oregon Habitat Branch
Attn: OSB-2002-0071-FEC
525 NE Oregon Street, Suite 500
Portland, Oregon 97232-2778

e. To ensure that these terms and conditions are met, BPA personnel will be on-site for all construction and monitoring activities.

## 3. ESSENTIAL FISH HABITAT

### 3.1 Background

The objective of the essential fish habitat (EFH) consultation is to determine whether the proposed action may adversely affect designated EFH for relevant species, and to recommend conservation measures to avoid, minimize, or otherwise offset potential adverse effects to EFH resulting from the proposed action.

### 3.2 Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-297), requires the inclusion of EFH descriptions in federal fishery management plans. In addition, the MSA requires federal agencies to consult with NOAA Fisheries on activities that may adversely affect EFH.

EFH means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (MSA §3). For the purpose of interpreting the definition of essential fish habitat: 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 (50CFR600.110).

Section 305(b) of the MSA (16 U.S.C. 1855(b)) requires that:

- Federal agencies must consult with NOAA Fisheries on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH.
- NOAA Fisheries shall provide conservation recommendations for any federal or state activity that may adversely affect EFH.

- Federal agencies shall within 30 days after receiving conservation recommendations from NOAA Fisheries provide a detailed response in writing to NOAA Fisheries 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 NOAA Fisheries, the federal agency shall explain its reasons for not following the recommendations.

The MSA requires consultation for all actions that may adversely affect EFH, and does not distinguish between actions within EFH and actions outside EFH. Any reasonable attempt to encourage the conservation of EFH must take into account actions that occur outside EFH, such as upstream and up slope activities, that may have an adverse effect on EFH. Therefore, EFH consultation with NOAA Fisheries is required by federal agencies undertaking, permitting or funding activities that may adversely affect EFH, regardless of its location.

## 3.3 Identification of EFH

The Pacific Fisheries Management Council (PFMC) has designated EFH for federally-managed fisheries within the waters of Washington, Oregon, and California. The PFMC has designated EFH for three species of Pacific salmon: chinook salmon (*Oncorhynchus tshawytscha*); coho (*O. kisutch*); and Puget Sound pink salmon (*O. gorbuscha*) (PFMC 1999). 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). In estuaries and marine areas, designated salmon EFH extends from the near shore and tidal submerged environments within state territorial waters out to the full extent of the exclusive economic zone (370.4 km) offshore of Washington, Oregon, and California north of Point Conception to the Canadian border. 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 potential adverse effects to these species' EFH from the proposed action is based on this information.

## 3.4 Proposed Actions

The proposed actions are detailed above in section 1.1. The action area includes McCoy Creek which is a tributary of the Grande Ronde River. This area has been designated as EFH for various life stages of chinook salmon.

## 3.5 Effects of Proposed Action

As described in detail in ESA portion of this consultation**,** the proposed activities may result in detrimental short-term adverse effects to a variety of habitat parameters.

### 3.6 Conclusion

NOAA Fisheries believes that the proposed action may adversely affect the EFH for chinook salmon.

### 3.7 EFH Conservation Recommendations

Pursuant to section 305(b)(4)(A) of the Magnuson-Stevens Act, NOAA Fisheries is required to provide EFH conservation recommendations for any federal or state agency action that would adversely affect EFH. The conservation measures proposed for the project by the BPA, all of the Reasonable and Prudent Measures and the Terms and Conditions contained in sections 2.2 and 2.3 are applicable to salmon EFH. Therefore, NOAA Fisheries incorporates each of those measures here as EFH recommendations.

### 3.8 Statutory Response Requirement

Please note that the Magnuson-Stevens Act (section 305(b)) and 50 CFR 600.920(j) requires the federal agency to provide a written response to NOAA Fisheries after receiving EFH conservation recommendations within 30 days of its receipt of this letter. This response must include a description of measures proposed by the agency to avoid, minimize, mitigate or offset the adverse impacts of the activity on EFH. If the response is inconsistent with a conservation recommendation from NOAA Fisheries, the agency must explain its reasons for not following the recommendation.

### 3.9 Supplemental Consultation

The BPA must reinitiate EFH consultation with NOAA Fisheries if either action is substantially revised or new information becomes available that affects the basis for NOAA Fisheries' EFH conservation recommendations (50 CFR 600.920).

## 4. LITERATURE CITED

Section 7(a)(2) of the ESA requires biological opinions to be based on "the best scientific and commercial data available." This section identifies the data used in developing this Opinion.


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## Appendix A. NOAA Fisheries Electrofishing Guidelines (NMFS 2000)

### ELECTROFISHING GUIDELINES

Suggested protocol for the use of backpack electrofishing equipment in waters containing fish listed under the Endangered Species Act (ESA). These recommendations should be seen as guidelines for developing consistent and safe electrofishingtechnique. It is hoped that these guidelines will ultimately help improve electrofishing technique in ways which will reduce fish injury and increase electrofishing efficiency.

**Purpose and Scope**

The purpose of this document is to recommend guidelines for using backpack electrofishing equipment to sample ESA-listed fish. Because electrofishing can kill or severely injure fish, every effort should be made to avoid electrofishing and use snorkeling or other fishery information collection techniques. Where electrofishing is the only suitable sampling method, these guidelines are suggested to help reduce the number of fish killed or severely injured. These guidelines are concerned only with studies that involve electrofishing juvenile or adult salmonids that are *not* in spawning condition. Electrofishing in the vicinity of adults in spawning condition or operating equipment in the vicinity of redds containing developing eggs is not discussed as there is no justifiable basis for permitting these activities near listed species. Also, these guidelines do not deal with factors such as temperature or fish handling technique both of which can significantly affect fish health during an electrofishing session. Nonetheless, all ESA-listed fish must be sampled with extreme care. The field crew must carefully design the sampling sessions to minimize fish stress by working within favorable temperature regimes, using anesthetics when necessary, and minimizing the time the fish are held before release. As with all fieldwork involving live ESA-listed fish, the best science should be used along with an experienced crew and good equipment in order to minimize handling stress.

**Equipment**

Equipment should be in good working condition. Operators should go through the manufacturer's preseason checks, adhere to all provisions, and record major maintenance work in a log.

**Training**

A crew leader having at least 100 hours of electrofishing experience in the field using similar equipment should train the crew. The crew leader’s experience must be documented and available for confirmation; such documentation may be in the form of a logbook. The training should occur before an inexperienced crew begins any electrofishing; it should also be conducted in waters that do not contain ESA-listed fish.

The training program must include the following elements:

1. Definitions of basic terminology: e.g. galvanotaxis, narcosis, and tetany.

2. An explanation of how electrofishing attracts fish.

3. An explanation of how gear can injure fish and how to recognize signs of injury.

4. A review of these guidelines and the manufacturer's recommendations.

5. A demonstration of the proper use of electrofishing equipment, the role each crew member performs, and basic gear maintenance.

6. A field session where new individuals actually perform each role on the electrofishing crew.

**Specific Electrofishing Guidelines**

1. In order to avoid contact with spawning adults or active redds, carefully survey the area to be sampled before beginning electrofishing.

2. Measure conductivity and set voltage as follows:

| Conductivity (umhos/cm) | Voltage |
|---|---|
| Less than 100 | 900 to 1100 |
| 100 to 300 | 500 to 800 |
| Greater than 300 | 150 to 400 |

3. Only direct current (DC) should be used.

4. Each session should begin with pulse width and rate set to the minimum needed to capture fish. These settings should be gradually increased only to the point where fish are immobilized and captured. Start with pulse width of 500 us and do not exceed 5 milliseconds. Pulse rate should start at 30Hz and work carefully upwards. *In general*, exceeding 40 Hz will injure more fish.

5. The zone of potential fish injury is 0.5m from the anode. Care should be taken in shallow waters, undercut banks, or where fish can be concentrated because in such areas the fish are more likely to come into close contact with the anode.

6. The stream segment should be worked systematically, moving the anode continuously in a herringbone pattern through the water. Do not electrofish one area for an extended period.

7. Crew should carefully observe the condition of the sampled fish. Dark bands on the body and longer recovery times are signs of injury or handling stress. When such signs are noted, the settings for the electrofishing unit may need adjusting. Sampling should be terminated if injuries occur or abnormally long recovery times persist.

8. When the sampling design involves taking scales and measurements, a healthy environment for the stressed fish must be provided and the holding time must be minimized. For these operations, additional crew members who are experienced in holding and processing stressed fish may be necessary.

9. Whenever possible, a block net should be placed below the area being sampled to capture stunned fish that may drift downstream.

10. The electrofishing settings should be recorded in a logbook along with conductivity, temperature, and other variables affecting efficiency. These notes, together with observations on fish condition, will improve technique and form the basis for training new operators.